General Service Compressed Air Piping

1.1 Summary

A. This section includes piping and related specialties for compressed- air systems operating at 150 psig or less. Compressed air usage within Bae Facilities primarily includes but is not limited to the following:
   1. Pneumatics
   2. Machinery
   3. Air bearing moves on large equipment
   4. Breathable air

B. Low-Pressure Compressed-Air: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.2 Definitions

A. MSS: Manufactures Standardization Society
B. ASME: American Society of Mechanical Engineers
C. AWS: American Welding Society
D. Owner: BAE Systems
E. ASTM: American Society for Testing and Materials
F. ASSE: American Society of Sanitary Engineering
G. ANSI: American National Standards Institute
H. MIL SPEC: Military Specifications
I. PTFE: Polytetrafluoroethylene
J. CR: Chlorosulfonated polyethylene synthetic rubber
K. CDA: Clean dry compressed air

1.3 Action Submittals

A. Product Data for the following:
   1. Flexible pipe connectors
   2. Manifolds
   3. Valves
      - Include body, seating, and trim materials, valve design, pressure and temperature classifications, end connections, arrangement, dimensions and required clearances.
   4. Quick couplings
   5. Hose assemblies
   6. Filters
      - Include rated capacities and operating characteristics
   7. Pressure Regulators
      - Include rated capacities and operating characteristics

1.4 Information Submittals

A. Brazing and welding certificates
B. Qualification Data: For Installers
C. Field quality-control test reports

1.5 Closeout Submittals

A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.
B. Record Drawings
C. Pressure Testing Documentation

1.6 Quality Assurance

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualifications.
B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX
C. ASME Compliance:
    1. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.7 Project Conditions

A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:
    1. Notify Owner no fewer than seven (7) days in advance of proposed interruption of compressed-air service.
    2. Do not proceed with interruption of compressed-air service without Owner's written permission.

1.8 Warranty

A. Special Warranty: Manufacturer agrees to repair or replace that fail in materials or workmanship within specified warranty period.
    1. Warranty Period: 1 year from date of Substantial Completion unless otherwise specified by project terms and conditions.

Part 2 - Products

2.1 General

A. All products containing silicone are not acceptable.
B. All products shall be suitable for breathable air.
C. Galvanized or zinc products shall be permitted in cleanrooms

2.2 Pipes, Tubes, and Fittings

A. All positive pressure compressed air piping, tubing, and fittings shall have been manufacturer cleaned, purged, and sealed as for oxygen service, according to CGA G-4.
    1. Each length of tubing shall be delivered plugged or capped by the manufacturer and kept sealed until prepared for installation.
    2. Fittings and other components shall be delivered manufacturer sealed and labeled, and kept sealed until prepared for install
B. Copper Tube: ASTM B 819, Type L seamless, drawn-temper, water tube markers as OXY/MED for medical gas systems.
    1. Wrought-Copper Fittings: ASME B16.22, wrought copper with dimensions for brazed joints.
    2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
    3. Copper Unions: ASME B16.22 or MSS SP-123.
    4. Press-Type Fittings: NOT PERMITTED IN ANY SIZE.
    5. Extruded-Tee Outlets: NOT PERMITTED IN ANY SIZE.
    6. Grooved-End Fittings and Couplings: NOT PERMITTED IN ANY SIZE
C. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
D. Preferred Manufacturers:
    1. Mueller Streamline Co.
    2. Cambridge-Lee Industries LLC

2.3 Joining Materials

A. Brazing Filler Metals: Provide 15% silver solder to braze fittings. Provide certifications for any technicians who will be brazing. AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.
   1. Approved Filler:
      - Canfield Sil-Can 15
      - The Harris Products Group Stay-Silv15

B. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      - Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
      - Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Threaded Joint Material:
   1. White Teflon Tape (PTFE) MIL-SPEC T-27730A.
   2. 16035, POLY-TEMP MD PTFE TAPE.
   3. HARVEY PTFE THREAD SEAL TAPE.
   4. Blue Monster Tape: NOT PERMITTED.
   5. Pipe Dope: NOT PERMITTED.
   6. Threadlock/Loctite: NOT PERMITTED.

