

## SECTION 25 0000

### INTEGRATED AUTOMATION

*This section is intended to describe requirements for all of Div 25.*

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#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section includes the general requirements for the Integrated Automation systems.
- B. Related Sections:
  - 1. All sections within Division 25.
- C. Where architectural features govern location of work, refer to architectural drawings and coordinate with other trades.

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

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##### **1.2 REFERENCES**

- A. This section includes any rules and regulations of Federal, State, local authorities, and utility companies in force at the time of execution of contract.
- B. Agencies or publications referenced herein refer to the following:
  - 1. ADA Americans with Disabilities Act
  - 2. ANSI American National Standards Institute
  - 3. ASHRAE American Society for Heating, Refrigeration, Air-Conditioning Engineers
  - 4. ASTM American Society for Testing and Materials
  - 5. BICSI Building Industry Consulting Services International
  - 6. EIA Electronic Industries Association
  - 7. FCC Federal Communications Commission
  - 8. ICEA Insulated Cable Engineers Association
  - 9. IEEE Institute of Electrical & Electronics Engineers
  - 10. ISO International Organization for Standards
  - 11. NEC National Electrical Code (2002)
  - 12. NECA National Electrical Contractors Association
  - 13. NEMA National Electrical Manufacturers Association
  - 14. NETA National Electrical Testing Association
  - 15. NIST National Institute of Standards & Technology
  - 16. OSHA Occupational Safety and Health Administration
  - 17. TIA Telecommunications Industries Association
  - 18. UL Underwriters Laboratories, Inc.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

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### 1.3 DEFINITIONS

- A. AHU Air Handling Unit
- B. ATC Automatic Temperature Control
- C. ATU Air terminal Unit
- D. AWG American Wire Gauge (standard wire size measurement)
- E. BAS Building Automation System
- F. Device Intelligent controller or other automated monitoring piece of equipment
- G. CD Compact Disc used for data storage
- H. Commissioning Process to ensure installation and functionality is per design
- I. Enterprise Top level of integrated systems for overall logistical monitoring and business planning
- J. EMS Enterprise Management System
- K. FCU Fan Coil Unit
- L. IBS Integrated Building Systems
- M. I/O Hardware inputs and outputs
- N. Instrument Device used to sense inputs or control outputs or both
- O. Integration Connection of disparate systems to a common platform using communication protocols.
- P. IP Address Internet Protocol node address
- Q. IT Information Technologies
- R. O&M Operation & Maintenance Manuals
- S. Object Hardware or Software component such as a device or point.
- T. Point Single hardware input/output or software data objects such as setpoints and attributes.
- U. Pointlist List of inputs, outputs and parameters for specific systems.
- V. RFI Request for Interpretation.
- W. Stand-Alone The ability to function upon loss of communication.

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

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### 1.4 SYSTEM DESCRIPTION

- A. The integrated automation system includes integration, control and monitoring of the various systems throughout the facility including:

1. Procurement and installation of integrated automated systems.
  2. Integration of systems with the Enterprise Management System.
  3. Integration of data from various systems to allow for seamless monitoring and control of the various systems.
- B. The functionality of the integrated automation system must include:
1. The ability to communicate with systems shown, utilizing protocols specified.
  2. Stand-alone functionality of critical HVAC and Fire sequences.
- C. Lead the coordination effort to integrate with the various networked equipment, systems, specialty vendors and the Enterprise.
- D. Lead the coordination effort of implementation meetings and activities.
- E. Integrated Automation includes but is not limited to labor and materials for terminations, pathways, installations, certifications, testing, system verification, project commissioning, network equipment, integration equipment, instrumentation and controls and integrated automated systems.
- F. Provide additional, supplementary or miscellaneous items, products and labor incidental to or necessary for a complete and operable system including but not limited to:
1. Uninterruptable Power Supplies (UPS)
  2. Surge suppression devices
  3. Transformers and power supplies
  4. Programming modifications
- G. Request IP addresses and other IT requirements from Owner to accommodate project schedule.

## 1.5 SUBMITTALS

- A. All submittals shall be original and searchable electronic pdf format.
- B. Submit complete schedule/outline of product submittals prior to submittal submission. Submit each section independent and separate from other sections. For each product submission:
1. Specification Section and Product number.
  2. Include only products within referenced specification section submission.
- C. Product Data: For each product submission, include the following:
1. Table of contents for each submission.
  2. Submit each section independent and separate from other sections. Include only products within referenced specification section submission.
  3. Product data sheets for all required components and accessories.
  4. Submit manufactures checklist & calibration documentation for calibrated instrumentation.
  5. Identify actual product model number used for each drawing.
  6. Identify any proposed modifications to system design. (Specifications or Drawings)
  7. Organize product data based on specification Section, Part, and Article.
  8. A paragraph-by-paragraph specification compliance report indicating compliance for each numbered paragraph. The following format shall be used in completing the compliance report:
    - a. Comply—without exception.
    - b. Qualify—meet the functional intent. For each paragraph, the contractor shall identify all differences in specific functions stated in the given paragraph and provide a description of what is excluded or how the qualifying system will meet the function specified.
    - c. Does not comply—cannot meet specified function.

d. Does not apply – not used or not required.

*Submittal requirements, if enforced, will save much time during review process.*

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D. Integration Plan

1. Network architecture and communications concepts/diagrams. Network architecture includes but is not limited to:
  - a. Nodes
  - b. Switches and Routers
  - c. Integrated systems and/or sub-systems
  - d. Dedicated I/O locations
2. Coordination of vendor protocol and pointlist submission. Include an integration matrix detailing systems and protocols to be used.
3. Workflow processes to integrate systems
4. Include communication hardware, software, and protocols to implement full systems integration.
5. Identify proposed enhancements or deviations from project documents. Include specific drawings or specifications impacted.
6. Provide coordination efforts to accommodate complete integration of systems including:
  - a. Vendor protocol requirements
  - b. Vendor pointlist
7. Submit communication risers for controllers and all integrated systems.
8. Submit maintenance schedules for all controller, valves, dampers, and instrumentation.

*Integration Plan is not a common requirement. Should only be used on large projects.*

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E. Start-up Plan

1. Coordination of equipment controlled and monitored
2. Workflow process to start equipment
3. Equipment start-up requirements
4. Checklist
5. Intended sequence of work items
6. Start dates of individual work items
7. Duration of individual work items
8. Planned delivery dates for major material and equipment, and expected lead times
9. Milestones indicating possible restraints on work by other trades or situations

*Start-up Plan is not a common requirement. Should only be used on large projects.*

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F. Owner Instruction and Training Plan

1. Organized list of specific equipment or systems that require training
2. Separate agenda for each training session including but be not limited to:
  - a. Construction Document review of systems
  - b. Installation and as-built conditions
  - c. Theory of operation
  - d. Demonstration of operation

- e. Operation and Maintenance Document
  - f. Servicing and Maintenance Schedules
  - g. Interlocks and Safeties
3. Manufactures recommended classroom training and schedule
- G. Record Documents:
1. Include field condition updates
  2. Document material, make and model numbers where appropriate
  3. Update details, schedules, risers, etc.
  4. I/O point as-builts
  5. Sequence details, modifications, or updates
  6. Control loops including final set-points and parameters
  7. Mark and detail on coordination drawings, exact locations of equipment installed
  8. Panel details for each unique panel
- H. Operation Manuals:
1. At minimum, submit one electronic copy and one hard copy.
  2. Do not include previously submitted product data
  3. Include a table of contents
  4. Tab manual based on specification chapters or sections
  5. Network architecture and communications concepts/diagrams
  6. Uploading and downloading software to the field hardware
  7. Finely detailed descriptions of all software programs
  8. Complete set of software engineering manuals
  9. Complete system design and engineering manual same as used by manufactures personnel
  10. Application Programming
  11. CD of any configuration tools used in project
  12. Operator instructions or User Manual
  13. Calibration and/or verification sheets for all instrumentation including but not limited to:
    - a. Liquid Flow Meters
    - b. Air Flow Meters
    - c. CO2 Sensors
    - d. Temperature Sensors
    - e. Humidity Sensors
- I. Project Maintenance Manuals:
1. Include a table of contents
  2. 1 copy on CD
  3. Organize by manual by specification section number
  4. Index sheet listing contents in alphabetical order
  5. Include the following:
    - a. Installation instructions
    - b. Manufacturer's operating and maintenance instructions (not product submittals)
    - c. Factory and field-test records, including calibration and factory setup
    - d. Printout of application control programs (typical)
    - e. Snapshot printout of each system installed
    - f. Signed checklist of each system

- g. Factory training schedule and course description catalog
  - h. Archived backup of software, drawings, and record documents
  - i. Installation contractor and service representative information
  - j. Licensing and warranty information
- J. Submit a User Workstation Planning Session Plan for each subject.
- 1. Graphics Generation
  - 2. Point naming
  - 3. Alarm management

*Edit the above submittal requirements each project. Make sure each item is appropriate. If the above submittals are not required in the project, delete them. Coordinate with Div. 1 requirement*

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## 1.6 QUALITY ASSURANCE

- A. All systems, equipment, components, accessories, and installation hardware must be new, free from defects, and currently in production.
- B. All work shall be compliant with applicable national and local codes.
- C. Demonstrate project compliance to Engineers satisfaction including construction and integration.
- D. Provide the same manufacturer components of a given type product throughout project.
- E. Support future compatibility for no less than 7 years with the ability to upgrade existing field panels and extend new field panels on an installed network.
- F. Digital equipment furnished under this contract shall have been tested and made to comply with limits of Class A computing device pursuant to Subpart J of Part 15 of FCC Rules.
- G. Maintain NEC workspace clearances.
  - 1. Install and operationally check systems utilizing factory-trained competent technicians skilled in the setting and adjustment of equipment used in this project.
- H. Test, adjust, and calibrate all end instruments.
- I. Follow project communication protocol for all correspondence. Any changes, decisions, etc. must be properly documented. The Engineer will not issue verbal directions. Verbal interpretations, clarifications, conversations, ect. are non-binding without proper documentation.
- J. Request for Interpretation (RFI) shall include:
  - 1. Referenced drawing and/or Specification Section number.
  - 2. Single request per RFI
  - 3. Single proposed solution per RFI
  - 4. Attached sketch of solution (if applicable)
  - 5. Attached specification verbiage (if applicable)
  - 6. Incomplete RFI's will be returned without response.
  - 7. Contact person.

*Edit the above submittal requirements each project. Make sure each item is appropriate. If the above RFI requirements are already in the Div 1, delete them. Coordinate with Div. 1 requirement*

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- K. RFI answers are for clarification only and do not authorize additional work or change orders.
- L. Install devices in appropriate enclosure and in an accessible location.
- M. Install systems and devices in a neat, workmanlike manner and in accordance with manufacturer's recommendations.
- N. Continually monitor the field installation for code compliance and quality workmanship.
- O. Remove and re-install any systems or devices where installation is deemed of poor quality by Owner or Engineer.
- P. Provide software and firmware updates prior to and within 2 months of substantial completion.
- Q. Lead the coordination effort to ensure integration of various systems prior to installation.
- R. Comply with all health and safety regulations
- S. Include automatic restart logic for loss of power, safeties, fire alarm shutdown, etc.
- T. Provide components not specifically indicated or specified, but necessary to make system function within the intent of contract documents.
- U. All electrical products to be listed and labeled by UL and comply with NEMA Standards.
- V. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BAS business for at least the last five (5) years and have successfully completed total projects of at least 5 times, the value of this contract, in each of the preceding five years.
- W. Provide a competent and experienced Project Manager
- X. Engineering services shall be performed by factory-trained engineers.
- Y. System shall be installed by factory trained mechanical and electrical installers either in direct employ of this Contractor or by subcontractors who are under direct supervision of this Contractor.
- Z. Use only manufacturer trained technicians who are skilled, experienced, trained, and familiar with the specific equipment, software and configurations to be provided under this section.
- AA. Coordinate with the Owner to ensure that the BAS will perform in the Owner's IT environment without disruption to any of the other activities taking place on that LAN or WAN

*The intent of locating the above list in this section is to prevent duplication in other sections. The above list should not be repeated and should apply to all sections within Division 25*

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products according to manufacturer's recommendations.
- B. Store products in original manufacturer's packaging.
- C. Do not store products more than 3 months prior to schedule installation.
- D. Coordinate deliveries of material with construction schedule and appropriate trades.

## 1.8 SCHEDULING

- A. Included in this project are connections to equipment provided by others. Coordinate deliveries, final locations, factory mounting, and various connections required.
- B. Coordinate activities with contract project schedule.
  - 1. Ensure integration activities are incorporated into project schedule.
  - 2. Communicate requirements to prevent potential damage from paint, dust, water, weather, etc. Monitor and take measure to assure protection for all equipment.
- C. Coordinate all IT requirements with owner and contract project schedule.

## 1.9 WARRANTY

- A. Submit warranty documentation upon completion of project or phase and acceptance by Engineer and Owner.
  - 1. Warranty start date shall be the date of substantial completion.
  - 2. Warranty period shall be 1 year on parts and labor and include 3 years of software upgrades.
- B. Repair or replace systems or parts found defective at no cost to Owner including: but not limited to:
  - 1. Operator workstation software, project-specific software, graphic software, database software, and firmware updates that resolve known software deficiencies as identified by the contractor shall be provided at no charge during the warranty period.
  - 2. All corrective software modifications made during the warranty period shall be updated on all user documentation and on user and manufacturer archived software disks.
  - 3. Include parts, labor, and necessary travel during warranty.
- C. Scheduled preventive maintenance (p.m.) visit twice a year to audit system performance.
  - 1. Each p.m. visit shall include exercising each control loop and control sequence for performance.
  - 2. A log of each loop tested and each control sequence verified shall be reviewed with the Owner.
- D. Provide vendor specific warranty information.
- E. Provide services incidental to proper performance.

*Coordinate specific Warranty requirements with Owner. Coordinate with Div. 1 requirement*

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## 1.10 SYSTEM STARTUP

- A. Start equipment according to manufacturer's recommendation.
- B. Document system start up time and date.
- C. Document person(s) performing startup.
- D. Provide completed vendor specific start up documentation.

## 1.11 OWNER'S INSTRUCTIONS

- A. Provide a factory-trained instructor to give full instructions to designated personnel in the operation, maintenance, and programming of each piece of equipment or system. Instructors shall be thoroughly familiar with all aspects of the subject matter.
- B. The training shall be specifically oriented to the system and interfacing equipment installed.



- C. Include classroom instruction and field demonstration.
- D. Classroom instruction should include at a minimum:
  - 1. Detailed review of and as-built documentation and conditions
  - 2. In depth discussion of theory or sequence of operations
  - 3. Review organization and usability of O&M documentation
  - 4. Maintenance procedures and schedules
- E. Field instruction should include at a minimum
  - 1. Normal maintenance procedures
  - 2. Demonstration of operation
  - 3. Demonstration of safeties and interlocks

*Edit the above training requirements for each project. Make sure each item is appropriate and coordinate with Owner. Coordinate with Div. 1 requirement*

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#### 1.12 COMMISSIONING

- A. Participate in the commissioning process.
- B. Refer to section 25 0800 for additional requirements for Division 25 work.

### **PART 2 - PRODUCTS**

#### 2.1 NOT USED.

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Prior to start of any work, check, verify, and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.
- B. Promptly request clarification and instruction or report any conflicts, inadequate conditions or missing information in the Project Documents. Report unacceptable conditions immediately.
- C. Inspect site to verify that equipment can be installed as shown.
- D. Examine drawings and specifications for work of others.
- E. Perform necessary changes in specified work caused by failure or neglect to report discrepancies.

#### 3.2 INSTALLATION

- A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- B. Provide sufficient slack, flexible connections and isolation to allow for equipment vibration.
- C. Verify elevations and measurements prior to installation of materials.
- D. Beginning installation means contractor accepts existing conditions.

- E. Conceal wiring in conduit in mechanical spaces, above hard ceilings, and other spaces where exposed wiring could be damaged.
- F. Provide temporary service, routing of service, or other temporary requirements to minimize downtime of service.
- G. Equipment and wiring shall be selected and installed for conditions in which it will be required to perform. (i.e., general purpose, weatherproof, rain-tight, explosion proof, dust tight, or any other special type as required.)
- H. Arrange for necessary openings in building to allow for admittance of all apparatus.
- I. Install equipment with ample space allowed for removal, repair or changes to equipment. Provide ready accessibility to equipment and wiring without moving other equipment which is to be installed or which is already in place.
- J. Coordinate all systems in order to minimize access door requirements.
- K. Coordinate final locations, sizes and rough-in dimensions for access doors.
- L. Verify door swings for proper clearance before installing.
- M. Perform of the work in a safe and competent manner and use of industry accepted installation procedures required for the work.

### 3.3 FIELD QUALITY CONTROL

- A. Testing:
  - 1. Conduct a complete performance test for all systems to assure compliance with the contract documents.
    - a. Any components on systems found defective or not performing satisfactorily shall be readjusted and retested after necessary corrective measures are performed.
    - b. Corrective measures may include modification or addition of equipment and devices, control strategies and/or software program.
  - 2. When testing is to be witnessed by Engineer or Inspector. Schedule Engineer at least 10 days prior to testing date.
  - 3. Conduct and lead the coordination effort to integrate systems. Verify communication capabilities of each integrated vendor prior to installation of each system. Provide documented integration capabilities.
  - 4. Certify in writing, successful equipment and system test results. Include in certifications the following:
    - a. Identification of system tested.
    - b. Date.
    - c. Test criteria.
    - d. Print name, title and company of person signing test certification documents.
    - e. Alternative solutions implemented to successfully complete test.
- B. Coordinate with the Owner and execute a User Workstation Planning Sessions including 1-2 day sessions (for each subject) to finalize details for the following:
  - 1. Integration of systems
  - 2. Graphics Generation
  - 3. Point naming
  - 4. Alarm management
  - 5. Energy management

6. Automated work order generation
7. Recommended Operation & Maintenance procedures.

*Edit the above paragraph as required to allow Owner input to final BAS operation. Make sure each item is appropriate and coordinate with Owner.*

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C. Repair, reprogram or replace any equipment or work that fails test.

#### 3.4 CLEANING

- A. Upon completion of each phase, system, panel, etc, clean all system panels, enclosures and field device enclosures.
- B. Clean debris from equipment, control panels, security panels, and fire panel enclosures, junction boxes and pull boxes and arrange wire neatly with surplus length cut off prior to installation of covers.
- C. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

#### 3.5 DEMONSTRATION

- A. Demonstrate operation of systems with Owner or Engineer.
- B. Coordinate with commissioning activities. Refer to section 25 0800.

#### 3.6 PROTECTION

- A. Protect installation against and be liable for damage to work and to material caused by Contractor's work or employees.
- B. Maintain protection for work and equipment until inspected, tested, and accepted.
- C. Protect material not immediately installed.
- D. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.
- E. Material sensitive to temperature, dust, humidity, or other elements and found unprotected shall be replaced.
- F. Material with showing signs of exposure shall be replaced.

**END OF SECTION**

## SECTION 25 0513

### CONDUCTORS AND CABLES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes Integrated Automation conductors and cable for signal transmission, communications, power, and other miscellaneous cables for complete integration of systems specified.
- B. Related Sections:
  - 1. 25 0528 Pathways

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

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##### 1.2 REFERENCES

- A. NEC 725                      Class 1, Class 2, and Class 3 Remote Control, Signaling And Power-Limited Circuits
- B. NEC 800                      Communication Circuits

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

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##### 1.3 DEFINITIONS

- A. AWG                      American                      Wire Gauge
- B. EMI                      Electromagnetic                      Interference
- C. kVA                      One                      thousand Voltamps
- D. Noise                      Unwanted electrical or electromagnetic energy
- E. Signal Wire                      Wire used to transmit an electrical signal such as voltage, amps, or resistance.
- F. PVC                      Poly                      vinyl Chloride

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

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##### 1.4 SYSTEM DESCRIPTION

- A. Final connectors to control device.
- B. Communication cables for integrated systems.
- C. Signal cables for Integrated Automated systems.
- D. Power cables for Integrated Automated systems.
- E. Final terminations of conductors and cables not specifically shown, but required for systems operation.

