

SECTION 23 09 43 - PNEUMATIC CONTROLS FOR HVAC

PART I - GENERAL

1.1 SECTION INCLUDES

- A. Control Air Compressor Units.
- B. Control Devices, Components, Piping and Material.
- C. Instructions for Owners.

1.2 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- A. Control Valves.
- B. Flow Switches.
- C. VAV Controllers
- D. Temperature Sensor Sockets (Thermowells).
- E. Gauge Taps.
- F. Automatic Dampers.

1.3 RELATED DOCUMENTS

- A. *Section 23 09 13 – Instrumentation and Control Devices for HVAC*
- B. *Section 23 09 23 - Building Automation Systems(BAS) for HVAC*

1.4 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.
- C. ANSI/ASTM B32 - Solder Metal.
- D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 volts Maximum).
- E. ANSI/NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.
- F. ASTM B280 - Seamless Copper Tube for Air Conditioning & Refrigeration Field Service.
- G. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
- H. ASHRAE 85 - Automatic Control Terminology for Heating, Ventilating, Air-Conditioning.
- I. ANSI/NFPA 70 - National Electrical Code.
- J. *Section 01 33 23 – Shop Drawings, Product Data, and Samples*

K. *Section 26 60 00 – Common Motor requirements*

L. *Drawing 23 09 43 -1 – Temperature Control Air Compressor Installation*

1.5 SYSTEM DESCRIPTION

- A. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems and perform functions specified.
- B. Provide materials and labor necessary to connect control components factory supplied to other control systems.
- C. Unless specified otherwise, provide fully proportional components.
- D. Provide all central and remote hardware and interconnecting wire and conduit.
- E. The system, as specified, shall independently control the building's HVAC equipment to maintain a comfortable environment in an energy efficient manner.
- F. All control panels shall be located away from sources of heat and humidity and away from the primary equipment room entry and exit paths.
- G. All main pneumatic piping shall be provided with isolation valves located at main LCP control panel and on main piping systems to isolate from main air source supply for maintenance purpose.
- H. Remodeling Projects: For all remodeling projects, New Pneumatic Thermostats must be provided, if pneumatic system is designed.

1.6 SUBMITTALS

- A. Submit shop drawings per *Section 01 33 23 – Shop Drawings, Product Data, and Samples*.
- B. Provide damper shop drawings showing arrangements, velocities, and pressure drops.
- C. Provide control valve shop drawings including materials, flow characteristics and pressure drops.
- D. Provide complete operating data, system drawings, wiring diagrams, and written detailed descriptions of sequences. One copy of the as-built control diagram shall be placed inside each control panel. Provide pocket inside the door.
- E. Provide description, engineering data and manufacturer's installation instructions on each control system component. Include sizing as requested.
- F. At completion of work, submit report of checkout of automatic control system.
- G. Submit record documents.
- H. Include actual location of control components, including panels, thermostats, and sensors. Include revised shop drawings to reflect actual installation and operating sequences.
- I. Submit operation and maintenance data. Include systems descriptions, setpoints, and controls settings and adjustments. Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years' experience.
- B. Installer: Company specializing in applying the work of this section with minimum 3 years' experience.
- C. Control Contractors are limited to firms regularly employing a minimum of 5 full time service people within 100 miles of the job site.

1.8 WARRANTY

- A. Provide a 1-year warranty period covering replacement costs, including materials and labor, for all components.
- B. Provide Start-up of a Compressor as per manufacturer recommendations, and as listed in manufacturer's O& Manual.
- C. Provide Maintenance & Lubrication of a Compressor as per manufacturer recommendations and as listed in manufacturer's O& Manual during 1 –year Warranty period.

1.9 MAINTENANCE SERVICE

- A. Furnish service and maintenance of automatic controls system for 1 year from Date of Substantial Completion.
- B. Provide complete service of controls systems, including callbacks. Make minimum of 2 complete normal inspections in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports to Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS for Pneumatic Sensors, Switches, Relays and Indicating Devices

- A. Schneider Electric Building Systems /TAC
- B. Siemens
- C. Johnson Controls

2.2 CONTROL AIR COMPRESSOR UNITS

- A. AIR COMPRESSOR UNITS
 - 1. Construction: The body and cylinder castings of each compressor shall be constructed entirely of cast iron.
 - 2. Lubrication: Each compressor shall be pressure lubricated with a dedicated oil pump and filter. Splash lubrication type compressors are not acceptable.
 - 3. Capacity: Each compressor unit with reciprocating type compressors shall be sized to maintain adequate control air capacity with neither compressor running more than 33 percent of the time. Each compressor unit that will operate in conjunction with a regenerative desiccant type air drier shall be sized with surplus capacity to provide the additional purge air required for regeneration of the dryer media.