2.4 Dielectric Fittings

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
   1. Standard: ASSE 1079
   2. Factory-fabricated, bolted, companion-flange assembly
   3. Pressure Rating: 300 PSIG
   4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.5 Valves

A. 3 Piece Ball Valves:
   1. Standard: MSS SP-110.
   2. Description: Three-piece body, brass or bronze, bronze preferred.
   3. Pressure Rating: 300 psig (2070 kPa) minimum.
   4. Ball: Full-port, chrome-plated brass.
   5. Seats and Seals: PTFE or TFE.
   6. Factory Brazed Male Extensions.
   7. Handle: Lever type with locking device.
   8. Ends: Threaded/soldered/brazed
   9. Stem: Stainless Steel, blowout proof with PTFE or TFE seal
   10. Preferred Manufacturers:
       - Apollo Vavles 82-200 Series
         - Basis of Design: Apollo 82C-240
       - NIBCO
       - Milwaukee Valve Company

B. 2 Piece Ball Valves:
   1. Standard: MSS SP-110
   2. Description: Two-piece body, brass or bronze, bronze preferred.
   3. Pressure Rating: 300 psig (2070 kPa) minimum.
   4. Ball: Full-port, chrome-plated brass or stainless steel.

5. Seats and Seals: PTFE or TFE.
6. Handle: Lever type with locking device.
7. Ends: Threaded and brazed.
8. Stem: Stainless steel or brass, blowout proof with PTFE or TFE seal
9. Preferred Manufacturers:
   - Apollo Valves.
     - Basis of design (hose end): Apollo 70LF-100/200-HC
     - Basis of Design: Apollo 77LF-100/200
   - NIBCO
   - Milwaukee Valve Company

C. Check Valves:
1. Description: In-line pattern, spring loaded, bronze.
2. Seats and Seals: PTFE or TFE
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Factory Brazed Male Extensions or threads
5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

2.6 Flexible Pipe Connectors

A. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: 250 PSIG minimum
2. End Connections, NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections, NPS 2 ½ and Larger: Flanged copper alloy.

B. Available Manufactures: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Flex-Hose Co., Inc.
2. Flexicraft Industries
3. Hyspan Precision Products, Inc.
4. Mercer Rubber Co.
5. Metraflex, Inc.
6. Proco Products, Inc.
7. Unaflex, Inc.
8. Universal Metal Hose; a Hyspan Company

2.7 Specialties

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, “Pressure Vessels”, construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.
1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Line Pressure Regulators: Diaphragm operated, bronze body, direct acting, spring-loaded manual pressure setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

C. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.

D. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.

E. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated.

F. Point of Use Filter/Regulators: In locations where both a filter and a regulator are required a combination filter/regulator shall be used. The filter/regulator shall be supplied with pressure gages on the upstream and downstream sides of the assembly.

1. Basis of Design (South Campus): Wilkerson series B18 for flow up to 150 SCFM and series B28 for higher flows. Metal bowl preferred. 5 Micron Filter.

2. Basis of Design (North Campus): Speedaire series Standard Duty. Metal bowl preferred. 40 Micron Filer

2.8 Quick Couplings

A. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.
B. Approved Quick Couplings – Parker 20 Series
   1. Parkin Hannifin B22 – Male NPT to Femail Coupler
   2. Parker Hannifin B23 – Female NPT to Make Coupler

2.9 Hose Assemblies

A. Description: Compatible hose, clamps, couplings, and splicers suitable for CDA service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.
   1. Hose: Reinforced single- or double-wire-braid, CR-covered hose for compressed-air service. Preferred.
   2. Hose: Flexible nonmetallic hose
      - Preferred only when impractical to use rigid metal pipe or reinforced tubing
   3. Hose Clamps: Stainless-steel clamps and bands
   4. Hose Couplings: Two piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
   5. Hose Splicers: One- piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

Part 3 – Execution

3.1 Piping Applications

A. Use the following compressed-air piping materials between source and point of use for all pipe sizes: ASTM B819 Type L, copper tube; wrought-copper fittings; brazed joints.

3.2 Valve Applications

A. All points of use shall include a BAE isolation valve and filter/regulator with pressure gage. Refer to detail.
B. For piping greater than or equal to 1in: 3 Piece ball valves required unless otherwise approved by owner
C. For piping less than 1in: 2 Piece BAE valves acceptable.