## 1.5 SUBMITTALS

- A. Submit installation plan including:
  - 1. Recommended modifications to design documents.
  - 2. Documentation for vendor specific limitations or modifications.
  - 3. Sequence of installation.
  - 4. Coordination requirements.

*Section specific submittal requirements should be defined here but not repeated from other sections...*

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## 1.6 QUALITY ASSURANCE

- A. All work shall meet the requirements of the National Electrical Code.
- B. All wiring shall be done in accordance with all local and national codes and authorities having jurisdiction.
- C. Ground and Bond according to manufacturer's recommendations. Refer to section 26 0526 for grounding and bonding requirements.
- D. Review test and documentation structured communication cables for acceptance.
- E. Splicing communication and instrumentation cables is prohibited.
- F. Kinked cable is prohibited and must be replaced.
- G. Conform to requirements of National Electrical Code Articles 725 and 800, as well as local electrical codes, where required by the various systems.
- H. Insure cable is free of tension at both ends. In cases where cable must bear stress, provide appropriate grips to spread stress over longer length of cable.
- I. Adhere to the following minimum distances to reduce effects of EMI:
  - 1. Five (5) inches from power lines of 2kVA
  - 2. Eighteen (18) inches from high voltage lighting (including fluorescent)
  - 3. Thirty-nine (39) inches from power lines of 5kVA or greater
  - 4. Thirty-nine (39) inches from transformers and motors
- J. Maintain separation of signal wire and wire carrying more than 100 VAC.
- K. Separate cable from other building systems.
- L. Install cables parallel and perpendicular to building walls. Coordinate space requirements with other trades.
- M. Conceal wiring in conduit in mechanical spaces, aboveceilings, and other spaces where exposed wiring could be damaged. Refer to Section 25 0528 for pathway requirements.
- N. Where conduit is not required:
  - 1. Space J-hook cable supports every 4 ft or in accordance with cable manufacturer's specifications, whichever distance is shorter. Use of tie-raps, structure, ductwork, wire, etc. for support is prohibited.
  - 2. Cable shall be free of tension at both ends. In cases where cable must bear stress, provide appropriate grips to spread stress over longer length of cable.
- O. Refer to Section 25 0553 for label requirements

*Section specific quality requirements should be defined here but not repeated from other sections...*

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## 1.7 DELIVERAY, STORAGE AND HANDLING

- A. Store all produces according to manufacture's recommendations.
- B. Protect stored cable from vandalism and weather.
- C. Store cable and equipment no more than 6 weeks prior to installation.
- D. Maintain a minimum storage temperature of 50 Deg F.

*Section specific requirements should be defined here but not repeated from other sections...*

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## 1.8 OWNER'S INSTRUCTION

- A. Provide 4 hours training on structured cable system.
- B. Include:
  - 1. Location of devices
  - 2. Terminations
  - 3. Troubleshooting
  - 4. Identification

*Section specific owner training requirements should be defined here but not repeated from other sections...*

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## PART 2 - PRODUCTS

### 2.1 FLOOR LEVEL COMMUNICATIONS CABLE

- A. Cabling Requirements:
  - 1. Min Size: 23 AWG
  - 2. Min number of Conductors 2 –4 (vendor specific)
  - 3. Jacket UL listed Teflon
  - 4. Jacket color: Violet

### 2.2 INSTRUMENTATION SIGNAL CABLE

- A. Cabling Requirements:
  - 1. Min Size: 18 AWG stranded (except vendor specific instrument)
  - 2. Min number of Conductors 2 –4 (application specific)
  - 3. Jacket PVC
  - 4. Jacket Color Grey
  - 5. Shield Per manufacturer recommendations

### 2.3 POWER WIRE (50 VOLTS OR LESS)

- A. Cabling Requirements:
  - 1. Min Size: 18 AWG stranded
  - 2. Number of Conductors 2
  - 3. Jacket PVC
  - 4. Jacket Color Grey

### 2.4 POWER WIRE (GREATER THAN 50 VOLTS)

- A. Refer to section 26 0519.

## **PART 3 - EXECUTION**

### **3.1 FLOOR LEVEL COMMUNICATIONS CABLE**

- A. Install cable in approved pathways only.
- B. Provide appropriate shielding to eliminate equipment noise from VFD's and other equipment.
- C. Provide additional shielding and grounding per applicable manufacturer's recommendations and/or job site conditions.
- D. Label cable according to Section 25 0553.

### **3.2 INSTRUMENTATION SIGNAL CABLE**

- A. Provide signal cables for instrumentation.
- B. Install cable in approved pathways.
- C. Provide appropriate shielding to eliminate equipment noise from VFD's and other equipment.
- D. Provide isolated instrument grounding system as per manufacturer's recommendations.
- E. Terminate instrument cables at terminal blocks or terminal strips in cabinets.
- F. Label cable according to Section 25 0553.

### **3.3 POWER WIRE (50 VOLTS OR LESS)**

- A. Unless otherwise specified or noted, provide final power connections including conduit, wire, and/or control panel disconnect switches to all control devices from appropriate electrical j-box.
- B. Provide power cables for instrumentation and devices.
- C. Install cable in approved pathways.

### **3.4 POWER WIRE (GREATER THAN 50 VOLTS)**

- A. Provide final power cables and connections for instrumentation and devices.
- B. Install cable in approved pathways.

### **3.5 FIELD QUALITY CONTROL (TESTING)**

- A. Verify cable shield or coupled bonding conductor for end-to-end continuity.

**END OF SECTION**

## SECTION 25 0528

### PATHWAYS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes complete pathway system and requirements for Integrated Automation including but not limited to:
  - 1. Conduit and fittings
  - 2. Outlet boxes
  - 3. Pull and junction boxes
  - 4. Sleeves
- B. Related Sections:
  - 1. 07 8413 Penetration Firestopping
  - 2. 25 0513 Conductors and Cables
  - 3. 26 0529 Hangers and Supports for Electrical Systems
  - 4. 26 0533 Raceway and Boxes for Electrical Systems
  - 5. 27 0533 Conduits and Backboxes for Communications Systems

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

##### 1.2 DEFINITIONS

- A. Pathways - Support and protection system for conductors and cabling.
- B. Sleeves - Protection for wall and other penetrations.

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

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##### 1.3 SYSTEM DESCRIPTION

- A. All integrated automation systems must be in approved pathways.
- B. Approved pathways include:
  - 1. Conduit as specified in section 26 0533.
  - 2. Cable tray as specified in section 27 0533
- C. Includes conduit pathway for the Integrated Automation System where not in cable tray.
- D. Includes a complete independent conduit pathway system for the Smoke Control System and any components of the Smoke Control System.
- E. Where specifically allowed or specified, pathway system includes hangers, bridle rings, j-hooks and other supports for cabling not required to be in conduit.

##### 1.4 SUBMITTALS

- A. Refer to section 26 0529 and 26 0533.



*Section specific submittal requirements should be defined here but not repeated from other sections...*

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## 1.5 QUALITY ASSURANCE

- A. Install pathways parallel and perpendicular to building structure. Coordinate space requirements with other trades. Avoid horizontal runs through walls.
- B. Provide appropriate protection at all penetrations.
- C. For fire-rated construction, seal penetrations to maintain fire rating of construction penetrated. Refer to requirements in Section 07 8413.
- D. In addition to other pathway requirements, low voltage cable must be in an enclosed pathway system for exposed areas, inaccessible spaces (including walls), electrical and mechanical spaces, etc.
- E. Do not install pathways on floor structure or in any way that may obstruct access to equipment, spaces, walkways, etc.
- F. Support pathways appropriately to avoid movement, vibration, etc
- G. Instrumentation boxes are not to be used for pathway junctions.
- H. Refer to section 26 0533 for additional requirements.

*Section specific quality requirements should be defined here but not repeated from other sections...*

---

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Refer to section 26 0529 and 26 0533.

*Section specific requirements should be defined here but not repeated from other sections...*

---

## **PART 2 - PRODUCTS**

- 2.1 Refer to Section 26 0529 and 26 0533 for pathway product requirements.

## **PART 3 - EXECUTION**

### 3.1 INSTALLATION

- A. Verify routing and termination locations of pathways prior to rough-in.
- B. Coordinate equipment, floor, wall and roof penetrations with appropriate trades.
  - 1. Provide penetrations for pathways.
  - 2. Provide appropriate sleeves for penetrations.
  - 3. Provide fire-stopping as described in section 07 8413.
- C. Provide pathways for all work within this division.
  - 1. Provide non-continuous pathway systems from wall sensor conduit stub to associated controller.
  - 2. Provide continuous enclosed conduit pathway systems in mechanical spaces, electrical spaces, exposed areas and in any areas not specifically allowed to be non-continuous pathways
  - 3. Provide continuous enclosed conduit pathway systems for Smoke Control System

- D. Size conduit and boxes by circular mil size of cable in conduit or box.
- E. Minimum conduit size is 3/4" unless otherwise noted.
- F. Maximum length of flexible conduit is 3 feet.
- G. Refer to section 26 0553 for additional requirements.

### 3.2 PROTECTION

- A. Conduit and raceway penetrations through walls, floors, and ceilings require firestopping. Refer to Section 07 8413.
- B. Provide sleeves for penetrations. Coordinate sleeve selection and application with section 26 0533.
- C. Furnish information as to size and location of built-in openings required.
- D. Do not cut, remove, or pierce general or mechanical insulation, fire rated walls, ceilings, or steelwork without prior permission and instruction.
- E. Provide conduit to protect pneumatic tubing outside of panels.
- F. Provide appropriate protection for all work within this division.
- G. Refer to section 26 0553 for additional requirements.

**END OF SECTION**

## SECTION 25 0553

### IDENTIFICATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This Section defines labeling requirements for control panels, instrumentation, including, control valves, control room instruments, panel instruments, wire, cable, and tubing.
- B. Related Sections
  - 1. All sections in Division 25.

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

##### 1.2 REFERENCES

- A. TIA/EIA-606-A - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

---

##### 1.3 SUBMITTALS

- A. Sample valve, damper and other instrument tags.
- B. Sample wire, cable and tubing tags.
- C. Sample panel tags.
- D. Sample tagging abbreviations (if used).
- E. Installation methods for each type and condition.

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

---

##### 1.4 QUALITY ASSURANCE

- A. Tag each valve, damper and instruments according to contract documents.
- B. Where major devices are above ceiling, provide identification on ceiling grid to assist in locating device.
- C. Tags shall be machine generated and easily readable.
- D. Tags shall be appropriate for the environment installed.
- E. Do not mark on instruments with permanent markers, i.e.: felt pens or paint sticks.
- F. Install tags for easy readability.
- G. All identification in a single infrastructure must have the same format where possible.

- H. Comply with TIA/EIA- 606A and Owner identification standards.

*Section specific quality requirements should be defined here but not repeated from other sections...*

---

## **PART 2 - PRODUCTS**

### **2.1 INSTRUMENT IDENTIFICATION**

- A. Construction:
1. 1/16" thick laminated phenolic plastic, white with black core.
  2. Nominal size of 1" high by 1 to 4" wide.
  3. Stamped in 1/4" high block characters.
- B. Self adhesive is acceptable where conditions will allow for permanent mounting.

### **2.2 CONTROL PANELS IDENTIFICATION**

- A. Construction:
1. 1/16" thick laminated phenolic plastic, white with black core.
  2. Nominal size of 2" by 4".
  3. Stamped 1" high block letters.
- B. Self adhesive is acceptable where conditions will allow for permanent mounting.

### **2.3 VALVE AND DAMPER IDENTIFICATION**

- A. Construction:
1. 1/16" thick laminated phenolic plastic, white with black core or minimum 0.032" thick, polished brass or 316 stainless steel.
  2. Nominal size of 2" by 4".
  3. Stamped 1" high block letters.
- B. Hanging type only, self adhesive is not acceptable for permanent mounting.

### **2.4 WIRE, CABLE AND TUBE IDENTIFICATION**

- A. Heat Shrink Tubing:
1. Manufacturer: Rhino or Brady Bradysleeve.
  2. Labels shall be heat shrink tubing type. Heat shrink labels shall be used on wire, cable, and tubing except for vendor specific cables which may not be cut.
- B. Self Laminating Wrap-On Labels:
1. Manufacturer: Rhino or Brady WML series.
  2. Self Laminating Wrap-On Type Labels shall be selflaminating wrap-on type. Self-laminating, wrap-on labels shall be used only on wire, cable, which may not be cut, and on tubing.
- C. Self adhesive is acceptable where conditions will allow for permanent mounting

### **2.5 JUNCTION BOX IDENTIFICATION**

- A. Blue paint and black stencil lettering.

## **PART 3 - EXECUTION**

### **3.1 INSTRUMENT IDENTIFICATION**

- A. Label each instrument with hardware tag and software name.
  - 1. Instrument hardware tagging shall be according to symbols and tag numbers used on control diagrams.
  - 2. Instrument software name shall be according to database generated point name. Coordinate with section 25 1223.
- B. Size label to accommodate instrument tag number and description.
- C. Affix label to permanent to instrument or housing (if direct instrument mounting is unreasonable).
- D. Fastening Methods for indoor applications:
  - 1. Self adhesive or double-side adhesive tape.
  - 2. Epoxy Cement as required
- E. Fastening Methods for weather exposed or other conditions where self adhesive is impractical:
  - 1. Field tags: Use Round head, No. 0 x 3/16", Type U, metallic drive screw, (0.075 diameter, blunt), size 51 (0.067") drill, stainless steel or chromium plated. Cadmium plated screws are not allowed. Similar screw may be substituted.
  - 2. Panel face: Use Phillips panhead, No. 2-56 x 5/16", Type T, self-tapping sheet metal screw (0.086 diameter., blunt, notched), size 48 (0.076") drill, stainless steel or chromium plated. Cadmium plated screws are not allowed. Similar screw may be substituted.
- F. Provide control panel interior mounted instrument tags. Engraved legend shall be instrument tag number

### **3.2 CONTROL PANEL IDENTIFICATION**

- A. Provide control panel face mounted instrument tags as required. Engraved legend form ad follows:
  - PROCESS EQUIPMENT IDENTIFICATION
  - DEVICE FUNCTION
  - INSTRUMENT TAG NUMBER
  - 1. Instrument tag number shall be per owner's standard.
  - 2. Coordinate label tags and format prior to purchasing or installation.
- B. Provide phenolic tag for each controller.

### **3.3 VALVE AND DAMPER IDENTIFICATION**

- A. Provide valve and damper tags for controlled equipment.
- B. Valve and damper tags number shall be per contract documents and owner's standard.
- C. Coordinate label tags and format prior to purchasing or installation.

### **3.4 WIRE, CABLE AND TUBE IDENTIFICATION**

- A. Provide cable sheaths labeling on both ends approximately 6 inches from the termination in case the cable becomes separated from its termination.
- B. Provide a complete documented cable record for Integrated Automation systems.
- C. Label Coverage area cables at each end:
  - 1. Label terminating end with distribution location identification serving terminal device.

2. Label distribution end with terminal device destination.
- D. Label instrumentation cable and tubing at each end:
1. Label terminating end with panel device tag.
  2. Label distribution end with instrument device tag.

# SECTION 25 1219

## INTEGRATION PROTOCOLS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes Network protocol for all Integrated Automated Systems.
- B. Related Sections:
  - 1. 25 1223 Client-Server Information Database Integration
  - 2. 25 1313 Control and Monitoring Supervisory Control
  - 3. 25 5600 Monitoring and Control of Electrical Equipment

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

#### 1.2 REFERENCES

- A. ANSI/ASHRAE Standard 135-2004 Data Communication Protocol for Building Automation and Control Systems.
- B. WS-1 – Web Services Interoperability Organization Basic Profile

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

---

#### 1.3 DEFINITIONS

- A. BACnet Building Automation and Control Network open communication protocol.
- B. BTL BACnet Testing Laboratory.
- C. ModBus Serial communication protocol developed by Modicon
- D. IP Internet Protocol
- E. PICS Protocol Implementation Conformance Statement
- F. Protocol An agreed-upon format for transmitting data between two devices.
- G. XML Extensible Mark Up Language
- H. Web Services The Integration of web applications using XML standards.

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

---

#### 1.4 SYSTEM DESCRIPTION

- A. Integrated Automated System protocol at the Enterprise level shall be BACnet/IP, MODBUS TCP, or XML/Web Services.

- B. Integrated Automation System at the floor level shall utilize the BACnet protocol.
- C. Integration to 3rd party equipment may utilize LonWorks or ModBus in addition to above protocols if BACnet is not available. Provide gateways as necessary to communicate to Automation System. Refer to section 25 1200 for additional gateway requirements. Coordinate polling rate and other requirements to minimize operation of integrated equipment.
- D. Proprietary protocols are not allowed.

#### 1.5 SUBMITTALS

- A. Protocol Plan:
  - 1. Proposed communication protocols integration
  - 2. Include latest version of protocol profiles used
    - a. A BACnet Protocol Implementation Conformance Statement (PICS) for each type of controller and operator interface included in the submittal.
    - b. Modbus profiles for electrical equipment.
- B. Industry compliance

*Section specific submittal requirements should be defined here but not repeated from other sections...*

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#### 1.6 QUALITY ASSURANCE

- A. BACnet products shall be BTL compliant.
- B. Coordinate other system requirements with owner.

*Section specific quality requirements should be defined here but not repeated from other sections...*

---

#### 1.7 WARRANTY

- A. Include protocol fixes and version upgrades during warranty period.

#### 1.8 SYSTEM STARTUP

- A. Document system start up.

### **PART 2 - PRODUCTS**

#### 2.1 ENTERPRISE COMMUNICAITON

- A. BACnet/IP
  - 1. Support BACnet read data request from the system network.
- B. Modbus/IP

#### 2.2 FLOOR LEVEL COMMUNICATION

- A. The following protocols shall be used
  - 1. BACnet/MSTP
  - 2. Modbus TCP



## **PART 3 - EXECUTION**

### **3.1 ENTERPRISE COMMUNICAITON PROTOCOL**

- A. Coordinate all integration activities with owner for connection to the existing automation server. Provide all information to the campus server system integrator.
- B. Enable all points for integration to existing automation server.
- C. Utilize published functional profiles wherever possible

### **3.2 FLOOR LEVEL COMMUNICATION**

- A. Utilize dedicated structured cable system for communication to floor level devices.
- B. Provide communication protocol necessary to communicate to floor level devices.

**END OF SECTION**

## SECTION 25 1223

### CLIENT-SERVER INFORMATION /DATABASE INTEGRATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes
  - 1. The database generation and integration of the Integrated Automated Systems to the Enterprise Building Management System.
- B. Related Sections:
  - 1. 25 1219 Integration Protocols

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

##### 1.2 DEFINITIONS

- A. Archive                      Data storage
- B. Command Priorities      The order in which commands are allowed to be executed.
- C. Escalation                 Alarm advancement after delay to the next level of notification.
- D. Event                        Alarm, transaction, or sequence.
- E. Mapping                    The act of integrating data points from different systems back to the Enterprise.
- F. Normalize                 Create consistency among dissimilar data for a specific use.
- G. Real-time                 Up to the minute.
- H. Trend                        Record data for specified time intervals

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

---

##### 1.3 SYSTEM DESCRIPTION

- A. The integration of the various systems throughout the facility using protocols specified in section 25 1219.
- B. Remote read/write capabilities of Integrated Automated Systems using open and industry standard protocols. Refer to section 25 1219 for command priorities.
- C. Scope includes but not limited to:
  - 1. Data collection
  - 2. Database generation
  - 3. Graphics generation.
  - 4. Scheduling generation.
  - 5. Trending and storage of all points
  - 6. Alarm generation and management.

