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## SECTION 22 60 00\_-COMPRESSED AIR AND VACUUM SYSTEMS

### PART 1 GENERAL

#### 1.1 SUMMARY

- A. This standard includes the requirements for compressed air, gas and vacuum pipe systems at the Newark Campus of the University of Delaware including the following:
  - 1. Instrument & Industrial Grade Compressed Air Systems designated “laboratory air”.
  - 2. Vacuum Systems designated “laboratory vacuum”.
- B. The intent of these standards is to provide input to the design team on the University’s preference of manufacturers, design, equipment options and quality assurance to maintain the longevity of its assets.
- C. For projects in laboratory settings, consult with researchers and technicians to determine their requirements are included in the design.

#### 1.2 RELATED SECTIONS:

- A. Section 22 05 00– Common Work for Plumbing Systems
- B. Section 22 05 01 – Common Requirements for Plumbing Systems
- C. Section 15050 – Basic Mechanical Materials and Methods

#### 1.3 DESIGN REQUIREMENTS

- A. Installer Qualifications: Engage an experienced Installer of laboratory system.
  - 1. The term "experienced Installer" is defined as having a minimum of five (5) previous projects similar in size to this project, and is familiar with the precautions required, and with requirements of the authority having jurisdiction.

- B. When designing laboratory compressed air and vacuum systems, all branch take offs into each individual laboratory suite shall have an isolation valve. Each connection to a laboratory bench or equipment must have an isolation valve. Maximum isolation within the laboratory is critical so that experiments can continue within the laboratory when repairs or tie-ins are required.
- C. Components and Installation: Capable of producing piping systems with following minimum working pressure ratings except were indicated otherwise:
  - 1. Laboratory Compressed-Air Systems: 55 psig.
  - 2. Laboratory High-Pressure Compressed-Air Systems: 125 psig.
  - 3. Laboratory Vacuum Systems: 20 inches mercury system (and 55 psig working pressure rating).
- D. Risers shall have isolation valves between each floor and at each floor branch. All take offs from mains shall have isolation valves.
- E. All branch take offs from piping mains are required to have shut off valves at the take offs so that repairs can be performed on the branch piping without shutting down the system.
- F. Provide shut off valves at each equipment connection.
- G. Route all compressed air and vacuum piping in inside concealed spaces (ceilings, walls, chases, shafts...etc.).
- H. For projects in laboratory settings, consult with researchers and technicians to determine their requirements are included in the design.
- I. Vacuum pumps shall be vented so that chemical, biological and radiological waste streams are not entrained into the campus buildings. Consult with the Sustainability, Energy and Engineering Group and the Department of Environmental Health and Safety to ensure proper venting of the exhaust.
- J. All oil-sealed mechanical vacuum pumps shall have oil mist eliminators.

#### 1.4 Submittals

- A. Product Data:
  - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturer's catalog information.
  - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
  - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.

4. Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
  5. Compressors: Submit compressor type, capacity, certified performance curves showing compressor performance characteristics with compressor and system operating point plotted. Include electrical characteristics and connection requirements. Provide electrical and piping diagrams.
- B. Manufacturer's Installation Instructions: Submit installation instructions for compressors, vacuum pumps, specialties, valves and accessories.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves and equipment on as-built drawings.
- B. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping, valves and fittings. Maintain in place until installation. Do not sit lengths of pipe on the ground.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

#### 1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.8 EXTRA MATERIALS

- A. Not Applicable

### PART 2 PRODUCTS

#### 2.1 INSTRUMENT AND LABORATORY GRADE COMPRESSED AIR SYSTEMS

- A. 2-1/2" AND SMALLER INSIDE OF BUILDINGS
  1. Copper Tubing ASTM B88, Type K drawn.

