

**SECTION 15957**  
**HVAC INSTRUMENTATION AND CONTROLS INSTALLATION**  
**(Applicable to IUPUI Only)**

**I. GENERAL**

**A. NOTES**

1. The University has a pre-purchase agreement (PPA) with Johnson Controls (JCI) and Siemens Building Technologies (SBT). The University will directly purchase all of the required control components as described in the PPA contractor bid documents, and control system engineering, to accomplish the design intent of the designer of record.
2. Installation of controls shall be performed by the Controls Installation Contractor (CIC) as part of this section, and not by the PPA contractor (JCI or SBT) as described in the project construction documents. Installation shall be subject to all applicable federal, state, and local codes as well as the installation standards specified here within. Contact Indiana University / IUPUI Engineering Services with questions and for further details. Contract issues should be referred to the designer of record.

**B. SYSTEMS**

1. Controls Installation Contractor (CIC) shall be responsible for installing all temperature control system components as described in the bid documents, to include all temperature control contractor documents. CIC is responsible for providing and installing all conduits, junction boxes, wire, pneumatic tubing, and any other installation component not specifically called out on the PPA contractor's documents but required for complete installation and operation of the temperature controls to achieve standards and design intent.
2. Installed systems shall be subject to continuous assessment by the PPA contractor and the University to ensure all installation standards are being met. All verifiable and documented discrepancies to the described installation standards, performed by the CIC, shall be promptly corrected at CIC's expense, and subject to all contract provisions.
3. CIC shall install all components according to manufacturers recommended installation specifications and specifications spelled

out herein. CIC shall co-ordinate with all trades to ensure that the installation standards can be and are achieved.

4. PPA Contractor shall be available to answer any questions about temperature controls installation from any trade.

### **C. DOCUMENTATION**

1. CIC shall provide a complete marked up as-built set of temperature control drawings to the PPA contractor and the A/E. As-built set shall include and document all wiring, wiring interlocks, pneumatic paths, field changes, additions, omissions, address sequencing, power trunk sequence, and cabling paths.

## **II. INSTALLATION GUIDELINES**

### **A. CODES AND STANDARDS**

1. Latest edition of NFPA 70 (NEC)
2. Current local codes
3. University standards
4. All project documents

### **B. VENDOR DEVICES**

#### **1. REFERENCE MANUALS**

- a) Johnson Controls
  - (1) Johnson Controls Installation Manual
- b) Siemens Building Technologies
  - (1) Powers Field Installation Manual
- c) All manufacturer provided installation guidelines and procedures.

#### **2. FLEXIBLE TEMPERATURE SENSORS**

- a) All flexible sensors shall be attached by wire ties to a suspended wire or insulated cable to prevent sensor contact with metal or other unit components.
- b) Install flexible sensors across all coils at a maximum of 6" from the bottom of the bottom coil and a minimum of 7" radius to turn the sensor.
- c) Staggered coils shall utilize multiple sensors; each sensor shall cover one section of the staggered coil.

- d) All flexible sensors shall be protected at point of penetration of unit via a section of poly tubing to prevent contact of the sensor and the unit.
- e) Install flexible sensor so as then entire length of the sensor, less the wiring connection point, shall be in contact with the air stream being monitored. Excessive lengths of sensor outside the air stream or located in areas without air movement is not acceptable.