7. Web Page Development
  8. Reports generation
  9. Coordination of integration activities.
- D. Provide supplementary or miscellaneous items, products and labor incidental to, or necessary for complete integration of systems to the Enterprise Building Management System.
- E. Lead the coordination effort with vendors for integration activities.

#### 1.4 SUBMITTALS

- A. Include the following:
1. All required hardware components and accessories.
  2. Sample proposed Graphics systems including:
    - a. Air Handling system
    - b. Air terminal box
    - c. Floor plan
    - d. Hydronic System
    - e. Energy Wheel
  3. Sample proposed Graphics status pages including
    - a. Area status pages
    - b. Group status pages
    - c. Overview pages
  4. Object and point naming conventions
  5. SOAP messaging methods
  6. External Web Services Interfaces including:
    - a. Include configuration requirements
    - b. Operational requirements
    - c. Hardware requirements
- B. Record Documents:
1. One copy of each type of report generated
  2. Copy of all schedules
  3. Copy of all Graphics
  4. Calculations used for control and monitoring
- C. Operation Manuals
1. System Overview
  2. Networking and communications concepts
  3. Web Services publishing
  4. Integration documentation
  5. Web browser applications for a networked PC/PDA
  6. Browser User Interface screen functions and their definitions
  7. Creating, modifying or deleting equipment and report schedules
  8. Uploading and downloading software to the field hardware
  9. Creating historical trends, collecting trend data and generating trend graphs
  10. Enabling and assigning alarms, priorities, suppression and messages to desired users
  11. Report generation and 'third party software'
  12. Procedures for backing up software and data files
  13. Project specific alarm priorities, limits and messages
  14. Finely detailed descriptions of all software programs

15. Complete system design and engineering manual. (Same as used by manufactures personnel).
16. Refer to 25 0000 for additional requirements.

*Section specific submittal requirements should be defined here but not repeated from other sections...*

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## 1.5 QUALITY ASSURANCE

- A. Scope and products included in this section shall be compatible and consistent with existing Enterprise Building Management System.
- B. Limit temperature readings to 1 decimal unless otherwise noted.

*Section specific quality requirements should be defined here but not repeated from other sections...*

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## 1.6 WARRANTY

- A. Refer to 25 0000.

## 1.7 OWNER'S INSTRUCTIONS

- A. Provide 32 hours of off-site training by factorytrained instructor for 4 people. Include travel and hotel accommodations.

*Section specific training requirements should be defined here but not repeated from other sections...*

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- B. Provide an additional 24 hours of on-ste training by factory trained instructor of owner specific subject, after 6 months of occupation and prior to end of warranty.
- C. Coordinate and schedule training with Owner.
- D. At minimum, include the following:
  1. Web services data management, functions and toolkit
  2. Design requirements.
  3. Using O&M documents.
  4. Basic and advanced operator functions.
  5. Graphic generation and modifications
  6. Report features and generations
  7. Exporting data to third party software.
  8. Drawings and Specification review
- E. Identify all project equipment locations
- F. Refer to 25 0000 for additional requirements.

## **PART 2 - PRODUCTS**

### 2.1 NOT USED.

## **PART 3 - EXECUTION**

### 3.1 DATA COLLECTION:

- A. Provide mapping of points from various automated systems. Provide the ability to read and display any value of any used property of any object from any networked device including properties available and supported optional properties, as well as proprietary extensions.
- B. Trending
  - 1. Trend all points at 15 minute intervals
  - 2. Normalize and archive data.
  - 3. Store data for minimum of 2 years
- C. Timestamp all data.
- D. Normalize data points shown in contract documents for ease of database management, graphic displays, readability, and simple identification.
- E. Provide real-time dynamic screen updates for all points
- F. Provide real time rates for all utilities.

### 3.2 DATABASE GENERATION:

- A. Develop relational database of data objects, time stamps, events, alarms, and transactions.
- B. Provide the ability to modify loop Object setpoints, alarm limits, tuning parameters, routing, scheduling etc. initiated through operator interaction with graphics displays.
- C. Archive all data points, graphics, reports, alarms, trends, events, and transactions.
  - 1. Store data for 2 years
  - 2. Make data available for industry standard 3<sup>rd</sup> party applications and application implementation.
- D. Develop databases including:
  - 1. Applications
  - 2. Configuration
  - 3. Trending or historical Data
  - 4. Event storage
- E. Include construction document Tag for Hardware objects.
- F. Link database graphic objects with associated product specification data sheet.
- G. Coordinate point naming standards with owner, prior to any database generation. First eleven(11) digits include:
  - 1. First number is the campus designation. It is one(1) digit in length. (1 = MMC (Main Campus), 2= BBC (Biscayne Bay Campus)
  - 2. Second number is the building number. It is three (3) digits in length.
  - 3. Third Number is the floor. It is Two (2) digits in length.
  - 4. Fourth Number is the room number. It is Five (5) digits in length.

### 3.3 GRAPHICS GENERATION

- A. Prior to generation/submission of graphics, coordinate with Owner/Engineer to ensure consistency with existing format. Utilize Graphic Library to generate color graphics including but not limited to:
  - 1. Legend:
    - a. Color codes
    - b. Definitions
    - c. Symbols
  - 2. Common Points (for every system)
    - a. Time/Date
    - b. Outside Air Temperature/Humidity
  - 3. Integrated systems
    - a. Communication Risers
  - 4. Site and Floor plans including integrated systems:
    - a. Automated Temperature Controls system
    - b. Fire Alarm system
    - c. Security system
    - d. Lighting system
    - e. Plumbing systems
    - f. Column numbers
    - g. Room numbers and names
  - 5. Dashboards including (coordinate symbols with Owner):
    - a. Picture of facility
    - b. Facility weather
    - c. Facility Pressurization
    - d. Facility cost per hour
    - e. Facility alarms
    - f. Facility utility usage
    - g. Security Alerts
    - h. Links to various major systems such as: Floor Air Systems, Water Systems, Energy, Reports etc.
  - 6. Provide system graphics such as:
    - a. AHU, FCU, and ATU equipment
    - b. Utilities
    - c. Security
    - d. Plumbing
    - e. Power Monitoring
- B. Include other points such as:
  - 1. Calculated points
  - 2. Alarms and Limits
  - 3. Shared points
  - 4. Integrated points
  - 5. Setpoints
- C. Site Plan
  - 1. Utilities
  - 2. Lighting
  - 3. Allow penetration to floor plans graphics

D. Floor Plans:

1. Coordinate with as-built drawings to include
  - a. Room name and numbers
  - b. Column numbers
2. Identify
  - a. HVAC zones by AHU
  - b. HVAC rooms served by single space sensor.
  - c. Fire Zones
3. Allow penetration to associated system graphic
4. Thermographics
5. Color Scheme

E. Risers:

1. Systems service and status
2. Hardware service and status

F. Summaries:

1. Alarms
2. Overrides
3. Transactions
4. Events

G. Links

1. Link to previous screen (top left corner)
2. Link to associated master system from sub-system

3.4 ARCHIVES

- A. Provide automatic trending for all points.
- B. Initiate trending for all points.
  1. Trend points every 5 minutes or change of state
  2. Normalize trend data for common reporting and archiving.
- C. Provide initial trend graphs and reports per owner request.
- D. Integrate information to existing Maintenance Management System.

3.5 ALARM MANAGEMENT

- A. Provide alarms including:
  1. Any point reaching a high or low limit.
  2. Anytime feedback does not equal command.
  3. Points overridden
- B. Provide alarms for points as shown in point list. Coordinate with Owner and include the following:
  1. Point Name and Description
  2. Alarm differentials (automatically adjust with setpoints)
  3. Units
  4. Coordinate settings (limits or state) with Owner
  5. Instrument tag
  6. Priority
  7. Message

- C. Coordinate and implement alarm notifications and routing with the Owner. Include:
  - 1. Paging/PDA
  - 2. Email
  - 3. Text Messaging
  - 4. Group and network notifications
  - 5. Alarm acknowledgement.
  - 6. Existing Maintenance Management System.
- D. Provide hardware or interface required to implement alarm notification and routing.
- E. Provide alarms suppression, to minimize nuisance alarms resulting from higher level alarms.
  - 1. Hot water and chilled water alarms master to AHU temperatures.
  - 2. AHU alarms master to associated ATU and room temperatures.
  - 3. Fire alarms master to associated HVAC equipment.
- F. Provide state-based alarming to prevent alarms during specific equipment states.
  - 1. Interlock equipment status and/or modes to lock out associated alarms during shutdowns.
  - 2. Interlock acknowledgement to lock out associated alarm for limited adjustable time period.
- G. Provide and implement alarm escalation for alarms.
- H. Filter and rout alarms based on user log in.
- I. Allow alarms to be sorted and displayed chronologically, priority, filtering, etc.
- J. Provide alarms for conditions such as offline and poor communication performance.
- K. Archive all data in standard database platform Microsoft Data Engineer Microsoft SQL. Including but not limited to:
  - 1. I/O points
  - 2. Software points such as
    - a. Alarm limits
    - b. Setpoints
    - c. Parameters
  - 3. Schedules
  - 4. Alarm messages

### 3.6 CALCULATIONS

- A. Coordinate with GRU and provide calculations for dynamic points including:
  - 1. Real Time chilled water consumption (KTons)
  - 2. Real Time cost per KTons of cooling
  - 3. Real Time steam consumption (lbs/hour)
  - 4. Real Time Electric consumption
  - 5. Real Time Domestic Water consumption
  - 6. Real Time total building energy cost (\$/sq. ft.)
  - 7. Real Time outside and return air enthalpy
- B. Provide calculations for tantalization points including:
  - 1. Runtime Hours on major equipment
  - 2. Monthly Energy Cost
  - 3. Yearly Energy Cost

**END OF SECTION**



## SECTION 25 1300

### CONTROL AND MONITORING NETWORK

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes a complete microprocessor controlled BACnet compatible control and monitoring MS/TP network for the various systems connected to the BAS communication network such as but not limited to:
1. Air Handlers
  2. Air Terminals
  3. Fan Coil Units
  4. Pumps
  5. Heat Exchangers
  6. Variable Frequency Drives
  7. Computer Room Air Conditioners
  8. Chillers
  9. Lighting
  10. Fire Alarm

*Identify other appropriate major equipment contained in the construction documents*

---

- B. The Control and Monitoring Network shall integrate to the following systems:
1. Variable Frequency Drives
  2. Lighting
  3. Electrical Power
  4. Fire Alarm
  5. Security
  6. Other BAS
  7. Emergency Power

*Coordinate integration requirements into other specifications to insure cooperation from each trade. Each piece of equipment should provide necessary hardware and software for integration, and shall cooperate fully with the BAS contractor in a timely manner at their cost to ensure complete data integration.*

---

- C. Related Sections
1. 23 0514 Variable Frequency Motor Controllers
  2. 23 8123 Computer Room Air Conditioners
  3. 25 1223 Client-Server Information Database Integration
  4. 25 1400 Local Control Units
  5. 25 1416 Application Specific Controllers
  - 6.

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

## 1.2 REFERENCES

- A. UL 864/UUKL Smoke Control Listing (Ninth Edition)
- B. UL 873 Temperature-Indicating and -Regulating Equipment
- C. UL 916 Energy Management Systems

*Carefully consider UL requirements particularly for smoke control. Delete if not needed.*

---

## 1.3 DEFINITIONS

- A. FLN Floor Level Network.
- B. MS/TP Master Slave Token Ring-Passing

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

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## 1.4 SYSTEM DESCRIPTION

- A. The Control and Monitoring Network shall utilize an open architecture capable of all of the following:
  - 1. Utilizing standard Ethernet communications and operating at a minimum speed of 10/100 Mb/sec.
  - 2. Connecting via BACnet/IP at the Tier 1 level in accordance with ANSI/ASHRAE Standard 135-2004.
  - 3. The BAS network shall support both copper and optical fiber communication media at the Tier 1 level.
- B. Include isolation modules, repeaters, etc to comply with UL 864/UUKL for the smoke control devices.

*Carefully consider UL requirements particularly for smoke control. Delete if not needed.*

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## 1.5 SUBMITTALS

- A. Submit device BAS device schedule. Include:
  - 1. Device name and physical address
  - 2. Device I/O points
  - 3. Associated Building Level Controller
  - 4. Device location
  - 5. Associated system
  - 6. Location served
  - 7. Make and model number of controller
  - 8. Shop Drawings:
    - a. Control drawings
    - b. Wiring details
    - c. Installation details
    - d. Bill of materials

- e. Sequence of Operations
  - f. Panel layout for major control panels
- B. Submit riser and protocol requirements for all devices on the FLN.
  - C. Submit grounding and shielding requirements.
  - D. Submit termination requirements.
  - E. Submit distance limitations if any.
  - F. Submit UL 864 UUKL compliance documentation.

*Section specific submittal requirements should be defined here but not repeated from other sections...*

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## 1.6 QUALITY ASSURANCE

- A. The control contractor shall have a manufacturer owned office within a 50-mile distance of the project site and offer complete maintenance and support services on a 24-hour, 365 day/year basis. The office shall be staffed by factory trained and certified technicians and an engineering staff. The office shall have direct access to inventory of spare parts and all necessary test equipment required to install, commission, and service the BAS provided.
- B. Programming, start-up, and service must be performed by factory trained, employee of Manufacturer.
- C. Installation of system must be performed or supervised by qualified employee of Manufacturer.
- D. Documented history of compatibility by design for a minimum of 2 years.
- E. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field panels and extend new field panels on a previously installed network.
- F. Conform to UL 864 UUKL for the smoke control system and computer interface.
- G. Conform to UL 916.

*Section specific quality requirements should be defined here but not repeated from other sections...*

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## 1.7 SYSTEM STARTUP

- A. Document system start up and provide upon request.
- B. Coordinate start up procedures and requirements with other trades.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Honeywell
- B. Johnson Controls, Inc.
- C. Siemens
- D. Trane

- E. Qualified equivalent. To be judged a “qualified equivalent” the vendor shall obtain a Systems Integration Certification Form that the proposed system meets all specifications and standards contained in the Division 25 standard and that the proposed system integrates with the existing campus Building Automation System (BAS) head-end (Metasys) for all agreed upon points. The certification must be signed by one of the MEP firms under continuing services contract to FIU.

## 2.2 NETWORK ARCHITECTURE

- A. Complete communication architecture for BAS devices as well as other integrated vendor devices.
- B. Complete device programming capabilities via Operator Workstation.

## **PART 3 - EXECUTION**

### 3.1 INSTALLATION

- A. Provide system to monitor and/or control of BAS devices.
- B. Connect to 3<sup>rd</sup> party equipment per network diagram.
- C. Provide and coordinate all points for inclusion in database generation per section 25 1223.
- D. Mount laminated and framed system specific control drawings near controlled equipment.

### 3.2 NETWORK ARCHITECTURE

- A. Coordinate all network communication and low voltage power requirements with appropriate contractor including the installation of cabling, and overall communication system architecture, signal quality, attenuation, power level or special needs of the control system.
- B. Coordinate communications systems design and requirements (segmenting, broadcasting, multicasting, etc.) with the owner’s Information Technology Services.

**END OF SECTION**

## SECTION 25 1313

### CONTROL AND MONITORING SUPERVISORY CONTROL

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. System includes:
  - 1. Building (or network) level control units for Integrated Automation systems
  - 2. Incidental labor and material required, for a complete and operable system.
- B. System Configuration & Definition
  - 1. Changes made at the server shall be automatically recorded and downloaded to the appropriate Controller. Changes made at the Controllers shall be automatically uploaded to the workstation, ensuring system continuity.
  - 2. System configuration, programming, editing, graphics generation shall be performed on-line. If programming and system back up must be done with the PC workstation off-line, the Controls contractor shall provide at least 2 operator workstations.
- C. Related Sections:
  - 1. 25 1219 Integration Protocols

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

##### 1.2 REFERENCES

- A. UL 916 Energy Management Equipment, per category PAZX for Energy Management Equipment.
- B. UL 864 Control units for Fire-Protective Signaling Systems, per category UUKL for Smoke Control System Equipment.
- C. ANSI/ASHRAE Standard 135-1995 BACnet protocol.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

---

##### 1.3 SYSTEM DESCRIPTION

- A. Acceptable Manufacturers
  - 1. Honeywell
  - 2. Johnson Controls, Inc.
  - 3. Siemens
  - 4. Trane
  - 5. Qualified equivalent. To be judged a "qualified equivalent" the vendor shall obtain a Systems Integration Certification Form that the proposed system meets all specifications and standards

contained in the Division 25 standard and that the proposed system integrates with the existing campus Building Automation System (BAS) head-end (Metasys) for all agreed upon points. The certification must be signed by one of the MEP firms under continuing services contract to FIU

- B. Microprocessor based, field programmable controllers to:
  - 1. Integrate systems specified
  - 2. Accept commands from existing enterprise server the following:
    - a. Commands
    - b. Overrides
    - c. Schedules
    - d. Interlocks
    - e. Adjustments
  - 3. Perform stand alone facility wide control strategies and sequences.
- C. Additional programming or hardware shall not be allowed at the Building Level controller to support various system integrations using a BACnet compliant interface.

#### 1.4 SUBMITTALS

PRODUCT DATA SHEET 1 - Identify specific parts and accessories proposed for project. Order submittals based on the specification section and include the following:

- 1.1 BAS network architecture diagrams including all Tier 1 nodes, Tier 2 interconnections, and 3rd party integration. Include repeater locations.
- 1.2 Provide floor plans locating all control units, workstations, servers, LAN interface devices, gateways, etc. Include all Tier 1 and Tier 2 communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Indicate network number, device ID, address, device instance, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the floor plans. As-built wire routing conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.
- 1.3 Schematic flow diagram of system showing all equipment and control devices. Diagram shall include designation of all inline devices, wells, taps and other devices furnished under this Section but installed by other trades.
- 1.4 Identification of immersion wells, pressure taps, associated shut-off valves, flow switches, level switches, flow meters, air flow stations and other such items furnished under this section but installed by other trades.
- 1.5 Setting or adjustable range of control for each control device.
- 1.6 Written description of detailed sequence of operations. Include all initial set-point values, time delay values, references to specific device names. The sequences shall be detailed and include all vendor specific pre-engineered logic. They should not be a duplication of the Engineer's sequences.
- 1.7 Points schedule for each real point in the BAS, including: Tag, Point Type, System Name and Display Units. Device Type, Address, Cable Destination, Module Type, Terminal ID, Panel, Slot Number, Reference Drawing, and Cable Number. Cable destination, terminal ID, slot number, etc... may also be identified in panel detail drawings.
- 1.8 Samples of each typical system Graphic Display screen and associated menu penetrations to show hierarchy and functional interrelationships for systems specified. Sample floor plan graphic showing all proposed components and colors.
- 1.9 Detailed Bill of Material list for each system, identifying quantity, part number, description, and optional features selected.
- 1.10 Relevant resumes and documentation for proposed project team members.
- 1.11 Control Dampers

- A. Schedule including a separate line for each damper and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Frame Type, Blade Type, Bearing Type, Seals, Duct Size, Damper Size, Mounting, Actuator Type, Actuator model number, Actuator torque rating and quantity of actuators required to ensure total closure of damper(s).
  - B. Leakage and flow characteristics data for all control dampers. Leakage ratings to be based on AMCA Standard 500 and dampers to bear AMCA leakage certification seal.
- 1.12 Control valve schedules including a separate line for each valve and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Actual Valve CV, Calculated CV, Design Pressure drop, Actual Pressure drop, Actuator Type and model number.
- 1.13 Room Schedule including a separate line for each terminal unit indicating terminal identification, minimum/maximum cfm, box area, thermostat/sensor location, Htg/Clg Set points and bias setting. The schedule shall include typical calibration factors to be filled in by TAB contractor during startup and verification.
- 1.14 Air Flow Measuring System Schedule including a separate line for each flow device and column for device type, model number, size, location.
- 1.15 Cabling indicate all required electrical wiring. Information including wire jacket colors for low voltage signal wiring, low voltage power wiring and communication cable. Indicate wire gauge for each type of cable.
- 1.16 Electrical wiring diagrams: Shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Ladder diagrams shall appear on system schematic. Clearly differentiate between portions of wiring which is existing, factory-installed and portions to be field-installed.
- 1.17 FCC compliance.