4. Redundancy: Each receiver tank mounted compressor or auxiliary receiver compressor unit shall incorporate two compressors to provide operational redundancy.
5. Air-Cooled: Air compressors units that are 10 hp and under shall be of the air-cooled type.
6. Receiver Tank: Each compressor unit shall incorporate an air receiver tank constructed in accordance with the ASME code and bear the ASME stamp. The compressed air system shall include a total air receiver capacity that is adequate to limit compressor cycling to a maximum of 10 starts per hour for units that are under 25 hp and a maximum of 6 starts per hour for units that are 25 hp and over, while maintaining a 20 psi maximum variation in receiver pressure.
7. Tank Accessories: Each receiver tank shall incorporate a dedicated pressure gauge and safety relief valve.
8. Compressor Motor: Each compressor motor shall satisfy the requirements of *Section 26 60 00 – Common Motor Requirements*.

B. UNIT CONTROLS

1. Dedicated Feed: Compressor unit controls shall incorporate a dedicated electrical power feed and starter for each compressor motor such that the failure of one compressor motor or circuit will not affect the operation of the other. Starters, contactors, and switches shall be NEMA design, as described in *Section 26 60 00 – Common Motor Requirements*.
2. Transformers: Compressor unit controls shall incorporate one or more control transformers as required to limit control circuit voltage to 120 volts. Electrical power shall be provided to the control circuit serving each compressor motor in such a manner that the failure of one compressor, motor or circuit will not affect the operation of the control circuit serving the other.
3. Alternators: Compressor unit controls shall incorporate an electric control relay type automatic alternator. Mechanical type alternators are not acceptable.
4. Pressure Switches: Compressor unit controls shall incorporate 2 independent pressure switches.
5. Compressor Staging: Compressor unit controls shall be capable of automatically and alternately cycling the 2 individual compressors under lighter load conditions to satisfy the set point of the first pressure switch. In addition, unit controls shall automatically operate the lag compressor as required under heavier load conditions to satisfy the set point of the second pressure switch.

C. APPROVED MANUFACTURERS

1. Quincy
2. Sullair
3. Atlas Copco

2.3 CONTROL AIR PIPING

- A. Copper Pipe: ASTM B280, Type K, Seamless, hard drawn or annealed with ANSI/ASME B16.22 wrought copper fittings, and ANSI/ASTM B32 95-5 solder joints. Copper pipe may always be used; however, its use is required in the following situations:
1. Systems greater than 30 psig.
 2. Exposure to temperatures in excess of 200 degrees F, or adjacent to heating pipes in a common sleeve.
 3. All exposed locations such as mechanical rooms, chases, crawl spaces, unfinished basement areas, or where exposed to potential damage.
 4. All inaccessible concealed locations such as in walls or above plaster ceilings.
- B. All control air piping shall be piping as described above, securely fastened with industry approved tubing hangers or pipe clips designed to keep all lines parallel to each other and on regularly spaced centers.
- C. All control piping bends shall be made so that the tubing is not damaged and the internal diameter of the tubing is not effectively reduced. All bends shall be made with benders manufactured specifically for the purpose of bending EMT conduit. There shall not be more than the equivalent of three quarter bends (270 degrees) between pull points, for example conduit bodies and boxes. All cut ends of EMT shall be reamed or otherwise finished to remove rough edges. EMT used as raceway for pneumatic poly lines shall be securely fastened in place at least every 10 ft. In addition, each EMT run between termination points shall be securely fastened within 3 ft. of each junction box or cabinet.
- D. Polyethylene: Flame retardant, virgin polyethylene tubing, passing ASTM D1693 stress cracking test, and bearing the UL flammability classification of V-2 may be used only under the following conditions:
1. In fully enclosed panels, raceways, troughs, conduits, trays, or other enclosures.
 2. In all accessible concealed locations such as above lay-in or clip-on acoustical tile or metal pan ceilings. Tubing must be run in thin-walled conduit or shielded polyethylene tubing and must be securely fastened to the building structure with joints in a suitable junction box.
 3. In unfinished exposed areas or inside walls, if fully enclosed in metallic conduit and easily replaceable. The final 12 inches of tubing in unfinished exposed areas may be outside of the conduit.
- E. Barbed Fittings: All barbed fittings shall be brass. Barbed plastic fittings may only be used when a restrictor is needed. No barbed fittings shall be used on plastic tubing larger than 3/8-inch or in systems with air pressure greater than 20 psig.
- F. Pneumatic Piping Demolition work: All pneumatic piping shall be removed and disconnected back to the mains and capped off there. All branch piping shall be completely removed.
- G. Remodeling Projects: For remodeling projects, new main and branch piping must be provided unless otherwise approved.