### 3. LOW TEMPERATURE DETECTOR SWITCH

- a) All low temperature detectors shall be attached by wire ties to a suspended wire or insulated cable to prevent detector contact with metal or other unit components.
- b) Install low temperature detectors across all coils at a maximum of 6" from the bottom of the bottom coil and a minimum of 7" radius to turn the detector.
- c) Staggered coils shall utilize multiple detectors; each detector shall cover one section of the staggered coil.
- d) All low temperature detectors shall be protected at point of penetration of unit via a section of poly tubing to prevent contact of the sensor and the unit.
- e) Install the detector in a slight downward incline with a maximum free distance of 12" between each pass.
- f) Install flexible sensor so as then entire length of the sensor, less the wiring connection point, shall be in contact with the air stream being monitored. Excessive lengths of sensor outside the air stream or located in areas without air movement is not acceptable.
- g) Install location
  - (1) If unit has heating water preheat
    - (a) Mount low temperature detector downstream of the preheat coil and upstream of chilled water coil.
  - (2) If unit has steam preheat
    - (a) Mount low temperature detector downstream of the chilled water coil and upstream of any device producing a heat load, such as heating coils, humidifiers, fans, etc.
  - (3) If the unit is without preheat
    - (a) Mount low temperature detector downstream of the first coil containing liquid.

### 4. HIGH STATIC SWITCH

- a) Install all static switches on the air-handling unit at a maximum height of 6'5" to the center of the switch. Utilize

hard or soft copper for pressure sampling tubes. Install sample tubes in a craftsman like manner and terminate in the sampled air with an appropriate pressure terminal. Bending the end of the copper tubing in the airstreams is not acceptable.

5. LOW STATIC SWITCH

- a) Install all static switches on the air-handling unit at a maximum height of 6'5" to the center of the switch. Utilize hard or soft copper for pressure sampling tubes. Install sample tubes in a craftsman like manner and terminate in the sampled air with an appropriate pressure terminal. Bending the end of the copper tubing in the airstreams is not acceptable.
- b) If unit contains a return fan, static switch shall be piped to sample the low-pressure side of the return fan.

6. FLUID DIFFERENTIAL PRESSURE SENSOR

- a) Fluid differential pressure sensors shall be mounted a minimum of 8" from the top of a wall or column, or as high as possible without interfering with other trades, manifold shall be on top. Utilize hard copper tubing for connection from pipe to manifold.

7. DAMPERS

- a) All dampers provided by PPA vendor(s) shall be installed with the dampers blades in a horizontal configuration and must be level, plumb, and square.
- b) All damper(s) shall be properly supported via mechanical methods in a manner that will maintain the damper(s) in a horizontal, level, plumb, and square configuration for the anticipated lifespan of the building.

8. VARIABLE FREQUENCY DRIVES

- a) Mount all VFD's on u-channel. VFD may be mounted on a stand constructed from u-channel and properly secured to the floor, if wall space is not available or if shown as such on construction drawings.
- b) The maximum mounting height is such that the user interface/display is no higher than 6' above the finished floor surface directly under the drive.

- c) VFD shall be installed in accord with manufacturer's instructions and the National Electric Code. If a remote disconnect is required by code, confirm whether the drive requires an auxiliary contact to disable the drive. Line and load cabling shall be in separate conduits. Coordinate start up with other contractors.

## 9. STEAM VALVES

- a) All electronic actuated steam valves must be mounted with the actuator at an angle of 15 to 45 degrees from the vertical.

## 10. CONTROL PANELS

- a) All control panels shall be mounted to u-channel. Panel may be mounted on a stand constructed from u-channel and properly secured to the floor, if wall space is not available or if shown as such on construction drawings.
- b) The maximum mounting height is such that the user interface/display is no higher than 6' above the finished floor surface directly under the control readout.
- c) All penetrations shall be made on the top of the control panel.
- d) 120VAC and low voltage must utilize separate penetrations.
- e) All pneumatic penetrations shall be made on the opposite end of the 120VAC penetration.

## C. MATERIALS

### 1. PNEUMATIC TUBING

- a) Adhere to current NEC and Local Codes
- b) Main 80# air line shall be run in hard copper, minimum 1/2" diameter, supported every 6 feet to the building structure.
  - (1) Main 80# air line shall have an air gage and tee tap with a ball valve capped off for future, located between the compressor tank and the refrigerated air dryer.
  - (2) Main 80# air riser shall have a ball valve at each floor prior to an adjacent pressure-reducing valve.
- c) Main 25# air line shall be run in black polyethylene tubing, minimum 3/8" diameter, supported every 6 feet to the building structure.
  - (1) All poly tubing conduit is EMT, 3/4" minimum size, and shall be installed in a craftsman like manner. All

connections, fittings, supports, etc. shall be tight and secure.

