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SECTION 22 60 00_AIR, GAS AND VACUUM PIPING 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
   2. Vacuum Systems
   4. Natural Gas Systems (< 1 psig)
   5. Inert Gas systems (Argon, CO2, Helium, Nitrogen…etc)
   6. Specialty Gas Systems (Oxygen, Helium…etc)

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 All natural gas services with a system pressure of 1psig or greater will be considered high pressure. Consult the University of Delaware Energy and Engineering Group if high pressure natural gas piping systems are involved in the project.

1.2 Related Sections:

A. Section 22 05 00– Common Work for Plumbing Systems

B. Section 22 05 01 – Common Requirements for Plumbing Systems

1.3 DESIGN REQUIREMENTS

1.3.1 All valves shall be shown on drawings.

1.3.2 Risers shall have isolation valves between each floor and at each floor branch. All take offs from mains shall have isolation valves.

1.3.3 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.

1.3.4 Provide shut off valves at each equipment connection.

1.3.5 Route all air, gas and vacuum piping in inside concealed spaces (ceilings, walls, chases, shafts…etc).

1.3.6 Flammable and highly reactive gases (Oxygen, Hydrogen…etc) will be specified on a case by case basis. Consult with the Energy and Engineering group if these systems are part of the project.

1.3.7 When designing laboratory gas 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.

1.3.8 For projects in laboratory settings, consult with researchers and technicians to determine their requirements are included in the design.

1.3.9 Vacuum pumps shall be vented so that chemical, biological and radiological waste streams are not entrained into the campus buildings. Consult with the Energy and Engineering Group and the Department of Environmental Health and Safety to ensure proper venting of the exhaust.

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 NATURAL GAS PIPING SYSTEMS, ABOVE GRADE

A. 3” AND LARGER (LOW PRESSURE)

Steel Pipe: ASTM A106 Schedule 80 black.
1. Fittings: butt weld type.
2. Joints: welded. (all joints shall be seal welded)

B. 2-1/2" AND SMALLER (LOW PRESSURE)

Steel Pipe: ASTM A53/A53M Schedule 80 black.
1. Fittings: ASME B16.3, malleable iron.
2. Joints: Threaded

C. NATURAL GAS PRESSURE REGULATORS

Manufacturers:
1. Fisher Regulator.
2. Maxitrol

Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
3. Temperatures: minus 20 degrees F to 150 degrees F.
4. Body: Steel.
5. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
6. Disk, diaphragm, and O-ring: Nitrile.
7. Maximum inlet pressure: 150 psig.
8. Furnish sizes 2 inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

D. NATURAL GAS PRESSURE RELIEF VALVES

Manufacturers:
1. Fisher Regulator
2. Honeywell

Product Description: Spring loaded type relief valve.
3. Body: Aluminum.
4. Diaphragm: Nitrile
5. Orifice: Stainless steel.
6. Maximum operating temperature: 150 degrees F
7. Inlet Connections: Threaded.
8. Outlet or Vent Connection: Same size as inlet connection.

E. NATURAL GAS COCKS

Manufacturers:
1. A. Y. McDonald Mfg Company Series 10558 with integrated handles.
2. Apollo 80 series bronze ball valve designed

Product Description: Natural gas rated, bronze body gas plug valve with built in check and square head.

F. BALL VALVES
1. Manufacturers:
   a. Apollo Valve Company GB Series
   b. Maxitrol BV series
   c. NIBCO Valve Company GB Series

2. NGBA-1: Forged bronze, chrome plated brass ball, brass stem, PTFE glass reinforced seat, nitrile O-ring, red aluminum handle

2.2 INSTRUMENT GRADE COMPRESSED AIR PIPING

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: Union 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 Model: QC00706D with QHPR5-10
   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 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 Energy and Engineering Group as well as all laboratory users of compressed air for selection of large scale compressors.

2.3 INERT GASES PIPING SYSTEMS (ARGON, CO2, HELIUM, NITROGEN…ETC) VACUUM PIPING SYSTEMS – This standard excludes C02 Systems for Beverage Dispensaries.