A. Refer to section 25 0000.

*Section specific submittal requirements should be defined here but not repeated from other sections...*

#### 1.18 QUALITY ASSURANCE

- A. The control contractor shall have a manufacturer owned office within a 50-mile distance of the project site and offer complete maintenance and support services on a 24-hour, 365 day/year basis. The office shall be staffed by factory trained and certified technicians and an engineering staff. The office shall have direct access to inventory of spare parts and all necessary test equipment required to install, commission, and service the BAS provided.
- B. Comply with ISO 9000 (Model for Quality Assurance in Production, Installation, and Servicing).
- C. Documented history of compatibility by design for a minimum of 2 years. Future compatibility shall be supported for no less than 7 years.
- D. Comply with the ANSI/ASHRAE Standard 135-1995 BACnet protocol in one open, interoperable system.
- E. Provide UPS for controller where required to accomplish sequences, failure scenarios, and/or power loss.
- F. Refer to section 25 0000 for additional requirements.

*Section specific quality requirements should be defined here but not repeated from other sections...*

## 1.19 WARRANTY

- A. Upon completion of final test of installation and acceptance by Engineer and Owner, provide any service incidental to proper performance for a period of two years.
- B. Include:
  - 1. Software revisions or updates during the warranty period.
  - 2. Two year warranty for parts replacement.
  - 3. Registration and warranty documents and warranty rights to the Owner.
  - 4. Extended warranties, if necessary, to meet the warranty requirement.
  - 5. Software and firmware updates which resolve known deficiencies.
- C. Refer to section 25 0000 for additional requirements.

## 1.20 OWNER'S INSTRUCTIONS

- A. Provide 8 hours training on Local Control Units.

*Section specific training requirements should be defined here but not repeated from other sections...*

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## PART 2 - PRODUCTS

### 2.1 SUPERVISORY CONTROLLERS

- A. The Supervisory Controller connects to high speed Local Area Network (LAN), serves as communications hub for other DDC on slower speed LANs, and has sufficient processor capabilities and RAM to implement all types of custom software applications.
- B. Include uninterrupted real time clocks capable of time of day, week, and year information to the system as needed to perform software functions.
  - 1. Clocks in multiple DDC's shall be synchronized to automatically match designated enterprise server.
  - 2. Accuracy shall be within 1 second per day.
  - 3. The general purpose DDC Controllers shall have the ability to perform all of the following energy management routines:
    - a. Time-of-day scheduling
    - b. Calendar-based scheduling
    - c. Holiday scheduling
    - d. Temporary schedule overrides
    - e. Start-Stop Time Optimization
    - f. Automatic Daylight Savings Time Switch-over
    - g. Night setback control
    - h. Enthalpy switch-over ( economizer)
    - i. Peak demand limiting
    - j. Temperature-compensated duty cycling
- C. Maintain volatile memory and real time clocks for a period of at least 72 hours during power failure.
  - 1. Batteries shall be maintenance free and have minimum life of 2 years.
  - 2. Upon power restoration, the following occurs automatically:
    - a. Orderly startup of controlled equipment (user defined)
    - b. Continuation of control algorithms



- c. Database revision
  - d. Logging of power interruption and restoration times
  - e. Battery recharging
- 3. Provide local visual indication and system annunciation of low battery power for each battery.
- D. The general purpose DDC Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
- E. Support firmware upgrades without the need to replace hardware.
- F. Communication Speed: Controllers shall communicate at a minimum of 100 – 200 MBps using Ethernet implemented over EIA-802.3 using a CAT.5 cable at the Data Link Layer.
- G. Include a communications port to connect display device for operator access to information and operating system functions.

### **PART 3 - EXECUTION**

#### **3.1 SUPERVISORY CONTROLLERS**

- A. Provide Supervisory Controllers as needed to accommodate network architecture and cable design. Floor level network will be by floor only (not floor to floor).
- B. Provide communication cards, repeaters, connectors, jumpers, terminals, and other hardware for complete system.
- C. Provide all software for a complete system.
- D. Coordinate final controller locations prior to installation.

**END OF SECTION**



# SECTION 25 1400

## LOCAL CONTROL UNITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. System includes Digital Controllers for automation systems.
- B. Related Sections:
  - 1. 23 3600 Air Terminal Units
  - 2. 25 1400 Local Control Units
  - 3. 25 1423 Field Equipment Panels

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

#### 1.2 REFERENCES

- A. UL 864/UUKL Smoke Control Listing
- B. UL 916 Energy Management Equipment, per category PAZX for Energy Management Equipment.
- C. ANSI/ASHRAE Standard 135-1995 BACnet protocol.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

---

#### 1.3 DEFINITIONS

- A. AI Analog Input
- B. AO Analog Output
- C. DI Digital Input
- D. DO Digital Output
- E. Dry Contact Contact closure without an electrical output (switch)
- F. I/O Inputs and Outputs.
- G. Ma Milliamps
- H. MS/TP Master/Slave Token Passing protocol used on the EIA-485 network.
- I. NC Normally Closed
- J. NO Normally Open
- K. Ohm Unit of electrical resistance
- L. PID Proportional Integral Derivative
- M. Setpoint The goal of any control loop

- N. Stand-Alone To operate or control without the need for higher level communications
- O. TAB Test Adjust and Balance
- P. Terminal Equipment HVAC equipment used for localized or zone control.
- Q. VDC Voltage Direct Current

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

#### 1.4 SYSTEM DESCRIPTION

- A. Microprocessor based, field programmable controllers, include controllers dedicated to monitor and control of specific equipment such as:
  1. Air Handling Units
  2. Air Terminal Units
  3. Laboratory Controllers
  4. Fan Coil Units
  5. Unit Ventilators
  6. Lighting Panels
  7. Pumps
  8. Fans
  9. Remote Dampers
  10. Other miscellaneous equipment
- B. Stand-alone controllers, performing specified control sequence independently of other controllers on the structured MS/TP network.
- C. Capable of performing control and monitor functions including:
  1. Stand-alone system control. (Normal control of each independent systems operation shall continue without the need for a communication network).
  2. Perform specific control sequences in contract documents. Revise sequences, timers, delays, intervals, as required to meet design intent and field conditions, for a fully operations system.
  3. Accepting voltages, current, thermistors or resistive inputs.
  4. Accepting discrete inputs from isolated, dry-type contacts (no grounds or no voltage) of either normally open (NO) or normally closed (NC) configuration.
  5. Convert controller information into output signals to actuators and field control devices.
  6. Accepting voltages 0-5 VDC or 0-10 VDC, current (0-20ma or 4-20 mA), thermistors or resistive input (0-1000 ohm).
  7. Maintain setpoints, flow limits, and occupancy schedules, etc. indefinitely in each controller's non-volatile memory.
  8. Unless otherwise specified, control to within 5% of set point.
  9. Control by VFD is not allowed.

#### 1.5 QUALITY ASSURANCE

- A. Comply with the ANSI/ASHRAE Standard 135-1995
- B. Comply with UL 916.
- C. Comply with category UUKL of UL 864 for controlling smoke and fire/smoke dampers.
- D. Limit quantity of controllers to 85% of capacity of network or segment. Include any additional hardware required.

- E. Mount controllers for easy accessibility within enclosure and outside of airstream.
- F. Limit quantity of controllers to maximum of 8 per HCP.
- G. At time of final observation, demonstrate the sequence of operation for each system to Owner.
- H. Provide services to assist Testing, Adjust and Balancing of systems.
- I. Provide weather protection cover or weatherproof control devices where required for control devices located outdoors. All control devices located outdoors shall be rated for the anticipated environment. Include provisions for supplemental ventilation when control devices must be located within these outdoor control panels. Refer to section 25 1423 enclosure requirements.
- J. In the event of a loss of communication, all lower controller and components shall revert to occupied mode.
  - 1. Power failures shall cause the control module to go into an orderly shutdown with no loss of program memory.
    - a. Upon resumption of power, the Control module shall automatically restart and report the time and date of the power failure and restoration.
    - b. The restart program shall automatically restart affected field equipment without human intervention.
  - 2. Hard-wired safeties including, but not limited to fire alarm, high/low static, high/low temperature, etc, that cause unit shutdowns, shall allow automatic restart upon manual reset of tripped device. (no additional reset at workstation required)
- K. Include spare I/O's for each major piece of equipment (non-terminal) controlled per the following:
  - 1. 2 spare AI's
  - 2. 2 spare AO's
  - 3. 2 spare DI's
  - 4. 2 spare AO's
- L. Provide Uninterruptable Power Supply for controllers as needed to accomplish sequences and recover from power loss...

*Section specific quality requirements should be defined here but not repeated from other sections...*

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## 1.6 WARRANTY

- A. Include:
  - 1. Software revisions or updates during the warranty period.
  - 2. Two year warranty for parts replacement.
  - 3. Registration and warranty documents and warranty rights to the Owner.
  - 4. Extended warranties, if necessary, to meet the warranty requirement.
  - 5. Software and firmware updates which resolve known deficiencies.

## 1.7 OWNER'S INSTRUCTIONS

- A. Refer to Section 25 0800 for requirements.
- B. Provide 8 hours training on Local Control Units.
- C. Provide 4 hours training for TAB contractor prior to start of Test, Adjust and Balance.

*Section specific training requirements should be defined here but not repeated from other sections...*

---

## PART 2 - PRODUCTS

### 2.1 FIELD EQUIPMENT CONTROLLERS

- A. Must include the following:
  - 1. Communicate on the local BAS structured cable system.
  - 2. Programs and parameters stored in nonvolatile memory.
  - 3. Access to parameters and program via laptop computer, hand held device or network.
- B. Applications include but are not limited to the following:
  - 1. Air Handling Units
  - 2. Large Unit Ventilators
  - 3. Large Fan Systems
  - 4. Other system specific control.
- C. Be expandable and act as one control unit.
- D. Include access to the controller's inputs, outputs and parameters by via standard IBM compatible laptop computer plugged in to the controller or room temperature sensor.

### 2.2 AIR TERMINAL CONTROLLERS

- A. Must include the following:
  - 1. Programs and parameters stored in nonvolatile memory.
  - 2. Access to parameters and program via laptop computer, hand held device or network.
  - 3. Integral actuator for air volume control (if available).
  - 4. Prevent overlapping of heating and cooling setpoints.
  - 5. Maintain airflow calibration without disrupting airflow.
  - 6. Include Analog Output for reheat control where applicable.

*Many vendors open and close VAV box to calibrate air-flow sensor. For critical pressure zones, make sure uninterrupted calibration is required...*

- B. Applications include:
  - 1. Air terminal boxes.
  - 2. Terminal Reheat Coils.
  - 3. Other zone specific control.
- C. Performance Requirements:
  - 1. Min. Actuator Torque                      35 in-lb
  - 2. Min. Operating Temperatures        40 to 120 Deg F
  - 3. Min. Operating Humidity              10 to 90% RH
  - 4. Maintain Airflow                      +/-        5%
  - 5. Maintain zone temperature            +/- .5 Deg F.

### 2.3 UNITARY EQUIPMENT CONTROLLERS

- A. Must include the following:
  - 1. Communicate on the local BAS structured cable system.
  - 2. Programs and parameters stored in nonvolatile memory.
  - 3. Access to parameters and program via laptop computer, hand held device or network.
- B. Applications include:
  - 1. Fan Coil Units.
  - 2. Unit Conditioners.

3. Heat Pumps.
  4. Simple Unit Ventilators.
  5. Small Fans.
  6. Floor Static Control stations.
  7. Other unit specific control.
- C. Performance Requirements:
1. Min. Operating Temperatures 40 to 120 Deg F
  2. Min. Operating Humidity 10 to 90% RH
  3. Maintain Airflow +/- 5%
  4. Maintain zone temperature +/- .5 Deg FAD POWER SUPPLIES (transformers)

## **PART 3 - EXECUTION**

### **3.1 FIELD EQUIPMENT CONTROLLERS**

- A. Provide controllers to accomplish monitoring and control of systems
- B. Provide additional miscellaneous equipment necessary for complete system control.
- C. Provide factory mounting in appropriate enclosures per Section 25 1423.
- D. To ensure stand-alone capability, provide a controller for each equipment (or group) such as Air Handling Unit, Heating Hot Water, Chilled Water, Exhaust Systems, and VFDs etc.

### **3.2 AIR TERMINAL CONTROLLERS**

- A. Provide Air Terminal Controllers to accomplish sequences for zone specific air terminal equipment including:
  1. Supply Air Terminals
  2. Return Air Terminals
  3. Exhaust Air Terminals
  4. Reheat Coils
- B. Provide additional I/O modules as needed to accomplish control sequences and meet point-list requirements.
- C. Provide coordination such as shipping, scheduling, and technical support for Air Terminal factory mounting and proper operation.
- D. To ensure stand-alone capability, provide a controller for each terminal or fan coil unit.
- E. Terminal Actuation fails in place unless otherwise noted.
- F. Coordinate power requirements with Section 23 3600.

### **3.3 UNITARY EQUIPMENT CONTROLLERS**

- A. Provide Unitary Equipment Controllers to accomplish sequences for zone specific air terminal equipment.
- B. Provide additional I/O modules as needed to accomplish control sequences and meet point-list requirements.
- C. Provide factory mounting in appropriate enclosures per Section 25 1423.
- D. To ensure stand-alone capability, provide a controller as needed for miscellaneous equipment.

**END OF SECTION**



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## SECTION 25 1416

### APPLICATION SPECIFIC CONTROLLERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. System includes Application Specific Controllers for automation systems.
- B. Related Sections:
  - 1. 23 3600 Air Terminal Units
  - 2. 25 1423 Field Equipment Panels

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

3.

##### 1.2 REFERENCES

- A. UL 916 Energy Management Equipment, per category PAZX for Energy Management Equipment.
- B. ANSI/ASHRAE Standard 135-1995 BACnet protocol.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

C.

##### 1.3 DEFINITIONS

- A. AI Analog Input
- B. AO Analog Output
- C. DI Digital Input
- D. DO Digital Output
- E. MS/TP Master Slave Token Ring-Passing
- F. Refer to section 25 1400 for additional definitions

##### 1.4 SYSTEM DESCRIPTION

- A. Microprocessor based, application specific field programmable controllers, include controllers dedicated to monitor and control of specific equipment such as:
  - 1. Air Handling Units
  - 2. Air Terminal Units
  - 3. Laboratory Controllers
  - 4. Fan Coil Units
  - 5. Unit Ventilators

- 6. Lighting Panels
  - 7. Heat Pumps
  - 8. Other packaged equipment
- B. Stand-alone controller, performing its specified control sequence independently of other controllers on the structured BACnet MS/TP network.
  - C. Capable of performing control and monitor functions including:
    - 1. Stand alone PID control.
    - 2. Perform specific, stand alone control sequences in contract documents.
    - 3. Accepting voltages, current, thermistors or resistive inputs.
    - 4. Accepting discrete inputs from isolated, dry-type contacts (no grounds or no voltage) of either normally open (NO) or normally closed (NC) configuration.
    - 5. Have isolated, dry-type contacts (no grounds or no voltage) of either normally open (NO) or
    - 6. Convert controller information into output signals to actuators and field control devices.
    - 7. Accepting voltages 0-5 VDC or 0-10 VDC, current (0-20ma or 4-20 mA), thermistors or resistive input (0-1000 ohm).
    - 8. Maintain setpoints, flow limits, and occupancy schedules, etc. indefinitely in each controller's non-volatile memory.
    - 9. Unless otherwise specified, control to within 5% of setpoint.

#### 1.5 SUBMITTALS

- A. Submit room schedules for all zone control devices.
- B. Refer to section 25 0000.

*Section specific submittal requirements should be defined here but not repeated from other sections...*

---

C.

#### 1.6 QUALITY ASSURANCE

- A. Comply with the ANSI/ASHRAE Standard 135-1995
- B. Comply with UL 916.
- C. Limit quantity of controllers to 85% of capacity of network or segment. Include any additional hardware required.
- D. At time of final observation, demonstrate the sequence of operation for each system to Owner.
- E. Provide services to assist Testing, Adjust and Balancing of systems.

*Section specific quality requirements should be defined here but not repeated from other sections...*

---

#### 1.7 WARRANTY

- A. Include:
  - 1. Registration and warranty documents and warranty rights to the Owner.
  - 2. Extended warranties, if necessary, to meet the warranty requirement.
  - 3. Software and firmware updates which resolve known deficiencies.

- B. Refer to section 25 0000 for additional requirements.

## 1.8 OWNER'S INSTRUCTIONS

- A. Provide 8 hours training on Application Specific Controllers.
- B. Provide 4 hours training for TAB contractor prior to start of Test, Adjust and Balance.

*Section specific training requirements should be defined here but not repeated from other sections...*

---

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT CONTROLLERS

- A. Must include the following:
  - 1. Communicate on the local BAS structured cable system.
  - 2. Programs and parameters stored in nonvolatile memory.
  - 3. Access to parameters and program via laptop computer, hand held device or network.
- B. Applications include but are not limited to the following:
  - 1. Air Handling Units
  - 2. Large Unit Ventilators
  - 3. Large Fan Systems
  - 4. Other system specific control.
- C. Programs and parameters stored in nonvolatile memory.
- D. Be expandable and act as one control unit.
- E. Include access to the controller's inputs, outputs and parameters by via standard IBM compatible laptop computer plugged in to the controller or room temperature sensor.
- F.

### 2.2 AIR TERMINAL CONTROLLERS

- A. Must include the following:
  - 1. Programs and parameters stored in nonvolatile memory.
  - 2. Access to parameters and program via laptop computer, hand held device or network.
  - 3. Integral actuator (for air volume control only).
- B. Applications include:
  - 1. Air terminal boxes.
  - 2. Terminal Reheat Coils.
  - 3. Other zone specific control.
- C. Performance Requirements:
  - 1. Min. Actuator Torque 35 in-lb
  - 2. Min. Operating Temperatures 40 to 120 Deg F
  - 3. Min. Operating Humidity 10 to 90% RH
  - 4. Maintain Airflow +/- 5%
  - 5. Maintain zone temperature +/- .5 Deg F.

## 2.3 UNITARY EQUIPMENT CONTROLLERS

- A. Must include the following:
  - 1. Communicate on the local BAS structured cable system.
  - 2. Programs and parameters stored in nonvolatile memory.
  - 3. Access to parameters and program via laptop computer, hand held device or network.
- B. Applications include:
  - 1. Fan Coil Units.
  - 2. Unit Conditioners.
  - 3. Heat Pumps.
  - 4. Simple Unit Ventilators.
  - 5. Small Fans.
  - 6. Floor Static Control stations.
  - 7. Other unit specific control.
- C. Performance Requirements:
  - 1. Min. Operating Temperatures 40 to 120 Deg F
  - 2. Min. Operating Humidity 10 to 90% RH
  - 3. Maintain Airflow +/- 5%
  - 4. Maintain zone temperature +/- .5 Deg FAD POWER SUPPLIES (transformers)
- D. Power supply
  - 1. Include power supplies.
  - 2. Power supplies shall be internal to controller enclosure or in an enclosure adjacent to the controller.
- E.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT CONTROLLERS

- A. Provide controllers to accomplish monitoring and control of systems
- B. Provide additional miscellaneous equipment necessary for complete system control.
- C. Provide factory mounting in appropriate enclosures per Section 25 1423.
- D.