- (a) Mechanical areas: All poly tubing in conduit EMT
  - (b) Space sensors: All poly tubing in conduit in wall construction EMT
  - (c) Accessible ceilings: Bundled neatly, run, and mechanically attached to and parallel with the building structure. Use of existing cable tray is not acceptable.
  - (d) Non Accessible ceilings: All poly tubing in conduit EMT
  - (e) Shaft spaces: All poly tubing in conduit EMT, 1" minimum size
- (2) Conduits for pneumatic tubing shall be sized by the following standard:
- (a) ¾" conduit
    - (1) Not to exceed three ¼" poly tubes
  - (b) 1" conduit
    - (1) Not to exceed six ¼" poly tubes
- (d) Main 25# air line for ELSAM shall be run in black polyethylene tubing, minimum 3/8" diameter.
- (1) ELSAM main air lines must be run completely in EMT conduit. The conduit must be labeled "ELSAM MAIN AIR" with a minimum of ½" lettering. Labels shall be placed on every box cover, every 20' on center and within 6" on each side of each wall or structural penetration.
- (e) Polyethylene connections to steam valve actuators shall utilize a minimum of 12" of coiled copper between the poly tubing and the valve actuator.
- (f) Polyethylene tubing inside equipment, such as air handling units, shall be run in conduit with a maximum of 12" of exposed tubing at the controlled device. All finished air handling unit penetrations shall be sealed air tight inside and out.
- (g) Polyethylene tubing shall be manufactured from virgin stock and shall meet the following specifications:
- (1) Density: 0.92 grams/cc
  - (2) Melt Index: 0.30 decigrams/min.
  - (3) Stress check resistance: 2000 hrs. Minimum per ASTM-D 1693
  - (4) Tensile strength: 2200 psi
  - (5) Fire resistance: "FR" type

## 2. METAL CONDUIT

- a. Adhere to current NEC and Local Codes
- b. Control conduits will be considered secondary to other trades and must heed right of way when there are conflicts.
- c. All control wiring conduit is EMT, ¾" minimum size, and shall be installed in a craftsman like manner, parallel to the building structure. All connections, fittings, supports, etc. shall be tight and secure.
  - (1) Mechanical areas: All wiring in conduit EMT
  - (2) Space sensors: All wiring in conduit in wall construction EMT
  - (3) Accessible ceilings: Plenum rated cable bundled neatly, run, and mechanically attached to and parallel with the building structure. Use of existing cable tray is acceptable with prior approval.
  - (4) Non Accessible ceilings: All wiring in conduit EMT
  - (5) Shaft spaces: All wiring in conduit EMT, 1" minimum size
  - (6) Pass through building structure walls above plenum ceiling spaces shall utilize a sleeve of EMT conduit, 12" in length, with end steel compression box end fittings or plastic/rubber grommets and fire stopped if the wall is fire rated.
  - (7) Flexible metal conduit (FMC) may be utilized when approved in instances where sensors are to be located in existing walls.
- (d) All EMT connections shall utilize steel compression fittings up to 1 ½" conduit. Above 1 ½" may utilize steel set screw fittings.
  - (1) All non-terminated, non-connected, open ends of conduit must utilize either a plastic/rubber grommet or box connector.
- (e) All conduits shall be supported directly from or to structural members. Additional support shall be provided at junction and pull boxes.
  - (1) Conduits shall be supported by trapeze hangers or pipe straps and shall have their support spaced not to exceed 10' on center, or a minimum of one support per piece of conduit. With approval, it is acceptable to use other electrical trapeze.
  - (2) All junction boxes must have a minimum of two anchors per box. Boxes larger than 8" X 8", shall have a minimum of four anchors per box.
  - (3) All conduits shall be run as close to the ceiling if possible. Make all conduit drops at point of connection. Do not run conduit across walls below 8' in mechanical spaces.