2.4 GAUGES

- A. Troubleshooting Points: Provide 1.5 inch minimum diameter air pressure gauges for indication of supply and control pressure at all thermostats (except room thermostats), EP

valves, PE switches, valves, damper motors, and other points in the system where indication of air pressure is needed for operating and troubleshooting.

- B. Controllers and Transducers: Each pneumatic controller and transducer shall be equipped with an outlet gauge to indicate the output from the controller to the control device. The gauge shall be a continuous reading device.
- C. Distant Control Devices: When the controlled device is not within sight of the controller a separate gauge shall be installed at the controlled device.
- D. Positioning Relays: Where positioning relays are used, a gauge shall be provided to indicate the actual pressure on the operator diaphragm.

2.5 LOCAL CONTROL PANELS

- A. Type: Enclosed panels with suitable brackets for either wall or floor mounting shall be furnished and installed with each system. They shall be fabricated from either steel or extruded aluminum and shall be equipped with hinged door and lock. Panels shall not be secured to any item of equipment.
 - 1. Locks: Provide tumbler locks with keys on all panels. All panels shall be keyed alike, and operable by the University master key.
 - 2. Test Line: Provide a 20 psi test air line with shut-off valve in each panel.
 - 3. Other Components: Panels shall contain DDC modules, relays, power supplies, a fused 120-vac receptacle, switches, and similar components.
 - 4. Control Diagram: All equipment shall be identified in relation to an as-built control diagram that shall be mounted adjacent to the main control panel under suitable protective cover or stored inside the panel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: Verify that systems are ready to receive Work. Beginning of installation means Installer accepts existing conditions.

3.2 INSTALLATION – GENERAL

- A. Air Compressor Unit and Associated Equipment
 - 1. Location: Each compressor unit and associated dryer shall be located in the main equipment room of the building it serves.
 - 2. Ventilation: The area surrounding each compressor unit and associated dryer shall be provided with sufficient ventilation/cooling to compensate for the heat rejected by this equipment.
 - 3. Vibration Isolation: Each compressor unit shall be mounted on spring vibration isolators. An inertia base shall be provided where needed to limit the transmission of vibration to the supporting structure and to maintain unit stability. Adequate consideration shall be given to vibration transmission limitations necessitated by sensitive laboratory equipment as applicable.
 - 4. Power Feed: A dedicated electrical power feed with a dedicated circuit breaker in the panel shall be provided for each compressor motor such that the failure of one compressor or motor or circuit will not

affect the operation of the other. A single electrical feed to serve a duplex compressor unit is expressly prohibited.