### 3.2 AIR TERMINAL CONTROLLERS

- A. Provide Air Terminal Controllers to accomplish sequences for zone specific air terminal equipment.
- B. Provide additional I/O modules as needed to accomplish control sequences and meet point-list requirements.
- C. Provide coordination such as shipping, scheduling, and technical support for Air Terminal factory mounting and proper operation.
- D. Coordinate power requirements with Section 23 3600.

### 3.3 UNITARY EQUIPMENT CONTROLLERS

- A. Provide Unitary Equipment Controllers to accomplish sequences for zone specific air terminal equipment.
- B. Provide additional I/O modules as needed to accomplish control sequences and meet point-list requirements.
- C. Provide factory mounting in appropriate enclosures per Section 25 1423.
- D.

**END OF SECTION**

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# SECTION 25 1423

## FIELD EQUIPEMENT PANELS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Control panel requirements for Integrated Automation Systems
- B. Related Sections
  - 1. 25 0553 - Identification
  - 2. 25 1400 - Local Control Units
  - 3. 25 3526 - Pneumatic Piping Tubing

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

#### 1.2 REFERENCES

- A. ANSI 61      Drinking Water System Components - Health Effects
- B. NEMA 1      General Purpose - for use in dry indoor locations.
- C. NEMA 4      Watertight - for use in locations where subjected to direct water spray and outdoors

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

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#### 1.3 DEFINITIONS

- A. Rung – Logical decision resembling the rung of a ladder within a ladder logic diagram.
- B. Wiring Duct – Pathway for wire management inside of panels.
- C. Wiring Trough – Wiring enclosure used to manage wiring outside of panels.
- D. Refer to section 25 0000 for additional definitions.

#### 1.4 SYSTEM DESCRIPTION

- A. Field equipment panels include, but not limited to control panels for:
  - 1. Air Handler systems
  - 2. Chiller systems
  - 3. Boiler systems
  - 4. Exhaust Fan systems
  - 5. Pumping Systems
  - 6. Miscellaneous systems
  - 7. Monitoring systems
- B. Enclosures for all controllers and instruments except those furnished by equipment manufacturers for factory mounted controls.

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*



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## 1.5 SUBMITTALS

- A. Submit control panel fabrication drawings including: back-panel layout, panel face arrangement, panel name, and panel tag number (if applicable) prior to fabrication or device installation.
  - 1. Drawings shall show operator interface configuration on panel face and device locations on back-panel. Also include panel tagging schedule or identification detailing nameplate text and size.
  - 2. Include panel power schematic showing power sources and protection device capacity.
  - 3. List manufacturer supplied devices in bill of material table.
- B. Submit schematic and wiring interconnection drawings in ladder format. Include rung numbers. Number relays with rung number.
  - 1. Each relay function shall be fully described to right of relay right rung. Each relay contact location shall be referenced at coil location.
  - 2. Each contact shall have associated coil reference and shortened description of coil function. Each contact shall have relay pin-out identifiers.
  - 3. Wire colors and designators shall be identified.
  - 4. Terminal blocks shall be uniquely identified. Field and panel wiring shall be differentiated by solid line for panel and dashed line for field.
  - 5. Each connection to field device or other remote panel shall be identified.
- C. Submit Calibration sheets for instruments and devices connected to panel.

*Section specific submittal requirements should be defined here but not repeated from other sections...*

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## 1.6 QUALITY ASSURANCE

- A. Enclosures shall be free of scratches, dents, overspray, oil, etc. at substantial completion. Thoroughly clean interior and exterior of all panels.
- B. Include instrument/equipment tag numbers, when available, on submittal documents whenever specific component appears.
- C. Install panels according to manufacturer's instructions.
- D. Space wire-ways and terminal strips 3" apart.
- E. Locate terminal strips either horizontally in upper half of back panel or vertically. Do not locate terminal strips below 2'-0" or above 6'-6" above finished floor.
- F. Separate 24 VDC and 120 VAC terminal strips, wire, cable, and devices by 6" minimum space.
- G. Provide terminal strips for total controller I/O count plus 20% spare capacity with analog and discrete spare capacity calculated separately.
- H. Size raceway to maximum fill of 40% per NEC.
- I. Space controllers according to manufacturer's requirements with 3" minimum between controllers and other devices on back panel and 6" between controller front and door mounted devices. Ensure adequate space is allowed for device heat dissipation.
- J. Control enclosure interior temperature to 80°F maximum.
- K. Do not place controller or control devices on enclosure sides.

- L. Provide 25% minimum spare capacity of panel space, spare controller chassis space, wiring duct space, and terminal blocks to allow for future expansion by adding I/O cards and associated cabling.
- M. Locate panels adjacent to equipment served with minimum of 3 ft clearance in front of door. Provide sufficient clearances to allow full door swing and full access to internal components. Remote mounted panels are acceptable where accessibility will be significantly improved.
- N. Mount top of panels between 5 and 6 ft above floor so that gauges and indicators are at eye level.
- O. Route and terminate wiring parallel and at right angles within panels.
- P. Terminate power within 4 inches of panel entrance.
- Q. Refer to section 25 0000 for additional requirements.

*Section specific quality requirements should be defined here but not repeated from other sections...*

## **PART 2 - PRODUCTS**

### **2.1 ENCLOSURES**

- A. Manufacturer: Hoffman, Hammond Manufacturing or approved equal.
- B. Construction:
  1. Minimum 14 gauge steel.
  2. Hinged door
  3. Include inner panel
  4. ANSI 61 external powder paint finish.
  5. Cylinder locks and master 4 master keys for all panels less than 8 foot above finished floor.
  6. Include print pockets on enclosure doors.
  7. Miscellaneous steel components, e.g. standoffs, shall be 12 gauge minimum rolled steel.
- C. Floor Mounted Panels:
  1. Minimum size for panel fastening anchors shall be 9/16".
  2. Unless otherwise specified, install floor mounted control panel(s) on four 4" concrete equipment pad(s) with grout as required.
  3. Install two (2) anchors for each four (4) feet of equipment length or minimum of four (4) anchors. Decrease anchor spacing for heavy panels as required. Bolt equipment to pad using cap screws and washers.
- D. Wall Mounted Panels:
  1. Minimum size for wall fastening anchors shall be 3/8".
  2. Provide one anchor for every 4'-0" of outside perimeter for wall mounted panels; minimum anchors for wall mounted panels shall be 4. Decrease anchor spacing for heavy panels as required.
  3. Provide clear space for dressing out wiring, cables and tubing entering panel. Provide 4" <sup>2</sup> unrestricted clear space for each inch of conduit size or each square inch of wiring duct size, with 4" x 4" being minimum area, in alignment with entering conduit or wiring duct, for bringing wiring into panel and routing to other locations
  - 4.

### **2.2 WIRING DUCT:**

- A. Manufacturers: Panduit, Tyton, or approved alternate.
- B. Construction:

1. Slotted plastic or vinyl (PVC)
2. Grey or white
3. Snap-on covers.

### 2.3 WIRING TROUGH

- A. Manufacturer: Hoffman, Hammond Manufacturing or approved equal.
- B. Construction:
  1. Minimum 14 gauge steel.
  2. Unpainted galvanized finish.
  3. Flat cover

### 2.4 AC POWER SUPPLIES

- A. Transformers for use with digital controllers, actuators, etc.
  1. Input Power: 120 VAC to 480 VAC
  2. Output Power: 24 VAC
  3. Minimum capacity 40 VA
  4. Resettable Circuit Breaker
  5. External Plug

### 2.5 UNINTERRUPTABLE POWER SUPPLY

- A. UPS for use with digital controllers.
  1. Input Power: 120 VAC
  2. Output Power: 120V VAC
  3. Minimum capacity 550 VA
  4. Resettable Circuit Breaker
  5. Battery Failure Notification
  6. Audible Alarm

## PART 3 - EXECUTION

### 3.1 ENCLOSURES

- A. Enclosures for all controllers and instruments except those furnished by equipment manufacturers for factory mounted controls.
- B. Provide NEMA type 1 enclosures for dry indoor locations.
- C. Provide NEMA type 4 control panel enclosures in outdoor locations or indoor locations (including maintenance spaces) where water damage is possible.
- D. Label enclosures with respective unique ID numbers in accordance with section 25 0553.
- E. Mount local control panels at convenient locations adjacent to and independent of equipment served. Install control panels in locations as shown on drawings and with proper clearance.
- F. Mount cooling devices, receptacles and incandescent lights (if applicable) on enclosure sides.
- G. Mount top of panels between 5 and 6 ft above floor. Mount panels at consistent height.
- H. Provide control panels where more than one control device requires field mounting.
- I. Instrument mounting:

1. Ensure connections can be easily made and ample room exists for servicing each item. Every component in and on enclosures shall be able to be removed individually without affecting other components and without the need to move other components.
2. Install devices prior to terminating wire or tubing.
3. Rigidly attach instruments with properly sized stainless steel screws or bolts so they may be removed.
4. Do not install instruments on panel sides, except for cooling devices, receptacles, and lighting, devices.
5. Provide gaskets for instruments penetrating panel exterior and seal in accordance with NEMA standards. Entire enclosure shall meet NEMA standard after installation of required devices.

J. Knockouts:

1. Distortion of panels is not permitted as a result of machining cutouts or mounting instruments and devices.
2. Cutouts shall be smooth and without irregularity from desired shape.
3. Flame cutting or arc-cutting is not permitted.
4. Align knockouts, sub-panels, and drilling for mounting to keep devices grouped and in vertical and horizontal alignment.
5. Provide rubber grommets in cutouts for wiring or tubing to prevent chaffing or scarring of insulation or jacketing of wiring or tubing.

K. Mounting fasteners:

1. Minimum size for panel fastening anchors shall be 9/16" for floor anchors and 3/8" bolt for wall anchors. Increase anchor sizes as required for heavy panels.

L. Floor Mounted Panels:

1. Unless otherwise specified, install floor mounted control panel(s) on four 4" concrete equipment pad(s) with grout as required.
2. Install two (2) anchors for each four (4) feet of equipment length or minimum of four (4) anchors. Decrease anchor spacing for heavy panels as required. Bolt equipment to pad using cap screws and washers.
3. Do necessary grouting after equipment is installed and leveled. Grouting material shall be Owner approved cement grout; mixed and placed in accordance with manufacturer's recommendations. Remove leveling shims and wedges after grout has hardened. Re-grout Shim and wedge areas after shims or wedges are removed.

M. Wall Mounted Panels:

1. Provide one anchor for every 4'-0" of outside perimeter for wall mounted panels; minimum anchors for wall mounted panels shall be 4. Decrease anchor spacing for heavy panels as required.
2. Provide clear space for dressing out wiring, cables and tubing entering panel. Provide 4" <sup>2</sup> unrestricted clear space for each inch of conduit size or each square inch of wiring duct size, with 4" x 4" being minimum area, in alignment with entering conduit or wiring duct, for bringing wiring into panel and routing to other locations. This space shall be sufficiently accessible to enable pulling wiring, cables, or tubing into panel for termination with initially installed equipment in place.

N. Wiring:

1. Provide flexible sleeves for protection of each wire bundle that passes across door hinge. Allow sufficient slack in wiring bundles so that door can fully open. Provide separate bundles for analog and discrete wiring crossing door hinges separated by > 6".
2. Install wire and cabling so that any item may be removed without interrupting circuit power or other terminations.
3. Use solder less spade-type compression lugs for wiring terminations except for pressure plate type terminations.
4. Identify power circuit.

5. Install wiring along vertical or horizontal runs to present neat appearance. Angled runs are not allowed.
6. Provide copper grounding lugs for electrical grounding of metal panels. Size lugs for system requirements but shall be less than #8.
7. Neatly land and terminate stranded conductors in terminal blocks. Do not remove strands of stranded wire out to make wiring fit terminal.
8. Fuses or circuit breakers shall be readily accessible and easily identified. Properly label each fuse or circuit breaker. Install circuit breakers and fuses in clear space as required by NEC.
9. Connect controller network cabling in accordance with manufacturer's connection practices and as shown on drawings.

O. Terminal Blocks:

1. Land cables on terminal blocks prior to controller terminations.
2. Assure ease of accessibility of terminal blocks.
3. Connect no more than 2 conductors under each terminal screw.
4. For terminal blocks located between 3" deep or deeper wiring duct, install terminal blocks on raised channel to facilitate ease of connection to terminal block.
5. Label terminal blocks.
6. Group terminal blocks in sequential manner following I/O type and device tag name.
7. Grouping or placement shall not compromise NEC wiring classification.

P. Power:

1. Terminate power wiring within 6 inches of enclosure entrance.
2. Include fused terminal strip with blown fused indicator.
3. Identify power source panel and breaker.

### 3.2 WIRING DUCT

- A. Install wiring duct along vertical or horizontal runs to present neat appearance.
- B. Permanently fasten wire duct into sub-panels using 10/32 screws.
- C. Support lower sidewall on horizontal runs of plastic wiring duct with bracing to avoid sagging.
- D. Install wiring between devices and terminal blocks in wiring duct except for dressing out to make terminations.
- E. Wiring duct fill shall not exceed 40% of wiring duct volume.
- F. Provide labels on wiring duct designating AC and DC wiring.

### 3.3 WIRING TROUGH

- A. Provide wiring trough above or parallel to field control panels.
- B. Route wiring through wire trough to minimize wire tension and allow re-routing of wire when necessary
- C. Wiring:
  1. Neatly arrange, bundle with nylon tie-wraps and support with adhesive backed tie-wrap supports wiring which must be outside wiring duct. Provide flexible sleeves for protection of each wire bundle that passes across door hinge. Allow sufficient slack in wiring bundles so that door can fully open. Provide separate bundles for analog and discrete wiring crossing door hinges separated by > 6".
  2. Install wire and cabling so that any item may be removed without interrupting circuit power or other terminations.

3. Use solderless spade-type compression lugs for wiring terminations except for pressure plate type terminations.
4. Identify power circuit.
5. Install wiring along vertical or horizontal runs to present neat appearance. Angled runs are not allowed.
6. Provide copper grounding lugs for electrical grounding of metal panels. Size lugs for system requirements but shall be less than #8.
7. Neatly land and terminate stranded conductors in terminal blocks. Do not remove strands of stranded wire out to make wiring fit terminal.
8. Fuses or circuit breakers shall be readily accessible and easily identified. Properly label each fuse or circuit breaker. Install circuit breakers and fuses in clear space as required by NEC.
9. Connect controller network cabling in accordance with manufacturer's connection practices and as shown on drawings.
10. Connect 120 VAC or low voltage power, as required, to each I/O module and to processor rack power supply.
11. Connect I/O to terminal blocks including controller I/O spares and spare I/O cards.

D. Terminal Blocks:

1. Land cables on terminal blocks prior to controller terminations.
2. Assure ease of accessibility of terminal blocks.
3. Connect no more than 2 conductors under each terminal screw.
4. For terminal blocks located between 3" deep or deeper wiring duct, install terminal blocks on raised channel to facilitate ease of connection to terminal block.
5. Label terminal blocks.
6. Group terminal blocks in sequential manner following I/O type and device tag name.
7. Grouping or placement shall not compromise NEC wiring classification. Give special attention to Intrinsically Safe wiring.

E. Power:

1. Terminate power wiring within 6 inches of enclosure entrance.

F. GENERAL PNEUMATIC PIPING/TUBING

1. Do not splice tubing within panel. Use bulkhead bars for circuit extensions.
2. Mount tubing so that tubing run(s) do not interfere with removal of components.
3. Terminate interior pneumatic components to bulkhead bars. Terminate incoming tubing to these bulkheads.
4. Install tubing along vertical or horizontal runs to present neat appearance. Angled runs are not allowed.
5. Label pneumatic tubing.

3.4 AC POWER SUPPLIES

- A. Provide power supply in control panel for major equipment (non terminal).

3.5 UNINTERRUPTABLE POWER SUPPLY

- A. Provide UPS in control panel for major equipment (non terminal).

**END OF SECTION**

## SECTION 25 1500

### SOFTWARE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

A. Section Includes software requirements for the following:

1. Operator Workstation
2. Network or Building level controllers
3. Application Specific or Terminal level controllers
4. Communication analyzer

B. Related Work

1. 25 1119 Network Operating Workstation
2. 25 1300 Control and Monitoring Network
3. 25 1400 Local Control Units

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

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##### 1.2 REFERENCES

A. UL 864/UUKL Smoke Control Listing

B. UL 916 Energy Management Equipment, per category PAZX for Energy Management Equipment.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

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##### 1.3 DEFINITIONS

A. Access Process or effort to communicate to system.

B. AutoCAD Computer Aided Design software

C. Communication Analyzer Software tool used to troubleshoot communication problems.

D. Firmware Hardware imbedded with software.

E. Hardware Physical components of a system.

F. License Permit rights and restrictions for legal use and access of software and applications.

G. Patch Software upgrade typically to correct know problems

H. Software Program

I. Stand Alone Control without the need for communications

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

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## 1.4 SYSTEM DESCRIPTION

A. Provide all required system software to support existing server/client architecture, designed around the open standards of web services.

### B. Software

1. Software shall be compatible and integrate with Enterprise Management System.
2. Includes project specific programming such that any of the following may be performed simultaneously on-line, and in any combination, via the browser interface:

### C. Licenses

1. Complete set of product licenses for systems and third party software used in system development, including documentation for all applications, databases, browsers, communications software etc.
2. Owner shall be the named license holder of all software.

### D. Alarms

1. Coordinate with Owner all alarm message requirements and guidelines.

### E. Security Access

1. Access control via user defined passwords for system operation.
2. Minimum of 3 access levels.
3. Campus Access Security: Communications between any campus Web browser and the BAS server shall be encrypted using 128-bit encryption technology within Secure Socket Layers 2 (SSL 2).
4. Allow authorized users complete access to the system via a web browser. The client web browser Graphical User Interface (GUI) shall support the latest version of Microsoft, Netscape or Mozilla browsers and Windows operating systems.
5. User security access from any web browser PC/PDA to the BAS controller or server shall require both a Login Name and password.

### F. Communication Analyzer for network troubleshooting.

## 1.5 SUBMITTALS

### A. Software Manual including:

1. System overview.
2. Describe operating procedures.
3. Software command descriptions
4. Password management
5. Control program functions.

### B. Data sheet for each software program used.

### C. Documented proof of compatibility with EMS.

### D. Provide all product licenses including:

1. System software
2. Documentation for all third party software.

*Section specific submittal requirements should be defined here but not repeated from other sections...*

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## 1.6 QUALITY ASSURANCE

- A. Provide most current revision of software.
- B. Operator workstation software, project-specific software, graphic software, database software, and firmware updates which resolve known software deficiencies as identified by this Contractor shall be provided at no additional charge during the 2 year warranty period.

*Section specific quality requirements should be defined here but not repeated from other sections...*

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## 1.7 OWNER'S INSTRUCTIONS

- A. Provide 32 hours of off-site training by factorytrained instructor for 4 people. Include travel and hotel accommodations.
- B. Provide an additional 24 hours of on-site training by factory trained instructor of owner specific subject, after 6 months of occupation and prior to end of warranty.
- C. Coordinate and schedule training with Owner.