- (f) Conduits serving air handler units shall be run either along the top of the unit along unit structural members or above the unit supported by u-channel. Drops for devices shall be run on the structural members of each unit, and shall not cross or attach to the panels. Conduit must be seismically isolated from the structure via FMC/LFMC.
- (g) All boxes shall utilize all normally provided mechanical fasteners to secure their covers.
- (h) All conduits and junction box covers shall be labeled "Temperature Controls" with a minimum of ½" lettering. Labels shall be placed on every box cover, every 20' on center and within 6" on each side of each wall or structural penetration.
- (i) A maximum of 20" of FMC may be used to connect any control device to a junction box. Use FMC to isolate all components that have the potential for vibration.
- (j) FMC must be secured with an appropriate sized FMC one hole clamp if used inside equipment, such as air handling units.
- (k) Liquid tight FMC must be utilized on all final connections in moist/damp locations and in all locations exposed to the weather.
- (l) Power and low voltage wiring shall not be run in the same conduit.
- (m) Electrical wiring shall not be run in the same conduit with poly tubing.
- (n) Where more than one panel is mounted together, utilize square duct wire way, 4" X 4" minimum, to connect all panels. Provide one extra 1" EMT conduit from each panel to square duct wire way for future expansion.

3. LOW VOLTAGE CABLE

- (a) Adhere to current NEC and Local Codes
- (b) Splicing of cables is not permitted. All connections shall be point to point.
  - (1) If splicing is completely unavoidable, utilize an appropriate sized junction box with terminal blocks to make the connections. Wire nuts are not acceptable.
- (c) Johnson Controls
  - (1) The following wiring will be utilized on all projects:

<u>Metasys Application</u>	<u>Cable</u>
Sensor Wiring	2C #18 Twisted/Shielded Plenum
Terminal Unit	3C #18 Twisted/Shielded Plenum
valves & actuators	
Communication	3C #18 Twisted/Shielded Plenum
24v power trunk	2C #14 Twisted/Shielded Plenum

- (d) Siemens Building Technologies  
 (1) The following wiring will be utilized on all projects:

<u>Apogee Application</u>	<u>Cable</u>
Sensor Wiring	2C #20 (STR) Plenum
TEC valves & actuators	3C #20 (STR) Plenum
Communication	1P #24 (STR) OAS Plenum
TEC 24v power trunk	2C #14 (STR) Plenum

4. LINE VOLTAGE CABLE

- (a) All 120VAC wiring shall be minimum solid copper, 12 THHN, 600-volt insulation.
- (b) Panel 120VAC power circuit shall be dedicated for building automation system components only. Power shall be run from emergency circuit panels, if emergency power is available in the building. Confirm responsibility for panel 120VAC.
- (c) External control devices powered via 120VAC from the control panel shall utilize a knife switch, or fuse switch to isolate those devices from the power to the controller. The switch shall be installed in the control panel in such a way as to allow power to be easily disconnected from each control device individually without removing power to the panel completely.

5. GAUGES

(a) THERMOMETERS

- (1) Thermometers shall be well type solar-powered digital thermometers similar to TREND brand. Range 30 Deg. F. to 200 Deg. F.
- (2) Install at all locations shown on the contract documents. Adjust unit so that the numeric display may be seen from the floor and that the solar power cells obtain as much light as possible.