2. Fittings: ASME B16.18 cast copper alloy or ASME B16.22, wrought copper and bronze.
  3. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting temperature range 430 to 535 degrees F.
- B. UNIONS (PIPE SIZES 2" AND SMALLER)
1. Copper Piping: Class 150, bronze unions with soldered joints.
  2. Dielectric Connections: Coupling or nipple with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- C. BALL VALVES (PIPE SIZES 2" AND SMALLER)
1. Manufacturers:
    - a. Apollo Valve 90 Series
    - b. NIBCO Valve FP-600A
  2. Class 150, bronze, two- or three-piece body, type 316 stainless steel ball, full port, Teflon seats, blow-out proof stem, solder ends with union, locking lever handle, bubble tight.
- D. CHECK VALVES (PIPE SIZES 2" AND SMALLER)
1. Manufacturers:
    - a. Kingston Valve
  2. Precision machined brass horizontal check valve with stainless steel spring; dash-pot design to reduce hammering effect caused by exhaust pulsation found in piston type air compressors.
- E. AIR COMPRESSOR SKID ASSEMBLY (for small scale instrument and controls applications only)
1. Manufacturers:
    - a. Quincy /Climate Control Duplex Reciprocating Air Compressor with Refrigerated Dryer
    - b. Equal Devilbiss
  2. Electric motor, high pressure duplex compressor unit. Provide compressor skid assembly with combination magnetic starters, totally enclosed belt guards, pressure switches, safety relief valves, gauges, intake filters, silencers, vibration isolators and air cleaners.
  3. Receiver shall be constructed in accordance with ASME code for unfired pressure vessels. Furnish ASME certification for each vessel.
  4. Compressor skid assembly shall include dryer; filter; automatic drain traps, flexible connectors, oil removal after filter, scales, no air loss electric drain and all required piping. Dryer shall be refrigerated, air cooled type and be located after the storage tank and before pressure reducing valve. Size dryer for 100% capacity of the compressor and shall have a bucket type sediment trap. Dryer shall have a dry contact to transmit alarm condition. Dryer shall bring dewpoint

down to 14F at 20psig pressure with 80psig inlet pressure and 80F ambient temperature. Particle filter shall filter down to 0.3microns.

5. Provide factory wired control panel.

F. LARGE SCALE AND SPECIALTY COMPRESSORS

1. Large scale and specialty compressors specification shall be developed on a case-by-case basis.
2. Consult with the Sustainability, Energy and Engineering Group as well as all laboratory users of compressed air for selection of large-scale compressors.

2.2 HOUSE DISTRIBUTED VACUUM SYSTEMS

A. 2-1/2" AND SMALLER INSIDE OF BUILDINGS

1. Copper Tubing ASTM B88, Type K drawn.
2. Fittings: ASME B16.18 cast copper alloy or ASME B16.22, wrought copper and bronze.
3. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting temperature range 430 to 535 degrees F.

B. UNIONS (PIPE SIZES 2" AND SMALLER)

1. Copper Piping: Class 150, bronze unions with soldered joints.
2. Dielectric Connections: Nipple or coupling with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

C. BALL VALVES (PIPE SIZES 2" AND SMALLER)

1. Manufacturers:
  - a. Apollo Valve 90 Series
  - b. NIBCO Valve FP-600A
2. Class 150, bronze, two- or three-piece body, type 316 stainless steel ball, full port, Teflon seats, blow-out proof stem, solder ends with union, locking lever handle, bubble tight.

D. CHECK VALVES (PIPE SIZES 2" AND SMALLER)

1. Manufacturers:
  - a. Kingston Valve
2. Precision machined brass horizontal check valve with stainless steel spring; dash-pot design to reduce hammering effect caused by exhaust pulsation found in piston type air compressors.

### 2.3 VACUUM PUMP

- A. Vacuum pump specification shall be developed on a case-by-case basis.

### 2.4 LABELING AND IDENTIFICATION

- A. Furnish labeling and identification in accordance with NFPA 99.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Prepare soldered joints in accordance with ASTM B828.
- B. Ream pipe and tube ends. Remove burrs. [Bevel plain end ferrous pipe.]
- C. Remove scale and dirt, on inside and outside, before assembly.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

### 3.2 INSTALLATION

- A. During brazing or welding of pipe connections, purge interior of pipe continuously with nitrogen.
- B. Cut pipe and tubing accurately and install without springing or forcing.
- C. Slope piping in direction of flow.
- D. Install pipe sleeves where pipes and tubing pass-through walls, floors, roofs, and partitions.
- E. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- F. Install pipe identification in accordance with University of Delaware Standards.
- G. Install non-conducting dielectric connections wherever joining dissimilar metals.
- H. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

- I. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- J. Group piping whenever practical at common elevations.
- K. Slope piping and arrange systems to drain at low points.
- L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings
- N. Provide access doors where valves and fittings are not accessible.
- O. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- P. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
- Q. Install unions downstream of valves and at equipment or apparatus connections.
- R. Install valves with stems upright or horizontal, not inverted.

### 3.3 FIELD QUALITY CONTROL

- A. Pressure test all air, vacuum and inert gases piping using nitrogen as per ASME pipe testing procedures.

### 3.4 CLEANING

- A. Prior to starting work, verify system is complete and properly cleaned and purged with nitrogen.
- B. All welded pipes shall be purged of welding slag and debris prior to pressure test.

## PART 4 END OF SECTION