*Section specific training requirements should be defined here but not repeated from other sections...*

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## PART 2 - PRODUCTS

### 2.1 OPERATOR WORKSTATION

- A. Operating System shall be Microsoft Windows
- B. Web Browsers
  - 1. Manufactures: Microsoft Explorer, Mozilla or Netscape
- C. Office Software
  - 1. Adobe Acrobat Professional
  - 2. Microsoft Office
- D. Anti-Virus
  - 1. Manufactures: Norton, McAfee or approved equal.
- E. Platform (Vendor specific)
  - 1. Provide access and control to Integrated Automation System
  - 2. Allow standard web-browsers for access to Integrated Automation Systems.
  - 3. Include real time control of system interactions
  - 4. Provide database information requests/transfers by system hardware or by operators
  - 5. Include uninterrupted real time clocks capable of time of day, week, and year information to the system as needed to perform software functions.
  - 6. Allow for Daylight Savings Time.
  - 7. Synchronize with BAS network
  - 8. Contain a HELP function key.
  - 9. Database management.
    - a. Point values
    - b. Controlled variables

- c. Setpoints
  - d. Tuning parameters
  - e. New hardware and software points.
  - f. Online modifications
  - g. Error detection, correction, re-transmission of database values, arithmetic or logical faults.
10. Alarm management.
    - a. Perform enhanced alarm analysis
    - b. Buffering alarms in order of importance
    - c. Filtering to minimize operator interruptions
    - d. Messages
    - e. Routing
    - f. Parameter modification
  11. Trending management.
    - a. Creating
    - b. Modifying
    - c. Deleting
  12. Field controller loop tuning.
  13. Enable and Disable control loops.
  14. Integration Capabilities multiple building functions including:
    - a. Equipment supervision and control
    - b. Alarm management
    - c. Energy management
    - d. Access control
    - e. Information management
    - f. Historical data collection and archiving
  15. Simulation software
    - a. Ability to view the logic execution in a step approach.
    - b. Ability to view the logic in real time for easy diagnosis of the logic execution.
    - c. Imbedded comment section
    - d. Boolean Logic
    - e. Ability to view the logic in a monitor mode.
    - f. Modular custom and standard applications

## 2.2 COLOR GRAPHICS PACKAGE

- A. Compatible with manufactures software platform.
- B. Compatible with Engineer's AutoCAD software.
- C. Include:
  1. Animation
  2. Text description
  3. Calculated and shared points
  4. Integrated points
  5. Associated points, including dynamic input values, output values, set points, gains, time schedules, etc.
  6. System schematic or picture
  7. Alarm fields

8. Database fields

D. Minimum Performance:

1. Display all points within 10 seconds.
2. Refresh all points every 15 seconds.
3. Colors change with conditions such as alarms, temperatures, etc.

## 2.3 BUILDING LEVEL CONTROLLERS

A. Appropriate functionality to accomplish monitoring and control of system.

B. Provide security by allowing assignment of a minimum of 50 passwords for access and control priorities to each controller point individually.

C. Capable of monitoring the status of all overrides and inform the operator that automatic control has been inhibited.

D. Alarm or point change reports shall include the point's English language description and the time and date of occurrence.

E. Contain self diagnostics that monitor panel operation.

F. Store trend and history data until uploaded to hard disk storage archival volume as required ensuring no data is lost.

G. Perform the following energy management routines

1. Automatic Daylight Savings Time Switch-over
2. Night setback control
3. Enthalpy switch-over (economizer)
4. Peak demand limiting
5. Temperature-compensated duty cycling
6. Runtime accumulation
7. Allow for comment lines for sequence of operation explanation

## 2.4 APPLICATION SPECIFIC AND MULTI-EQUIPMENT APPLICATION CONTROLLER

A. Stand alone control capability.

B. Allow access to the controller's application parameters via standard Microsoft compatible laptop computer plugged in to the room temperature sensor.

C. Includes a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.

D. Include time delays between successive start commands to heavy electrical loads (user selectable).

E. Returns equipment to normal operation upon power restoration.

F. Perform the following algorithms:

1. Two-position control
2. Proportional, integral, plus derivative control
3. Automatic tuning of control loops
4. Floating control

## **PART 3 - EXECUTION**

### **3.1 OPERATION WORKSTATION**

- A. Provide latest software compatible with automation system.
- B. Provide available upgrades, patches, etc. up to substantial completion date.
- C. Coordinate system requirements with owner.

### **3.2 COLOR GRAPHICS**

#### **A. Provide color graphics**

- 1. Provide graphical representation of every system monitored or controlled.
- 2. Utilize current systems library of graphics for consistency.
- 3. Provide consistent use of colors, units, descriptions, symbols, etc. Color scheme includes but is not limited to the following:
- 4. Provide a color legend for object points
  - 1) White or No Color – Normal
  - 2) Orange – Override
  - 3) Yellow – Trouble/Warning
  - 4) Grey – Offline
  - 5) Red – Alarm
  - 6) Blue – Below Set Point
  - 7) Violet –Above Set Point
- b. Piping:
  - 1) Blue – CHWS
  - 2) Purple – CHWR
  - 3) Light Green – CWS
  - 4) Dark Green – CWR
  - 5) Red – HWS
  - 6) Dark Red – HWR
  - 7) Dark Orange – Condensate
  - 8) Light Yellow – Steam
  - 9) Neon Green – Gas
  - 10) Grey – None/Other
- 5. Coordinate with Owner prior to installation of graphics.

#### **B. Include the following:**

- 1. Graphic symbols consistent with most current version of BAS.
- 2. Major equipment such as, but not limited to:
  - a. AHU, FCU, and ATU equipment
  - b. VFD's and other intelligent equipment.
  - c. Plumbing systems
  - d. Utilities
  - e. Misc. connected systems
- 3. Integrated systems such as:
  - a. Security
  - b. Fire Alarm
  - c. Plumbing

- d. Electrical
  - 4. Site Plan
    - a. Utilities
    - b. Lighting
    - c. Weather conditions
    - d. Allow penetration to floor plans graphics
  - 5. Floor Plans:
    - a. Coordinate with as-built drawings to include
      - 1) Room name and numbers
      - 2) Column numbers
      - 3) Keyplan (for floor plans with multiple screens)
      - 4) Thermographics
    - b. Identify
      - 1) HVAC zones by AHU
      - 2) HVAC rooms served by single space sensor.
      - 3) Fire Zones
    - c. Allow penetration to associated system graphic
  - 6. Additional floor plan requirements including:
    - a. Automated Temperature Controls system
    - b. Fire Alarm system
    - c. Simultaneous display of smoke control system per UUKL.
    - d. Lighting system
    - e. Color coded temperature and/or pressure zones.
    - f. Color coded alarms.
    - g. Provide small key plan for partial floor plans.
  - 7. Provide dynamic Risers:
    - a. Electrical- metering
    - b. Chilled Water – valves, temperatures, flow, pumps, etc.
    - c. Air Distribution- AHU, Exhaust, dampers, temperatures, flow, etc
    - d. Steam – Exchangers, flow, temperatures, pressures,
    - e. Heating Hot Water flow, temperatures, pressures,
    - f. BAS Communications - status
  - 8. Summaries:
    - a. Alarms
    - b. Overrides
    - c. Transactions
    - d. Terminal Equipment
    - e. AHU's (if more than 3)
- C. Provide organized hierarchy:
1. Provide penetration from main page down to instrument level using mouse point and click feature.
  2. Provide penetration from instrument level back up to main page level using mouse point and click feature.
  3. Provide links from sub-systems to main systems such as:
    - a. Air terminal shall have a link to associated AHU, lighting, etc.
    - b. AHU shall have a link to cooling, heating, exhaust, energy recovery, etc.
    - c. Labs shall have a link to supply and exhaust systems.

- d. Rooms shall have a link to floor plan.
- 4. Provide links to
  - a. Equipment schedules
  - b. Sequences of operations
- D. Simulation software
  - 1. Provide programming for the system and adhere to the sequences of operation provided.
  - 2. Imbed into the control program sufficient comment statements to clearly describe each section of the program.
  - 3. Document all programming in the form of a logic flowchart.
  - 4. Provide actions for all possible situations.
  - 5. Programming shall be modular and structured.

### 3.3 BUILDING LEVEL CONTROLLERS

- A. Provide software as utilized for complete operating system.
  - 1. Include building level controller software for engineering and application modifications.
  - 2. Include software data/configuration files for each separate controller, programming code and documentation.
- B. Provide a software data/configuration files for each separate controller.

### 3.4 APPLICATION SPECIFIC AND MULTI-EQUIPMENT APPLICATION CONTROLLER

- A. Provide software as utilized for complete operating system.
  - 1. Include software for engineering and application modifications.
  - 2. Include software data/configuration files for each separate controller, programming code and documentation.
- B. Provide a software data/configuration files for each separate controller.

**END OF SECTION**

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**SECTION 25 3313**  
**UTILITY METERING**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Systems include metering and integration of electric metering for the facility:
- B. Related Sections:
  - 1. 25 0000 Integration Automation.
  - 2. 25 1219 Integration Protocols

1.2 REFERENCES

- A. Refer to section 25 1219 for protocol compliance.

1.3 SYSTEM DESCRIPTION

- A. Installation of electrical metering and accessories.
- B. Low voltage wiring and pathways for metering.
- C. Integration of metering to the Building Automation System.
- D. Coordinate installation of metering electronics, including but not limited to:
  - 1. Power requirements
  - 2. Meter and panel locations
- E. Provide access to points via shared hardwired or integration.

1.4 QUALITY ASSURANCE

- A. Refer to section 25 0000 for additional requirements.



## **PART 2 - PRODUCTS**

### 2.1 ENERGY METER

#### A. Electric Meters

1. Manufacturers: Energy Monitoring Products & Systems.
2. Model: Class 3400 Smart Meter
3. Protocol: Modbus RTU, TCP/IP
4. Enclosure: NEMA 4x

## **PART 3 - EXECUTION**

### 3.1 ENERGY METER

- A. Install metering panels and electronics.
- B. Install wiring and pathways.
- C. Provide access to points via shared hardwired or integration.

**END OF SECTION**

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## SECTION 25 3513

### ACTUATORS AND OPERATORS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes control valve actuators, damper actuators, and positioners for systems as shown in Contract Documents and where provide by equipment manufacturer.
- B. Related Sections
  - 1. 25 0523 Conductors and Cables
  - 2. 25 0528 Pathways
  - 3. 25 3519 Control Valves
  - 4. 25 3523 Control Dampers
  - 5. 25 3526 Compressed Air Supply

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

##### 1.2 REFERENCES

- A. ISO 9001
- B. UL 873 Temperature-Indicating and -Regulating Equipment

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

---

##### 1.3 DEFINITIONS

- A. Sub-circuit - Branch supply and return piping to terminal device, including valve, coil, control valve, and balancing valve.

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

---

##### 1.4 SYSTEM DESCRIPTION

- A. Actuators and operators for control valves, control dampers, smoke dampers, fire/smoke dampers, etc.

##### 1.5 SUBMITTALS

- A. Include Product data sheets shall include construction materials and assembly methods, maximum design parameters (temperature, pressure, velocity, etc.), and performance data for full range of actuator stroke.
- B. Include actuator torque capacities locations.

*Section specific submittal requirements should be defined here but not repeated from other sections...*

---

1.6 QUALITY ASSURANCE

- A. Manufacturer shall be ISO9001 certified.
- B. UL listed under standard 873 for Temperature-Indicating and Regulating Equipment.
- C. Obtain adequate system information necessary for sizing.
- D. Mount actuators outside air-stream.
- E. Provide manual override option for all actuators.
- F. Refer to section 25 0513 for power connections and other cable requirements.
- G. Refer to section 25 0528 for pathway requirements.

*Section specific quality requirements should be defined here but not repeated from other sections...*

---

**PART 2 - PRODUCTS**

2.1 ANALOG ELECTRONIC ACTUATORS

- A. Manufacturers: Belimo, Delta, Johnson Controls, Siemens Building Technologies .....
- B. Modulating actuator input signals shall be 0-20ma, 4-20ma, 0-5VDC, 1-5VDC, 2-10VDC, or 0-10VDC. Floating or pulsing signals are not allowed.
- C. Provide spring return feature for fail open or closed positions as required by control sequence. Terminal units such as air terminals and fan coils actuators fail in place, unless otherwise noted.
- D. Provide actuator with a conduit fitting.
- E. Non-spring return actuators and spring return actuators with more than 60lbs torque shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered.
- F. Spring return not required for terminal equipment.

2.2 DISCRETE TWO-POSITION ELECTRIC ACTUATORS

- A. Manufacturers: Belimo, Honeywell, Johnson Controls, Siemens Building Technologies or Invensys Building Systems
- B. Provide spring return feature for fail open or closed positions as required by control sequence.
- C. Provide actuator with a conduit fitting.
- D. Non-spring return actuators and spring return actuators with more than 60lbs torque shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered.

**PART 3 - EXECUTION**

3.1 ELECTRIC/ELECTRONIC ACTUATORS

- A. Provide actuator for each automatic damper or valve with sufficient capacity to operate damper or valve under all conditions.

- B. Select actuators to provide tight shut-off against maximum system temperatures and pressure encountered.
- C. Each actuator shall be full-modulating or two-position type as required or specified, and shall be provided with spring-return for fail open or fail closed position for fire, freeze, occupant safety, equipment protection, heating or cooling protection on power interruption as indicated and/or as required.
- D. Fail smoke dampers and steam valves serving pressure rated heat exchangers or converters closed unless otherwise shown.
- E. Valve and damper operating speeds shall be selected or adjusted so that actuators will remain in step with controllers without hunting, regardless of load variations. Actuators acting in sequence with other actuators shall have adjustment of control sequence as required by operating characteristics of system.
- F. Provide proper linkage and brackets for mounting and attaching actuators to devices. Design mounting and/or support to provide no more than 5% hysteresis in either direction (actual movement of valve stem or damper shaft versus ideal movement) due to deflection of actuator mounting.
- G. Coordinate the factory installation of control valve actuators and operators.
- H. Mount actuators and operators outside the airstreams.

**END OF SECTION**

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**SECTION 25 3515**  
**SWITCHES AND RELAYS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Systems include switches and relays for the control of Heating, Ventilation, and Air Conditioning systems.
- B. Related Sections:
  - 1. 25 0553 Identification

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

1.2 REFERENCES

- A. UL 20 – General Use Snap Switches.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

---

1.3 SYSTEM DESCRIPTION

- A. Include all components not specifically indicated or specified, but necessary to make the system function within the intent of the specification and in accordance with control sequences located on contract documents.
- B. Unless otherwise specified, functionality of interlocks and safeties shall be operational in hand, auto, or bypass (for VFD's).

*Section specific submittal requirements should be defined here but not repeated from other sections...*

---

1.4 QUALITY ASSURANCE

- A. Electrical devices, switches, and relays shall be UL listed and of type meeting current and voltage characteristics of project.
- B. Ratings of normally open and normally closed contacts shall be adequate for applied load (minimum 5 amps at 240 Volts) unless otherwise specified.
- C. Accuracy of devices shall be  $\pm 1\%$  of scale with adjustable offset unless otherwise specified.
- D. Mount adjustable or resettable instruments for easy access without the need for a ladder, flashlight, etc.

*Section specific quality requirements should be defined here but not repeated from other sections...*

---

## PART 2 - PRODUCTS

### 2.1 LOW LIMIT TEMPERATURE SWITCHES

- A. Electric 2-position type with temperature sensing element and manual reset.
- B. Capable of opening circuit if any one-foot length of sensing element is subject to temperature below setting.
- C. Include auxiliary contact for alarm condition reporting to the control system.
- D. Sensing element shall not be less than one lineal foot per square foot of coil surface areas.
- E. Include auxiliary contact for alarm condition reporting to the control system.

### 2.2 DRY PRESSURE SWITCHES

- A. Manufacturers: Cleveland, Allen Bradley, Ashcroft, Dwyer, Honeywell, Johnson Controls/Penn, Siemens Building Technologies, Invensys, SOR, or United Electric. Or approved equal.
- B. Field adjustable set point, differential pressure type.
- C. Manual Reset. (for safety switches only)
- D. Minimum Requirements:
  - 1. Set Point Range 2 times normal operating pressure
  - 2. Switch differential .06"min to 0.8"max
  - 3. Contact Type 2 SPST-NC
  - 4. Ratings:
    - a. 15 amps @ 125, 250 or 277 VAC
    - b. .5VA @ 24 VAC
    - c. ¼ HP @ 125 VAC
    - d. ½ HP @ 250 VAC
- E. UL approved for application.
- F. Include auxiliary contact for alarm condition reporting to the control system.

### 2.3 CONTROL RELAYS

- A. Manufacturers: IDEC, Potter Brumfield, Square D, or Allen Bradley.
  - 1. Equal to IDEC type RH2B-U, miniature 8 blade pilot relay with DPDT silver cadmium oxide contacts rated at 10A, 30 VDC, or 120 VAC. Coil shall match control circuit characteristics.
  - 2. Rectangular base socket mount with blade type plug-in terminals and polycarbonate dust cover.
  - 3. Provide DIN rail mountable (Snap type) mounting sockets equal to IDEC SH2B-05.
- B. Enclosed Relay (Relay-in-a-Box):
  - 1. Manufacturers: Veris Industries, Kele & Associates, Functional devices, Inc. or approved equal.
  - 2. 1 or 2 SPDT relays in NEMA 1 or better enclosure. Coil shall be selected for control circuit characteristics.
  - 3. Contacts rated at 10A, 28 VDC or 120 VAC. Conduit nipple is 1/2" NPT. Maximum coil current burden 50 milliamps.
  - 4. LED status indication.



- 5. Include Hand-Off-Auto (HOA) switch.

## 2.4 CURRENT SWITCHES

- A. Manufacturers: Hawkeye, Veris Industries, N-K Technologies, Absolute Process Instruments, Kele & Associates, R-K Electronics or approved equal.
- B. Induction type sensors clamped over single- phase conductor of AC electrical power and shall be solid-state sensors with adjustable threshold, visual indication and normally open contacts. Each current switch shall be selected for proper operating range of current.

## 2.5 POSITION SWITCHES (END SWITCHES)

- A. Manufacturers: Allen Bradley, Johnson Controls/Penn, Honeywell, Ruskin, Greystone Energy Systems, NAMCO, Kele & Associates, Omron or Westlock
- B. SPDT contacts rated for application
- C. Provide damper brackets and connecting rods for connecting position switch actuation levers to damper blades or jackshafts.

## 2.6 LEVEL SWITCHES:

- A. Manufacturers: Drexelbrook, Magnetrol, Endress and Hauser or Dwyer.
- B. Radio Frequency (RF) type continuous level probe with multiple adjustable setpoints and SPDT snap action contacts to meet intended use. Probe shall have probe shielding to reject build up of conductive, sticky or viscous material. Probe length shall match vessel dimensions to measure within 6" of bottom.
- C. Provide probe brace every 4 ft if probe length exceeds 6 ft, and not installed in stilling well.
  - 1. Supply Voltage: 120 VAC/60 Hz
  - 2. Fail Safe: Low Level output on instrument failure
  - 3. Ambient Temperature Limits: -40 to 160°F
  - 4. Minimum Enclosure Rating: NEMA 4
  - 5. Transmitter Mounting: Remote
  - 6. Performance:
    - a. Accuracy: ± 2% nominal
    - b. Linearity: ± 1% nominal
    - c. Repeatability: ± 1% nominal
    - d. Response Time: 20 milliseconds
    - e. Ambient Temperature Effect: 2% per 100°F max.
    - f. Voltage Variation Effect: ± 0.2% maximum per 10 V change

## PART 3 - EXECUTION

### 3.1 LOW LIMIT TEMPERATURE SWITCHES

- A. Provide low limit temperature switches where indicated on drawings or as required to accomplish sequences.
- B. Unless otherwise indicated, install sensing element on upstream face of cooling coil where cooling coil is provided, or at downstream side of heating coils where no cooling coil is provided.
- C. Size element or add additional elements to cover no less than one lineal foot per square foot of coil surface areas.

- D. Unless otherwise indicated, adjust temperature switch setpoint to 38°F.
- E. Distribute sensing element across entire area of medium being sensed.
- F. Install controls at accessible location with suitable mounting brackets and element duct collars where required.