5. Disconnect Switch: A dedicated lockable disconnect switch shall be installed in conjunction with each power circuit. Each disconnect switch shall be located near the air compressor unit. The Electrical Contractor shall provide wiring up to this disconnect from an appropriate electrical distribution panel
 6. Conduit: Compressor electrical connection shall be installed in flexible conduit.
 7. Air Dryer: A refrigerated or desiccant air dryer unit shall be installed in conjunction with each compressor unit. It shall physically be supported independently of the compressor unit. Each dryer shall be sized for 100 percent of the airflow capacity of the associated compressor unit. Each dryer with a capacity of 20 cfm or greater shall have a minimum piping connection of 1/2-inch ID. A regenerative desiccant dryer shall be installed with each compressor unit serving a compressed air piping system with outdoor temperature exposure.
 8. Air Filter: An air filter assembly that is specifically designed to remove oil and water shall be installed in the compressed air piping system upstream of the dryer. An air filter assembly that is specifically designed to remove particulates shall be installed in the system downstream of the dryer. These filters shall be constructed and installed so as to be easily serviceable.
 9. Drains: An electric automatic drain unit with manual override shall be installed to serve the compressed air receiver tank. A mechanical float type drain shall be installed to serve the oil/water removal filter. Another mechanical float type drain shall be installed to serve the dryer.
 10. Pressure Regulation: Two pressure regulating valves, each with a 20 psig setpoint, shall be installed in the piping system downstream of the particulate removal filter. Each valve shall be sized for full system capacity to provide operational redundancy.
 11. Pressure Relief: A pressure relief valve designed for a relief pressure of 30 psig shall be installed in the piping system downstream of the pressure regulating valve isolation valves.
 12. Single-Use: Control air compressor units shall be piped to serve temperature control systems exclusively. They shall not be piped to also serve laboratory or other process air systems.
 13. Main Sizing: All main control air piping shall be sized equal to or greater than the connection size of the associated dryer.
 14. Flexible Connector: The control air piping system shall connect to the compressor with a flexible connector.
 15. Bypasses: A 3-valve bypass piping arrangement shall be installed at each filter and dryer to allow maintenance of this equipment without interruption of compressed air service to the system. Isolation valves shall be installed upstream and downstream of each pressure-regulating valve to provide operational redundancy.
 16. Schematic: See *Drawing 23 09 43-1, Temperature Control Air Compressor Installation* for schematic arrangement of components.
- B. Other Control System Components
1. Installation: Install in accordance with manufacturer's instructions.
 2. Installation Locations: Install all operators, sensors, and control devices where accessible for service, adjustment, calibration, and repair. Do not install devices where blocked by piping or ductwork. Do not install any control system components other than sensors and control dampers within the airstream of an air distribution system. Devices with manual reset or limit adjustments shall be installed in a locked

control panel. Low Temperature Protection devices shall be mounted below 6 feet on the fan structure, if practical, to allow inspection without using a ladder.

3. Workmanship: Run instrument air piping in all areas parallel to the building construction lines and in a neat and workmanlike manner. Any tubing not run in a workmanlike manner, not supported properly, or if plastic is used where copper is required, shall be replaced at the discretion of the Architect/Engineer.
4. Pressure Test: The entire piping system shall be tested by placing it under design pressure for 24 hours. Design pressure for control systems is 20 psig. The pressure drop during this period shall not exceed 3 psi.
5. Tubing Support: The field installation drawings shall give complete instructions for use of tubing types so field personnel are aware of these restrictions. Support all tubing or conduit from the building structure. Do not fasten tubing to any piping, duct, conduit, or other mechanical or electrical equipment. Tubing shall be secured with appropriate screws, expansion anchors, toggle bolts, hollow wall anchors, nylon expansion anchors or expansion shields. All purpose plastic anchors, also known as "blue anchors", are not acceptable. Sleeve tubing through concrete surfaces.
6. Pipe Fasteners: Where piping is exposed, fasten it within 12 inches of valves, damper motors, thermostats, and other devices. Space fastenings along piping on 48-inch maximum centers.
7. Tubing Exposure: In finished areas where the tubing cannot be exposed in walls, tubing shall be fully enclosed in a surface raceway. Install raceway in a neat and inconspicuous manner and paint to match adjacent surfaces. Do not run pneumatic and electrical wiring in the same raceway. Tubing may be exposed in unfinished areas such as mechanical and storage rooms.
8. Tube Purging: Purge tubing with dry, oil-free compressed air before connecting control instruments.
9. Sensor Locations: Verify locations of thermostats, humidistats, and other exposed sensors with drawings and room details before installation. Locate top of each room thermostat a maximum of 48 inches above the floor or per ADA requirements.
10. Valve Positioners: Provide valves over 3/4-inches in size with position indicators and pilot positioners where sequenced with other controls.
11. Control Panels: Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room.
12. Testing: Test and adjust control equipment after installation. Check calibration of instruments; recalibrate or replace if in error.

3.3 SUBMITTALS

- A. As-built drawings shall be submitted to the engineer after completion of the job.

END OF SECTION **23** 09 43

This section of the *U of I Facilities Standards* establishes minimum requirements only.
It should not be used as a complete specification.