A. TUBING

1. Copper Tubing ASTM B88, Type K drawn, seamless.
1. Fittings: ASME B16.18 cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

B. UNIONS (PIPE SIZES 2" AND SMALLER)
1. Copper Piping: Class 150, bronze unions with soldered joints.
2. Dielectric Connections: Union 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 Company Series 82
b. Milwaukee Valve Company MG series
c. NIBCO Inc. CS Series

D. CHECK VALVES (PIPE SIZES 2' AND SMALLER) – INERT GASES ONLY
1. Manufacturers:
a. Apollo Valve Company CVB series
b. Milwaukee Valve Company 548 series
c. NIBCO Inc. 480 Series

2.4 VACUUM PUMP

A. Vacuum pump specification shall be determined by the customer (end user) and will developed on a case by case basis.

B. Oil containing vacuum pumps shall be equipped with an oil trap and exhaust filter to remove oil mist from the exhaust.

2.5 SPECIALTY & MEDICAL GRADE GASES PIPING SYSTEMS (Oxygen, Hydrogen…etc)

Specialty gases tubing can be either copper or stainless steel based on the gases flowing through the system and the needs of the end user. Consult with the energy and engineering group when specifying.

A. COPPER TUBING

1. Copper Tubing ASTM B88, Type K drawn, seamless.
2. Fittings: ASME B16.18 cast copper alloy or ASME B16.22, wrought copper and bronze.
3. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

OR

B. STAINLESS STEEL TUBING
1. Stainless Steel Tubing, 1/8 thick wall thickness, seamless.
2. Fittings: stainless steel to match tubing. Swagelock brand stainless steel fittings shall be used within laboratory suites for tubing to individual equipment. Fittings in other applications shall be welded.
3. Joints: orbital welded

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

Consult with the University of Delaware Energy and Engineering Group when specifying ball valves for specialty and medical gas systems.

D. CHECK VALVES (PIPE SIZES 2' AND SMALLER) – INERT GASES

Consult with the University of Delaware Energy and Engineering Group when specifying check valves for specialty and medical gas systems.

E. END DEVICES

End devices for specialty and medical gas systems shall be determined by the customer. Consult with the University of Delaware Energy and Engineering Group.

2.6 LABELING AND IDENTIFICATION

F. 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. Install inert gas systems in accordance with NFPA 99.

B. During brazing or welding of pipe connections, purge interior of pipe continuously with nitrogen.

C. Cut pipe and tubing accurately and install without springing or forcing.

D. Slope piping in direction of flow.

E. Make branch connections in accordance with NFPA 99.

F. Install pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions.

G. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.

H. Install pipe identification in accordance with NFPA 99.

I. Install non-conducting dielectric connections wherever jointing dissimilar metals.

J. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

K. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

L. Group piping whenever practical at common elevations.

M. Slope piping and arrange systems to drain at low points.

N. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

O. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings

P. Provide access doors where valves and fittings are not accessible.

Q. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

R. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

S. Install unions downstream of valves and at equipment or apparatus connections.

T. Install valves with stems upright or horizontal, not inverted.

3.3 INSTALLATION – NATURAL GAS PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54, International Fuel Gas Code and City of Newark Plumbing Code.

B. Provide support for utility meters in accordance with requirements of utility company.

C. Install vent piping from gas pressure reducing valves to outdoors and terminate in weatherproof hood.

D. Install gas pressure regulator vent full size opening on regulator and [terminate outdoors] as indicated on Drawings.

E. Do not terminate gas vents within 10’-0” of any operating exterior door, operating exterior window or intake louver, or follow City of Newark building code, whicherver is more stringent.

3.4 FIELD QUALITY CONTROL

A. Pressure test natural gas piping in accordance with NFPA 54 and City of Newark Plumbing Code.

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

3.5 CLEANING

A. Prior to starting work, verify system is complete and properly cleaned and purged with nitrogen.

B. All welded pipe shall be purged of welding slag and debris prior to pressure test.

END OF SECTION