(b) PRESSURE

- (1) Pressure gauges shall be installed with an isolation valve and snubber to damper pulsations, ease of maintenance and replacement. Scale of gauge shall be of a reasonable nature to allow for accurate reading of operating pressures. Use the following guidelines for gauge ranges.
- (a) Piping
- (i) Water Lines: 0-150 psig
  - (ii) 150 psig steam 0-200 psig
  - (iii) 40 psig steam 0-100 psig
  - (iv) 15 psig steam 0-30 psig

- (b) Compressed control air
  - (i) Compressor/receiver 0-200 psig
  - (ii) Field devices
    - (a) 1 1/2" gauge with 1/4" OD poly tubing
      - barbed fitting.
      - (i) Johnson Controls
      - (ii) Siemens Building Technologies

6. RELAYS

- a) Install in accordance to (NEC) NFPA 70-2005 Article 725.55

7. THERMOSTAT DETAIL

- a) See sheet MD1 following

**END OF SECTION**

PROJECT TITLE:

**DETAIL**

SHEET TITLE:

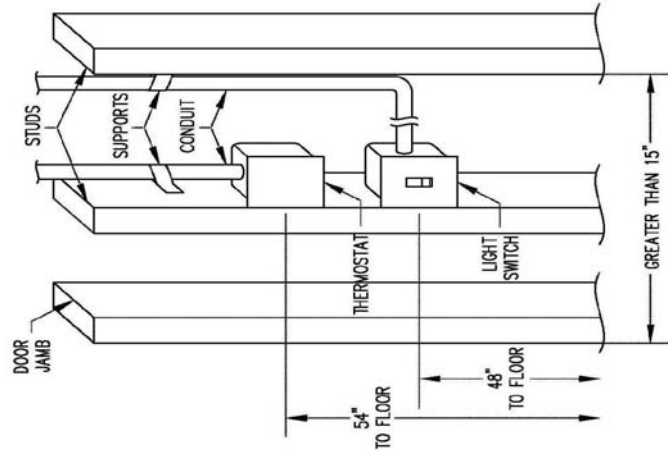
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LIGHT SWITCH  
DETAIL

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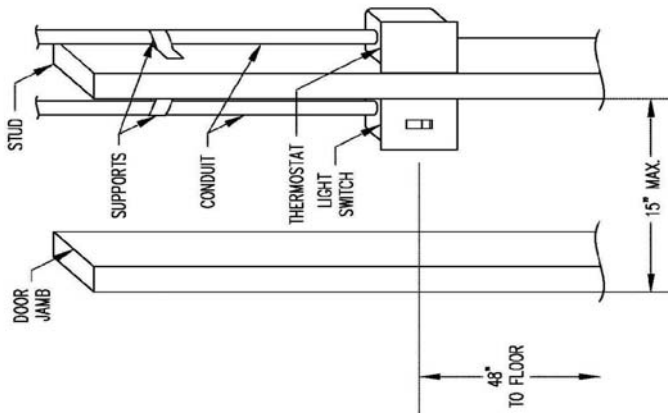
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**MD1**

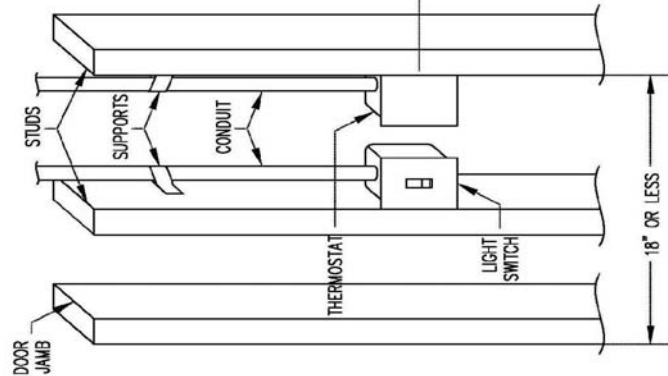
SHEET 1 OF 1 SHEETS



ALTERNATE (2)



ALTERNATE (1)



PRIMARY

TYPICAL LIGHT SWITCH AND  
THERMOSTAT DETAIL

NOTE: LOCATE ANY RECEPTACLE NOT TO CONFLICT WITH THERMOSTAT BY USING FAR SIDE OF STUD OR CROSS SUPPORT FOR CONDUIT BETWEEN STUDS.