3.3 Piping Installation

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.
C. Install Piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
D. Install piping above accessible ceiling to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
E. Install piping adjacent to equipment and machines to allow service and maintenance.
F. Install air and drain piping with 1 percent slope downward in direction of flow.
G. Install nipples, flanges, unions, transition and special fittings, and valve with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
H. Equipment and Specialty Flanged Connections:
   1. Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.
I. Flanged joints may be used instead of specified joint for any piping or tubing system.
K. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
L. Install piping to permit valve servicing.

M. Install piping free of sags and bends.
N. Install fittings for changes in direction and branch connections.
O. Install sleeves for piping penetrations of walls, ceilings, and floors.
P. Install sleeve seals for piping penetrations of concrete walls and slabs.
Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 Joint Construction

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
B. Remove scale, slag, dirt and debris from inside and outside of pipe and fittings before assembly.
C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    1. Apple appropriate tape to external pipe threads unless dry seal threading is specified.
    2. Damaged Threads: Do not use pipe or pipe fitting with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
D. Brazed Joints for copper tubing: Join according to AWS's "Brazing Handbook". "Pipe and Tube" Chapter.
E. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
F. Dissimilar Metal Piping Material Joints: Use dielectric fittings

3.5 Valve Installation

A. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.
B. Install shutoff valve at inlet to each automatic drain valve, filter, and pressure regulator.
C. Install check valves to maintain correct direction of compressed-air flow to and from compressed- air piping specialties and equipment.

3.6 Dielectric Fitting Installation

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
B. NPS 2 and Smaller: Use dielectric unions or nipples, nipples preferred.
C. NPS 2-1 ½ to NPS 4: Use dielectric flanges.

3.7 Flexible Pipe Connector Installation

A. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.
B. Install Flexible pipe connectors in discharge and inlet piping at air-inlet filter/dryer system and where GN2 piping connects to source.

3.8 Specialty Installation

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors
B. Install air-main pressure regulators in compressed-air piping at or near air compressors.
C. Install air-line pressure regulators in branch piping to equipment and tools.
D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest flow drains.
E. Install coalescing filters in compressed air- piping at or near compressors and upstream from mechanical filters. Mount on wall at locations indicated.
F. Install mechanical filters in compressed-air piping at or near compressors and downstream from coalescing filters. Mount on wall at locations indicated.
G. Install quick coupling at piping terminals for hose connections.
H. Install hose assemblies at hose connections.

3.9 Connections

A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.
B. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

3.10 Hanger and support Installation

A. Vertical Piping: MSS Type 8 or 42, clamps
B. Individual, Straight, Horizontal Piping Runs:
1. 100 Feet or less: MSS Type 1, adjustable, steel clevis hangers
2. Longer than 100 Feet: MSS Type 43, adjustable roller hangers
C. Multiple, Straight, Horizontal Piping Runs 100 Feet or Langer: MSS Type 44, Pipe rolls. Support pipe rolls on trapeze.
D. Support horizontal piping within 12 inches of each fitting and coupling.
E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8 inch minimum rods.
F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1 NPS 1/4: 60 inches with 3/8-inch rod.
   2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
   3. NPS 3/4: 84 inches with 3/8-inch rod.
   4. NPS 1: 96 inches with 3/8-inch rod.
   5. NPS 1-1/4: 108 inches with 3/8-inch rod.
   6. NPS 1-1/2: 10 feet with 3/8-inch rod.
   7. NPS 2: 11 feet with 3/8-inch rod.
   8. NPS 2-1/2: 13 feet with 1/2-inch rod.
   9 NPS 3: 14 feet with 1/2-inch rod.
   10. NPS 3-1/2: 15 feet with 1/2-inch rod.
   11. NPS 4: 16 feet with 1/2-inch rod.
G. Install supports for vertical copper tubing every 10 feet.
H. At point of use, provide support within 6 inches from end piping/assembly. An additional support point shall also be provided within 2 feet of point of use.
I. Galvanized hangers and support shall not be used in cleanrooms.

3.11 Labeling and Identification

A. Comply with requirements as specified in Section 220553 “Identification for Plumbing Piping and Equipment”

3.12 Field Quality Control

A. Perform field tests and Inspections
B. Tests and Inspections
   1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed- air piping with oil-free dry air pressure of 50 psig above system operating pressure, but not to exceed 150 psig. Isolate test source and let stand to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drip in pressure.
   2. Repair leaks and retest until no leaks exist.
   3. Inspect filters and pressure regulators for proper operation
C. Prepare test reports