### 3.2 DRY PRESSURE SWITCHES

- A. Provide pressure switches where indicated on drawings or as required to accomplish sequences.
- B. Select switches for accuracy, ranges (20 to 80% of operating range) and dead-band to match process conditions, electrical requirements and to implement intended functions.
- C. Unless otherwise indicated, adjust high static pressure switch to 4" w.c.

### 3.3 CONTROL RELAYS

- A. Provide control relays where indicated on drawings or as required to accomplish sequences.
- B. Provide DIN mounted relays in control panels.
- C. Provide RIB type relays for field control devices such as starters, VFD's, etc.
  - 1. Mount relay on controlled equipment for easy accessibility.
  - 2. Mount relay on controlled equipment for easy visual accessibility.

### 3.4 CURRENT SWITCH

- A. Provide current switches where indicated on drawings or as required to accomplish sequences.
- B. Locate in starter or VFD or in an appropriate adjacent enclosure.

### 3.5 POSITION SWITCHES (END SWITCHES)

- A. Provide end switches where indicated on drawings or as required to accomplish sequences.
- B. Install

### 3.6 LEVEL SWITCHES:

- A. Provide level switches where indicated on drawings or as required to accomplish sequences.

**END OF SECTION**

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## SECTION 25 3516

### SENSORS AND TRANSMITTERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes

1. Instrumentation for the following Sensors and Transmitters for HVAC

###### B. Products Supplied But Not Installed Under This Section

1. Sensor wells

###### C. Related Sections:

1. 23 0513 Common Motor Requirements for HVAC Equipment
2. 23 2120 Piping Specialties
3. 23 2123 Pumps

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

##### 1.2 REFERENCES

A. DIN-IEC -751 Standard for platinum sensors

B. UL 773A – Non-Industrial Photoelectric Switches for Lighting Controls.

C. NEMA WD7 – Occupancy Motion Sensors.

D. Refer to section 25 0000 for additional references.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

---

##### 1.3 SYSTEM DESCRIPTION

A. Provide supplementary or miscellaneous items, products and labor incidental to or necessary for a complete and operable installation.

B. Wiring shall be done in accordance with all local and national codes.

C. Coordinate installation of instrumentation, including but not limited to:

1. Power requirements
2. Panel locations
3. Commissioning
4. Test and Balance
5. Equipment start-up
6. User access

## 1.4 SUBMITTALS

A. Refer to section 25 0000.

*Section specific submittal requirements should be defined here but not repeated from other sections..*

---

## 1.5 QUALITY ASSURANCE

A. Coordinate timely delivery of materials.

B. Coordinate installation activities of inline devices such as immersion wells, pressure tapping's, any associated shut-off valves, flow switches, level switches, flow meters, air flowstations, and othersuch items.

C. Install control devices in appropriate enclosure and in an accessible location.

D. Provide junction box or enclosure to protect wiring and allow conduit connection for all sensors

E. Mount duct instrumentation on side of horizontal ducts. Do not mount on bottom of duct.

F. Refer to section 25 0000 for additional requirements.

*Section specific quality requirements should be defined here but not repeated from other sections..*

---

## 1.6 WARRANTY

A. Refer to section 25 0000.

## PART 2 - PRODUCTS

### 2.1 AVERAGING TEMPERATURE SENSORS

A. Platinum RTD type, with the following minimum performance

1. Accuracy:  $\pm 1.0\%$  at 32°F (Class B)
2. Operating Range: -50 to 170°F  
0 to 99% RH
3. Conformance: DIN-IEC 751

### 2.2 SINGLE POINT TEMPERATURE SENSORS

A. Platinum RTD type, with the following minimum performance

1. Accuracy:  $\pm 0.1\%$  at 32°F (Class B)
2. Operating Range: -50 to 170°F  
0 to 99% RH
3. Conformance: DIN-IEC 751

B. Thermistors type, with the following minimum performance

1. 5 yr guarantee that device will maintain its accuracy within tolerance of  $\pm 0.36^\circ\text{F}$  between 32°F and 150°F, and  $0.5^\circ\text{F}$  between  $-20^\circ\text{F}$  and 212°F.
2. Accuracy:  $\pm 0.1\%$  at 32°F (Class B)
3. Operating Range: -50 to 170°F  
0 to 99% RH

### 2.3 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS

A. Thermister or RTD type, with the following minimum performance

1. Minimum Accuracy:  $\pm 1.0$  Deg F at 70°F (Class B)
2. Operating Range: -50 to 170°F  
0 to 99% RH

### 2.4 SPACE TEMPERATURE SENSORS

A. Warmer/Cooler adjustable, with programmable minimum/maximum setpoints. (Non-adjustable in corridors, restrooms and other public spaces)

B. Compatible with the intended service (VAV, VAV Reheat, Dual-duct, unoccupied setback, etc.), and associated controlled devices (DDC air terminal controller, damper, valve, etc.).

C. Incorporate a portable operator communication bus and terminal plug-in port, under the cover.

D. RTD type, with the following minimum performance:

1. Accuracy:  $\pm 0.1\%$  at 32°F (Class B)
2. Temperature Operating Range: -50 to 500°F
3. Humidity Operating Range: 0 to 99% RH

E. Thermistors will be acceptable in lieu of RTD provided that device will maintain its accuracy within tolerance of  $\pm 0.36^\circ\text{F}$  between 32°F and 150°F, and  $0.5^\circ\text{F}$  between -20°F and 212°F.

### 2.5 SPACE HUMIDITY SENSORS/TRANSMITTERS

A. Manufactures: Viasala, General Easter, or Automation Components.

1. Vendor specific humidity sensors can be substituted for specified manufactures.

B. Space humidity sensors shall be wall mount type to match room thermostats and/or temperature sensors.

C. Sensing element shall be resistive bulk polymer, or thin film capacitive type. Sensor/transmitter shall have the following minimum performance:

1. Accuracy:  $\pm 2\%$  RH at 25°C over range of 20-95% RH including hysteresis, linearity and repeatability
2. Temperature Effect: Less than 0.06% per °F at baseline of 68°F
3. Sensitivity: 0.1% RH
4. Repeatability: 0.5% RH
5. Hysteresis: Less than 1%
6. Long Term Stability: Less than 1% RH drift per year
7. Adjustment:  $\pm 20\%$  RH zero, non-interactive  
 $\pm 10\%$  RH span, non-interactive
8. Operating Range: 0-99% RH, non-condensing, sensor  
-95% RH, non-condensing, electronics
9. Output: 4-20mA or 0-10VDC 0-100% linear, proportional
10. Power: 12-36 VDC or 24VAC

### 2.6 SENSOR WELLS

A. Compatible with sensor and application.

B. Include thermal compound.

## 2.7 DUCT MOUNTED HUMIDITY SENSORS/TRANSMITTERS

A. Probe type, temperature compensated, resistive bulk polymer or thin film capacitive type.

B. Sensor/transmitter shall have the following minimum performance.

1. Accuracy:  $\pm 2\%$  RH at 25°C over 20-95% RH including hysteresis, linearity and repeatability
2. Temperature Effect: Less than 0.06% per °F at baseline of 68°F.
3. Sensitivity: 0.1% RH
4. Repeatability: 0.5% RH
5. Hysteresis: Less than 1%
6. Long Term Stability: Less than 1% drift per year
7. Adjustment:  $\pm 20\%$  RH zero, non-interactive  
 $\pm 10\%$  RH span, non-interactive
8. Operating Range: 0-99% RH, non-condensing, sensor  
0-95% RH, non-condensing, electronics
9. Output: 4-20 mA or 0-10VDC 0-100% linear, proportional
10. Power: 12-36 VDC or 24VAC

## 2.8 WATER DIFFERENTIAL PRESSURE TRANSMITTERS

A. Manufacturers: Veris, Mamack.

B. Pressure sensor and integral transmitter.

C. Include 3-valve manifold for servicing.

D. Performance:

1. Zero: Continuously adjustable within 1% of span.
2. Span: Zero-based calibration span
3. Output: Linear 4-20 mA or 0-10VDC
4. Accuracy:  $\pm 1\%$  of span, including effects of linearity, hysteresis, repeatability.
5. Stability:  $\pm 0.25\%$  for 12 months.

## PART 3 - EXECUTION

### 3.1 AVERAGING TEMPERATURE SENSORS

A. Provide flexible averaging element for air ducts where prone to temperature stratification or where ducts are larger than 9 square feet.

B. Provide rigid averaging probe for air ducts smaller than 9 square feet.

C. Provide multiple averaging type sensors as required for sufficient duct or coil coverage. At minimum provide appropriate size and number of sensors as necessary to provide 1 linear foot of sensing for every 1 sq. ft of coil.

### 3.2 SINGLE POINT TEMPERATURE SENSORS

A. Provide single point duct mounted probes where ducts are too small for averaging elements.

### 3.3 SINGLE POINT AIR TERMINAL TEMPERATURE SENSORS

A. Provide single point duct mounted sensors at air terminal coils.

### 3.4 SPACE TEMPERATURE SENSORS

- A. Provide space thermostats/sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions.
- B. Coordinate mounting height prior to installation. Unless otherwise noted, mount sensors at 48" above finished floor.
- C. Recess mounting box unless otherwise indicated, or required by the building construction materials.
- D. Unless otherwise noted provide at minimum, 1/2" conduit from room sensors to corresponding controller.
- E. Mounted space thermostats/sensors, located on exterior walls, on thermally insulated sub-base.
- F. Relocate space thermostats/sensors if required due to draft, interferences with cabinets, chalkboards, etc., or improper sensing.
- G. Label, inside cover, with tag number of equipment serving the area.

### 3.5 SPACE HUMIDITY SENSORS/TRANSMITTERS

- A. Provide space thermostats/sensors where indicated, as required to perform specified control sequences, and as directed to meet job site conditions.
- B. Mount sensors at 48" above finished floor.
- C. Recess mounting box unless otherwise indicated, or required by the building construction materials.

### 3.6 SENSOR WELLS

- A. Furnish wells for installation.
- B. Coordinate with Section 23 2120 for location placement.
  - 1. Wells mounted in pipe 3" and larger may be installed in horizontal or vertical lines provided that element is always in the flow, (for condensate and other gravity return lines, install in bottom of pipe).
  - 2. Wells mounted in pipe 2-1/2" and smaller shall be installed at elbow tee fittings with well pointed upstream. Minimum of 2" pipe size for elbow tee installation.

### 3.7 DUCT MOUNTED HUMIDITY SENSORS/TRANSMITTERS

- A. Provide duct humidity sensors and transmitters where indicated, and as required to perform specified control sequences, and as directed to meet job site conditions.

### 3.8 WATER DIFFERENTIAL PRESSURE TRANSMITTERS

- A. Provide Water differential pressure transmitters where required.

**END OF SECTION**



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## SECTION 25 3517

### AIR AND GAS MEASUREMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Systems include air flow measurement, static pressure measurement, and differential pressure measurement.
- B. Related Sections:
  - 1. 23 3300 Air Duct Accessories
  - 2. 23 7323 Custom Indoor Central-Station Air Handling Units
  - 3. 25 1219 Integration Protocols

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

- 
- C. Products Supplied But Not Installed Under This Section:
    - 1. Duct mounted Air Flow measuring stations
    - 2. Inlet fan mounted Air Flow measuring stations.

##### 1.2 SYSTEM DESCRIPTION

- A. Provide supplementary or miscellaneous items, products and labor incidental to or necessary for a complete and operable installation.
- B. Wiring shall be done in accordance with all local and national codes. Communication via protocols as described in section 25 1219 are acceptable.
- C. Coordinate installation of instrumentation, including but not limited to:
  - 1. Power requirements
  - 2. Panel locations
  - 3. Communication requirements (if applicable).
  - 4. Commissioning
  - 5. Test and Balance
  - 6. Equipment start-up
  - 7. User access

##### 1.3 SUBMITTALS

- A. Include recommended probe quantities to meet specified accuracies for air flow devices.
- B. Identify locations where measurement accuracy may be negatively affected and demonstrate solution to maintain specified accuracy.
- C. Meter Schedule including:
  - 1. Manufacturer
  - 2. Size
  - 3. Location

#### 4. Range

### 1.4 QUALITY ASSURANCE

- A. Coordinate timely delivery of materials.
- B. Coordinate installation activities of inline devices such as immersion wells, pressure tapping's, any associated shut-off valves, flow switches, level switches, flow meters, air flow stations, and other such items.
- C. Install control devices in appropriate enclosure and in an accessible location.
- D. Provide access doors where removal of instrument is not possible or practical for maintenance.

*Section specific quality requirements should be defined here but not repeated from other sections...*

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## PART 2 - PRODUCTS

### 2.1 DUCT MOUNTED AIR FLOW MEASURING STATION

- A. Manufacturers: Ebtron (gold series).
  - 1. Transmitter and/or systems, which require periodic calibration to maintain accuracy specified shall not be acceptable.
  - 2. Provide display of air flow.
  - 3. Minimum Requirements:
    - a. Accuracy:  $\pm 2.0\%$  of Reading
    - b. Span: Less than twice maximum flow
    - c. Temperature Range -20 Deg F to 160 Deg F.
    - d. Humidity Range 0-99% RH (non-condensing)
    - e. Power 24 VAC
    - f. Output Signal: 4-20 mA or 0-10VDC
- B. Velocity measured by each sensor shall be linearized, summed, averaged, and an output signal proportional to air-flow rate (cfm) or velocity (fpm) by transmitter electronics.

### 2.2 DIFFERENTIAL PRESSURE TRANSMITTERS

- A. Manufacturers: GE Modus, Setra, Veris, Ashcroft XLDP or approved equal.
- B. Sensors shall convert velocity pressure differential or static duct pressure relative to sensor location into electronic signal.
- C. Unit shall be capable of transmitting linear signal proportional to differential (total minus static or static minus ambient) pressure input signals with the following minimum performance and application criteria:
  - 1. Span: Less than twice maximum reading.
  - 2. Accuracy:  $\pm 1.0\%$  of span or  $\pm 1.0\%$  of full scale
  - 3. Dead Band: Less than 0.5% of output
  - 4. Hysteresis: Within 0.5% of span or within 0.5% of full scale
  - 5. Linearity: Within 1.0% of span or within 0.5% of full scale
  - 6. Repeatability: Within 0.5% of output
  - 7. Response: Less than 1 second for full span input

8. Output Signal                      4-20 mA or 0-10VDC

2.3 CO2 SENSORS

A. Manufacturers: Veris,

B. Units shall have following minimum characteristics:

- |                          |           |                   |
|--------------------------|-----------|-------------------|
| 1. Range                 | 0-2000ppm |                   |
| 2. Power Supply          | 20-30     | VDC/VAC           |
| 3. Output                | 0-10VDC   | or 4-20ma         |
| 4. Operating Temperature | 40 – 100  | Deg F             |
| 5. Operating Humidity    | 0 to 85%  | RH non-condensing |
| 6. Accuracy              | 5.0%      | or 30ppm          |

**PART 3 - EXECUTION**

3.1 DUCT MOUNTED AIR FLOW MEASURING STATION

- A. Furnish and coordinate the installation of Air Flow Measuring Stations according to contract documents, control sequences or to achieve LEED credit.
- B. Include manufacturer's recommended number of probes for the proper traverse of the air duct, and required mounting hardware.
- C. Provide transmitter as part of air flow sensor and shall include integral diagnostics with on-line zeroing and sensor operation verification
- D. Provide all cabling required for connection to probe assemblies and transmitter electronics.

3.2 DIFFERENTIAL PRESSURE TRANSMITTERS

- A. Provide Differential Pressure Transmitters according to contract documents or to accomplish sequences.
- B. Locate static pressure transmitters and transducers in control panel where controlled from.
- C. Select instrument for intended usage range, maximum pressure/temperature.
- D. For indicating type instruments, locate indicating element with 6 ft of floor with readout easily visible from floor level.

3.3 CO2 SENSORS

- A. Provide CO2 sensors according to contract documents, control sequences or to achieve LEED credit.

**END OF SECTION**

## SECTION 25 3518

### LIQUID PRESSURE AND FLOW MEASUREMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Systems include instrumentation for the following water systems pressure and flow measurement for Integration and Automation.
- B. Products furnished but not installed under this section:
  - 1. Chilled Water Meter/BTU Meter
  - 2. Pressure Transmitters
  - 3. Domestic water flow meter
  - 4. Heating hot water flow meter.
  - 5. Reverse Osmosis
- C. Related Sections:
  - 1. 22 6700 Reverse-Osmosis Water System
  - 2. 23 2120 Piping Specialties
  - 3. 25 3313 Utility Metering

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

##### 1.2 REFERENCES

- A.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

---

##### 1.3 SUBMITTALS

- A.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

---

##### 1.4 QUALITY ASSURANCE

- A. Coordinate timely delivery of materials.
- B. Coordinate installation activities of inline devices such as immersion wells, pressure tapping's, any associated shut-off valves, flow switches, level switches, flow meters, air flowstations, and other such items.

*Section specific quality requirements should be defined here but not repeated from other sections...*

---

## 1.5 WARRANTY

A.

## PART 2 - PRODUCTS

### 2.1 DIFFERENTIAL PRESSURE TRANSMITTERS

A. Manufacturers: Foxboro, Rosemount, or Yokogawa.

B. Pressure sensor and integral transmitter.

C. Enclosures to be NEMA 4 or NEMA 4X.

D. Include 3-valve manifold for servicing.

E. Performance:

1. Zero: Continuously adjustable within 1% of span.
2. Span Zero-based calibration span
3. Output Linear 4-20 mA or 0-10VDC
4. Accuracy:  $\pm 0.075\%$  of span, including effects of linearity, hysteresis, repeatability.
5. Stability:  $\pm 0.1\%$  of upper limit for 60 months.
6. Power Supply Effect: Less than 0.01% of output span per volt.
7. Static Pressure Effect: Zero Error:  $\pm 0.1\%$  of upper range limit per 1000 psi
8. Span Error:  $\pm 0.2\%$  of reading per 1000 psi
9. Temperature Effect:  $\pm (0.025\%$  upper range limit plus 0.125% span) per 50°F.

F. Provide remote sensing element(s) whenever operating temperature exceeds transmitter maximum temperature.

### 2.2 PRESSURE TRANSMITTERS

A. Manufacturers: Foxboro, Rosemount, or Yokogawa.

B. Pressure sensor and integral transmitter.

C. Enclosures to be NEMA 4 or NEMA 4X.

D. Performance:

1. Zero: Continuously adjustable within 1% of span.
2. Span Zero-based calibration span
3. Output Linear 4-20 mA or 0-10VDC
4. Accuracy:  $\pm 0.075\%$  of span, including effects of linearity, hysteresis, repeatability.
5. Stability:  $\pm 0.1\%$  of upper limit for 60 months.
6. Power Supply Effect: Less than 0.01% of output span per volt.
7. Static Pressure Effect: Zero Error:  $\pm 0.1\%$  of upper range limit per 1000 psi
8. Span Error:  $\pm 0.2\%$  of reading per 1000 psi
9. Temperature Effect:  $\pm (0.025\%$  upper range limit plus 0.125% span) per 50°F.

E. Provide remote sensing element(s) whenever operating temperature exceeds transmitter maximum temperature.

## 2.3 WATER FLOW METER

### A. Insertion Type

### B. Magnetic Insertion Flow meter/Transmitter

1. Manufacturers: Onicon
2. Electromagnetic induction type with hot tap design.
3. Transmitter shall be fully field configurable microprocessor based unit.
  - a. Flow Range : .1ft/s to 20 ft/s
  - b. Operating Temperature: -20-150°F (Ambient)
  - c. Operating Pressure up to 400psi
  - d. Power Requirements: 20-28 VDC or VAC
  - e. Output: 4 - 20 mA DC current or 0-10 VDC.
  - f. Turndown Ratio 200:1

### C. BTU Meter

1. Manufacture: Onicon System 10
2. NIST traceable calibration with Certification
  - a. Temperatures  $\pm 0.15$  Deg F from 32-200 Deg F.
3. MODBUS TCP communication protocol.

## PART 3 - EXECUTION

### 3.1 DIFFERENTIAL PRESSURE TRANSMITTERS

- A. Provide differential pressure transmitters as shown in construction documents or as required to implement sequences.
- B. Coordinate installation and location with Section 23 2120.

### 3.2 PRESSURE TRANSMITTERS

- A. Provide pressure transmitters as shown in construction documents or as required to implement sequences.
- B. Coordinate installation and location with Section 23 2120.

### 3.3 WATER FLOW METER

- A. Furnish Flow Meter for Hot Water Systems.
  1. Span flow meter for twice design flow.
  2. Provide wiring, pathways, terminations, etc.
- B. Install metering instrumentation.
  1. Coordinate with meter installer.
  2. Coordinate final location with other trades.
- C. Coordinate installation of flow meter with Section 23 2120.

**END OF SECTION**

**SECTION 25 3519**  
**CONTROL VALVES**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. Section includes:
  - 1. Control valves for systems as shown in Contract Documents, except where provide by equipment manufacturer.
- B. Products Supplied But Not Installed Under This Section:
  - 1. Control Valves
- C. Related Sections:
  - 1. 23 2120 Piping Specialties
  - 2. 25 3513 Actuators and Operators
  - 3. 25 0553 Identification

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

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1.2 DEFINITIONS

- A. Sub-circuit - Branch supply and return piping to terminal device, including valve, coil, control valve, and balancing valve.

1.3 SYSTEM DESCRIPTION

- A. Pressure independent control valves for the HVAC systems.

1.4 SUBMITTALS

- A. Valve Schedule:
  - 1. Indicate size, location and model of each control valve.
  - 2. Indicate unique tag numbers for each device, equipment item or system served, d
  - 3. Include sizes, shut-off head required, actuator air pressure or force required to meet shut-off head, torque requirements for rotary valves, actual flow requirements based on equipment shop drawings, and calculation of actual pressure drops.
- B. Include construction materials and assembly methods, maximum design parameters (temperature, pressure, velocity, etc.), and performance data for full range of actuator stroke.
- C. Include charts, graphics or similar items used in making selections

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

---

1.5 QUALITY ASSURANCE

- A. Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.



- B. Obtain adequate system information necessary for valve sizing.
- C. Water Valves:
  - 1. Pressure independent control valves shall be factory calibrated and tested.
  - 2. Provide ability to manually override valve position.
- D. Coordinate pneumatic actuated pressure independent valves for factory mounting.
- E. Tag control valves appropriately. Refer to 25 0553.

*Section specific quality requirements should be defined here but not repeated from other sections...*

**PART 2 - PRODUCTS**

2.1 WATER CONTROL VALVES (2" OR SMALLER):

- A. Manufacturers: Belimo, Bray, or Delta P.
  - 1. Valves shall be pressure independent.
  - 2. Control flow from 0 to 100%
  - 3. Include pressure/temperature ports
- B. Characteristics:
  - 1. Valve Body: Brass
  - 2. Max Operating Temperature: 212°F
  - 3. Rated Pressure: 150 PSI
  - 4. Accuracy +/- 10%

2.2 WATER CONTROL VALVES (LARGER THAN 2"):

- A. Manufacturers: Belimo, Bray, or Delta P.
  - 1. Valves shall be pressure independent.
  - 2. Control flow from 0 to 100%
  - 3. Include pressure/temperature ports
- B. Characteristics:
  - 1. Valve Body: Iron, Bronze, or Steel
  - 2. Max Operating Temperature: 212°F
  - 3. Rated Pressure: 150 PSI
  - 4. Accuracy +/- 5%

2.3 TWO POSITION CONTROL VALVES (2" and Larger)

- A. Manufacturers:
  - 1. Meet ANSI Class 150 rating design,
  - 2. Provide bubble-tight shut off with pressures in either direction to 275 psi suitable for 150 psi steam.
  - 3. External disc position indication.
  - 4. Valve neck extensions with sufficient length to allow for insulation.
  - 5. Provide threaded lug type valves for equipment isolation, permitting removal of downstream piping without removing valve. Dead end pressure rating of lug type valves shall be 275 psi.
- B. Characteristics:

- |                               |                                 |
|-------------------------------|---------------------------------|
| 1. Valve Body:                | Carbon or Cast steel, Cast Iron |
| 2. Valve Type                 | Butterfly                       |
| 3. Max Operating Temperature: | 250°F (minimum)                 |
| 4. Min Rated Pressure         | 150 PSI                         |
| 5. Shaft                      | Stainless steel                 |
| 6. Disc                       | Stainless steel                 |
| 7. Seat                       | Reinforced PTFE                 |
| 8. Packing                    | graphite                        |

### **PART 3 - EXECUTION**

#### 3.1 WATER CONTROL VALVES (2" OR SMALLER):

- A. Furnish pressure independent control valves for terminal units.
- B. Factory mount actuator.
- C. Select valves to provide tight shut-off against maximum system temperatures and pressure encountered.

#### 3.2 WATER CONTROL VALVES (LARGER THAN 2"):

- A. Furnish pressure independent control valves for larger equipment.
- B. Factory mount actuator where possible

*Valve manufactures are limited for pneumatically operated Pressure Independent Control Valves. (Delta P allows pneumatic actuators to be mounted on their valves.*

- C. Shut-off against maximum system temperatures and pressure encountered.
- D. Select valve components to withstand maximum pressure and temperature encountered in system.

#### 3.3 TWO POSITION CONTROL VALVES (2" and Larger)

- A. Furnish two position control valves for equipment isolation.
- B. Factory mount actuator.
- C. Select valves to provide tight shut-off against maximum system temperatures and pressure encountered.
- D. Size valve to full pipe size

**END OF SECTION**

**SECTION 25 3523**  
**CONTROL DAMPERS**

**PART 1 - GENERAL**

1.1 SUMMARY

- A. This section includes control dampers for systems shown in Contract Documents and except where provide by equipment manufacturer.
- B. Products Supplied But Not Installed Under This Section:
  - 1. Control dampers.
  - 2. Optional factory mounted actuators.
- C. Related Sections:
  - 1. 23 3300 Air Duct Accessories
  - 2. 25 3513 Actuators and Operators
  - 3. 25 0553 Identification

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the bodyof this section) and coordinated.*

---

1.2 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. AMCA 511 - Certified Ratings Program for Air Control Devices.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

---

1.3 DEFINITIONS

- A. AMCA – Air Movement and Controls Association
- B. Duct Section- Ductwork containing flow control damper starting with inlet or branch tee and ending with outlet or branch tee.

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

---

1.4 SYSTEM DESCRIPTION

- A. High performance low leakage Class I control dampers suitable for HVAC applications.

1.5 SUBMITTALS

- A. Damper Schedule:
  - 1. Indicate size, location and model of each damper
- B. Product Data shall Include:

1. Construction materials and assembly methods
  2. Maximum design parameters (temperature, pressure, velocity, etc.)
  3. Performance data for full range of actuator stroke and installation details.
  4. Graphics or similar items used in making selections, including damper to duct area ratio and free area ratio.
  5. Sizing calculations
- C. Indicate AMCA certified leakage rates for given pressure differentials.
- D. Indicate pressure drop ratings based on AMCA tests and procedures.

*Section specific submittal requirements should be defined here but not repeated from other sections...*

---

## 1.6 QUALITY ASSURANCE

- A. Meet certified leakage rates and pressure drop ratings in accordance with AMCA. Leakage ratings shall be based on AMCA Standard 500 and dampers shall bear AMCA Air Leakage Seals.
- B. Base sizing calculations on actual characteristics of ductwork system being installed.
- C. Size dampers as close as possible to duct size, but in no case is damper size to be less than duct size.
- D. Size opposed blade dampers shall for minimum of 10% of duct system pressure drop.
- E. Size parallel blade dampers for minimum of 30% of duct system pressure drop.
- F. Calculate actual duct pressure drops for each dud section containing modulating damper using latest version of ASHRAE Handbook of Fundamentals.
- G. Obtain adequate system information necessary for sizing.
- H. Two position dampers to be sized as close as possible to duct size, but in no case is damper size to be less than duct area.
- I. Select dampers to meet their intended service with respect to maximum approach velocities and maximum pressure differential.
- J. Damper materials shall meet intended service for which they are installed (galvanized steel, aluminum, 304 or 316 stainless steel, etc. unless otherwise noted).
- K. Dampers shall be tested, rated and labeled in accordance with the latest UL requirements.
- L. Tag control dampers appropriately. Refer to 25 0553.

*Section specific quality requirements should be defined here but not repeated from other sections...*

---

## 1.7 WARRANTY

- A. Include two-year warranty for parts replacement.
- B. Include registration and warranty documents and warranty rights to the Owner.

## **PART 2 - PRODUCTS**

### **2.1 STANDARD CONTROL DAMPERS**

- A. Manufacturers: Ruskin, Tamco, Johnson Controls, Siemens or Honeywell.
- B. Opposed or parallel blades for modulating dampers and opposed blade only for 2 position dampers.
- C. Aluminum dampers in dampers exposed to outside air conditions.
- D. Blade linkage hardware shall have corrosion-resistant finish.
- E. Requirements:
  - 1. Frame 16 ga galvanized steel or 14 ga extruded aluminum hat-shaped channel.
  - 2. Blades 16 ga galvanized steel or 14 ga aluminum airfoil shaped
  - 3. Max Blade Width 8 inches
  - 4. Bearings Molded synthetic, nylon, bronze, or ball
  - 5. Max Leakage Less than 3 cfm per square foot at 1 inch of static pressure.
  - 6. Temp. Range -40 to 250 Deg F.
  - 7. Diff. Pressure 6.0 INWG
  - 8. Approach Velocity 6000 fpm

### **2.2 EXHAUST FAN SHUT-OFF DAMPERS:**

- A. Manufacturers: Swartwout 902 or Ruskin CDR92.
- B. 304 stainless steel construction, flanged connection, grease lubricated ball bearings, continuous shaft with seal, suitable for maximum temperature 250°F, approach velocity 6000 fpm, and differential pressure of 13" WG.
- C. Furnish dampers with neoprene blade seals.
- D. Stainless steel may be changed to galvanized steel where application allows. Change 304 to 316 if ductwork is 316 SS. If rectangular dampers are required, consider Ruskin CD80AF3 or CD80AF4 Industrial Control Dampers for Fume Exhaust Fan Shut-off Dampers.

### **2.3 OUTSIDE AIR DAMPERS:**

- A. Manufacturers: Ruskin Model CD80AF2 or American Warming and Ventilating Model VC-423.
- B. Galvanized steel construction, suitable for maximum temperature 250°F, approach velocity 6000 fpm and differential pressure of 13.5" WG.
- C. Air foil blade design, 16 gauge minimum and 12" maximum width.
- D. Furnish with flexible jamb seals, EPDM, silicone or neoprene blade seals.

## **PART 3 - EXECUTION**

### **3.1 STANDARD CONTROL DAMPERS**

- A. Furnish control dampers as shown on drawings or as required to perform control sequences specified, except those furnished with other equipment.
- B. Coordinate delivery, storage and installation with Section 23 3300.
- C. Mount blade linkage hardware to be readily accessible for maintenance.

- D. Mount actuator to achieve fail safe condition as shown on drawings or as needed to accomplish sequences.

### 3.2 EXHAUST FAN SHUT-OFF DAMPERS

- A. Furnish for exhaust fan systems as indicated.
- B. Coordinate delivery, storage and installation with Section 23 3300.
- C. Mount actuator to fail damper to the closed position, unless otherwise shown.

### 3.3 OUTSIDE AIR DAMPERS:

- A. Furnish dampers located in outside air ducts or where exposed to outside air conditions.
- B. Provide cover or enclosures to protect exposed linkage and actuators from weather.
- C. Coordinate delivery, storage and installation with Section 23 3300.
- D. Mount actuator to fail damper to the closed position, unless otherwise shown.

**END OF SECTION**

## SECTION 25 3524

### SMOKE DAMPERS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. This section includes dampers systems as shown in Contract Documents and except where provide by equipment manufacturer.
- B. Products Supplied But Not Installed Under This Section:
  - 1. Smoke rated dampers and combination fire/smoke dampers.
  - 2. Required factory mounted actuators.
- C. Related Sections:
  - 1. 23 3300 Air Duct Accessories
  - 2. 25 3523 Control Dampers
  - 3. 25 0553 Identification

*Edit the above list for each project. Make sure each item is appropriate (mentioned in the body of this section) and coordinated.*

---

##### 1.2 REFERENCES

- A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- B. NFPA 92A - Smoke-Control Systems.
- C. NFPA 92B - Smoke Control Systems in Atria, Covered Malls, and Large Areas.
- D. UL-864/UUKL Smoke Control Listing
- E. UL 555/555S - Standard for Safety; Leakage Rated Dampers for Use in Smoke Control Systems.
- F. Refer to section 25 0552 for additional references.

*Edit the above list for each project. Make sure each item is appropriate and are coordinated.*

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##### 1.3 DEFINITIONS

- A. Reset – Device returns to normal operating position.
- B. Refer to section 25 3523.

*Edit the above list for each project. Make sure each item is appropriate. If the above referenced definitions are not included in the project, consider incorporating them or delete them from the list.*

---

##### 1.4 SYSTEM DESCRIPTION

- A. Class 1 rated Smoke Dampers and Combination Fire Smoke Dampers for HVAC systems.

## 1.5 SUBMITTALS

- A. Damper Schedule:
  - 1. Indicate size, location and model of each damper
- B. Include:
  - 1. Construction materials and assembly methods
  - 2. Maximum design parameters (temperature, pressure, velocity, etc.)
  - 3. Performance data for full range of actuator stroke and installation details.
  - 4. Graphics or similar items used in making selections, including damper to duct area ratio and free area ratio.
  - 5. Sizing calculations
- C. Indicate AMCA certified leakage rates for given pressure differentials.
- D. Indicate pressure drop ratings based on AMCA tests and procedures.

*Section specific submittal requirements should be defined here but not repeated from other sections...*

---

## 1.6 QUALITY ASSURANCE

- A. Calculations for sizing dampers shall be based on actual characteristics of ductwork system being installed. Opposed blade dampers shall be sized for minimum of 10% of duct system pressure drop.
- B. Meet certified leakage rates and pressure drop ratings in accordance with AMCA. Leakage ratings shall be based on AMCA Standard 500 and dampers shall bear AMCA Air Leakage Seals.
- C. Base sizing calculations on actual characteristics of ductwork system being installed.
- D. Size dampers as close as possible to duct size, but in no case is damper size to be less than duct size.
- E. Size opposed blade dampers shall for minimum of 10% of duct system pressure drop.
- F. Size parallel blade dampers for minimum of 30% of duct system pressure drop.
- G. Calculate actual duct pressure drops for each dud section containing modulating damper using latest version of ASHRAE Handbook of Fundamentals.
- H. Obtain adequate system information necessary for sizing.
- I. Two position dampers to be sized as close as possible to duct size, but in no case is damper size to be less than duct area.
- J. Select dampers to meet their intended service with respect to maximum approach velocities and maximum pressure differential.
- K. Damper materials shall meet intended service for which they are installed (galvanized steel, aluminum, 304 or 316 stainless steel, etc.).
- L. Dampers shall be tested, rated and labeled in accordance with the latest UL requirements.
- M. Tag smoke dampers appropriately. Refer to 25 0553.

*Section specific quality requirements should be defined here but not repeated from other sections...*

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## 1.7 WARRANTY

- A. Include two-year warranty for parts replacement.
- B. Include registration and warranty documents and warranty rights to the Owner.

## PART 2 - PRODUCTS

### 2.1 SMOKE DAMPERS

- A. Manufacturers: Air Balance, Johnson Controls, Ruskin, Greenheck, NCA Manufacturing, Cesco or Prefco.
- B. Requirements:
  - 1. Leakage rated under UL 555S (less than 4 cfm per square foot at 1" of static pressure and 8 cfm at 4" static pressure) at temperature category 250°F
  - 2. Maximum blade width of 8".
  - 3. Minimum 16 gauge galvanized steel or aluminum airfoil shaped blades.
  - 4. Stainless Steel or bronze bearings.
  - 5. Dampers and seals shall be suitable for maximum system temperature, pressure differential and approach velocity, but not less than temperature category 250°F, pressure differential of 4" WG, and approach velocity of 2000 fpm.
- C. Actuator mounting assemblies shall be outside airstreams.
- D. Include damper position switch linked directly to damper blade to provide capability of remotely indicating damper blade open position and closed position.
- E. Dampers shall fully open in 15 seconds or less and fully close in not more than 15 seconds and not less than 5 seconds when activated.
- F. Electric actuators shall be 120 volt non-stall type unless otherwise stated, and shall be rated for energized hold open position period of 6 months or more.
- G. Allow reset from fire alarm control panel.

### 2.2 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Ruskin, Air Balance, Prefco, Greenheck, Nailor, Cesco, equal to Ruskin FSD-60.
- B. Requirements
  - 1. Meet requirements of NFPA 90A.
  - 2. 1-1/2 or 3 hr rated as shown on drawings,
  - 3. Maximum blade width of 6".
  - 4. Minimum 14 gauge galvanized steel or aluminum airfoil shaped blades.
  - 5. Leakage rated at no higher than leakage Class I (4 cfm/ft<sup>2</sup> at 1" WG and 8 cfm/ft<sup>2</sup> at 4" WG) under UL 555/555S at temperature category 350°F, and compatible with system static pressures.
  - 6. Rated pressures to 4" WG and velocities to 3000 fpm.
- C. Operators shall be electric, factory installed outside of air stream, linked to dampers for fail closed operation, and be UL listed and labeled for the application.
- D. Include damper position switch linked directly to damper blade to provide capability of remotely indicating damper blade open position and closed position.

- E. Operators to be capable of closing damper at pressures encountered in system. Electric operators shall be rated for energized hold open position period of 6 months or more.
- F. Dampers shall fully open in 15 seconds or less and fully close in not more than 15seconds and not less than 5 seconds when activated.
- G. Firestat
  - 1. Dampers shall be furnished with UL classified firestat, functioning to close dampers when duct temperatures exceed 165°F while allowing reset capability from fire alarm system or building automation system.
  - 2. Include damper position switch linked directly to damper blade to provide capability of remotely indicating damper blade position. Firestat and position indicator switches to be capable of interfacing electrically with building fire alarm system or automation system.
  - 3. Firestats shall be equipped with high limit temperature sensors meeting requirements of NFPA 92A by returning damper to fire protection mode when temperature reaches 350°F.
- H. Furnish EP switches where pneumatic operators are used.
- I. Submit UL installation details showing mounting method and duct connection method.

### 2.3 FACTORY MOUNTED ACTUATORS

- A. Pneumatic Diaphragm with Spring Return
  - 1. Provide spring return feature for fail closed positions.
- B. Discrete Two-Position Electric:
  - 1. Provide spring return feature for fail open or closed positions as required by control sequence.

## PART 3 - EXECUTION

### 3.1 SMOKE DAMPERS

- A. Furnish smoke dampers as shown on drawings or as required to perform control sequences specified.
- B. Furnish factory mounted actuator mounted outside airstream.
- C. Coordinate delivery, storage and installation.
- D. Coordinate final power requirements and locations.

### 3.2 COMBINATION FIRE AND SMOKE DAMPERS

- A. Furnish combination fire/smoke dampers as shown on drawings or as required to perform control sequences specified.
- B. Furnish factory mounted actuator mounted outside airstream.
- C. Coordinate delivery, storage and installation.
- D. Coordinate final power requirements and locations.

### 3.3 FACTORY MOUNTED ACTUATORS

- A. Select actuators to provide tight shut-off against maximum system temperatures and pressure encountered.
- B. Fail smoke dampers serving pressure rated heat exchangers or converters closed unless otherwise shown.

**END OF SECTION**