SECTION 22 1500

COMPRESSED-AIR SYSTEMS

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LANL MASTER SPECIFICATION SECTION

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| Rev. 6 Summary of Changes  Updated Articles *Related Sections* and *References*. Revamped *Submittals* to standardize across piping specifications. Clarified when unlisted component evaluations are required in submittal space. Revised piping, fittings, and components throughout Part 2 to ensure template is ASME B31.9-compliant. Added Article on *Seismic Performance Requirements* in Part 2. Clarified some items in Article *Installation*. Miscellaneous updates throughout to better align with ESM Ch. 6 and Ch. 17 requirements. Updated Part 3 to standardize across other piping sections and other minor editorial changes. |

Word file at <http://engstandards.lanl.gov>

The designer is encouraged to review ESM Chapters 6, 13, and 17.

This template was developed to meet the requirements of ASME B31.9-2020. Use with a different edition will require a detailed review of the code and ESM Chapter 17. Note that some items listed in this section may have pressure or temperature ratings below that of the limits of the scope of the code. It is the designer’s responsibility to select components compatible with the design parameters of the piping system.

**NOTE for systems with pressures greater than 150 psig**: These must be constructed to ASME B31.3, *Process Piping* and this section edited by Design Agency to reflect the requirements of the selected code edition, including verifying that all material specified meets the design pressure/temperature requirements. If designing to ASME B31.3, designer may opt to use 40 0504, *Process Piping*, in lieu of this section.

For compressed air component details, refer to [LANL Standard Drawing](https://engstandards.lanl.gov/Dwgs_Details.shtml) ST-D2090-1, Sheets 1 through 4.

Seismic: To properly edit this section for Project-specific seismic requirements, refer to author notes that say/begin with “Seismic” and the “*Seismic Specification Editing Guide Mechanical Components*” and flowchart posted with the templates for guidance.

This template must be edited for each project. In doing so, specifier must add job-specific requirements. Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer. Once the choice is made or text supplied, remove the brackets. This section must also be edited to delete requirements for processes, items, or designs that are not included in the project—and specifier’s notes such as these. To seek a variance from or alternate method to requirements in the section that are applicable, contact the ESM Pressure Safety [POC](https://engstandards.lanl.gov/POCs.shtml#pressure) and/or Mechanical [POC](http://engstandards.lanl.gov/POCs.shtml#mech). Please contact POCs with suggestions for improvements.

When assembling a specification package, include applicable sections from all Divisions, especially Division 1, General Requirements.

This template was developed for ML-4 projects.  For ML-1, 2, and 3 applications, additional requirements and independent reviews should be added if increased confidence in procurement or execution is desired; see ESM Chapter 1 Section Z10 Specifications and Quality sections.  
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1. GENERAL
   1. SECTION INCLUDES
      1. Requirements for
         1. Air Compressors
         2. Tube
         3. Pipe
         4. Piping Components
         5. Fittings
         6. Valves
         7. Flanges
         8. Installation of Compressed Air Piping Systems applicable to ASME B31.9.

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Seismic: If compressed-air systems are exempt from seismic design, then delete both 01 8734 and 22 0548.23. Otherwise, see the seismic portion of the previous author note.

In the listing below, designer shall eliminate sections that are not applicable to the project.

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* 1. RELATED SECTIONS
     1. Section 01 2500, *Substitution Procedures*
     2. Section 01 3300, *Submittal Procedures*
     3. Section 01 4000, *Quality Requirements - Non-nuclear*
     4. Section 01 4115, *Pressure Safety Submittals*
     5. Section 01 4216, *Definitions*
     6. Section 01 4444, *Offsite Welding, Brazing and Joining Requirements*
     7. Section 01 4455, *Onsite Welding, Brazing and Joining Requirements*
     8. Section 01 4525, *Nondestructive Examination (NDE) Requirements*
     9. Section 01 4631, *Welding, Brazing, and Soldering of ASME B31 Piping*
     10. Section 01 4731, *Flange Assembly for ASME B31 Systems*
     11. [Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*, for requirements pertaining to [manufacturer’s certification] [and] [special certification].]
     12. [Section 05 0520, *Post-Installed Concrete and Grouted-Masonry Anchors – Normal Confidence*]
     13. [Section 07 8400, *Firestopping*]
     14. Section 22 0529, *Hangers and Supports for Plumbing Piping and Equipment*
     15. [Section 22 0548.23, *Vibration and Seismic Controls for Mechanical Systems* for [seismic-design criteria,] submittal requirements, devices for seismic restraint, and installation requirements for these devices.]
     16. Section 22 0554, *Identification for Plumbing, HVAC, and Fire Piping and Equipment*
     17. [Section 22 0713, *Plumbing and HVAC Insulation*]
     18. Section 22 0813, *Testing Piping Systems.*

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In the listing below, designer shall eliminate code and standards that are not applicable to the project and add other code and standards that are. The referenced standards editions are based on the code of record ASME B31.9-2020 and ASME BPVC-2023. If the Code of Record for the project refers to a different version of ASME B31.9 & ASME BPVC, the designer is responsible to update the years/editions for the invoked standards. If the invoked standards editions do not comply with those referenced by the Code of Record, EOR needs to evaluate and verify those for equal or better. For the standards without an edition/year, the latest edition is to be used. In addition, the designer must ensure the code and standards editions align between sections in the project specification package and the project design drawings.

Note: ASCE 7 edition is based on Code of Record IBC 2021.

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* 1. REFERENCES
     1. ASCE 7-[16], *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*
     2. ASME B1.20.1-[2013(R2018)], *Pipe Threads, General Purpose (Inch)*
     3. ASME B16.3-[2021], *Malleable Iron Threaded Fittings Classes 150 and 300*
     4. ASME B16.5-[2020], *Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24 Metric/Inch Standard*
     5. ASME B16.9-[2018], *Factory-Made Wrought Buttwelding Fittings*
     6. ASME B16.18-[2021], *Cast Copper Alloy Solder Joint Pressure Fittings*
     7. ASME B16.22-[2021], *Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings*
     8. ASME B16.34-[2020], *Valves – Flanged, Threaded, and Welding End*
     9. ASME B16.39-[2020], *Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300*
     10. [ASME B31.3-[2022], *Process Piping*]
     11. [ASME B31.9-[2020], *Building Services Piping*]
     12. ASME B40.100, *Pressure Gauges and Gauge Attachments*
     13. ASME BPVC Section VIII, Division 1-[2023], *Rules for Construction of Pressure Vessels*
     14. ASME BPVC Section IX-[2023], *Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators*
     15. ASME BPVC Section XIII-[2023], *Rules for Overpressure Protection*
     16. ASTM A53/A53M-[2012], *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*
     17. ASTM A105/A105M-[2014], *Standard Specification for Carbon Steel Forgings for Piping Applications*
     18. ASTM A197/197M-[2000(R2015)], *Standard Specification for Cupola Malleable Iron*
     19. ASTM A216/A216M-[2007], *Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service*
     20. ASTM A234/234M-[2015], *Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service*
     21. ASTM B68/B68M-[2011], *Standard Specification for Seamless Copper Tube, Bright Annealed*
     22. ASTM B75/B75M-[2011], *Standard Specification for Seamless Copper Tube*
     23. ASTM B88-[2014], *Standard Specification for Seamless Copper Water Tube*
     24. ASTM B280-[2016], *Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service*
     25. ISO 1217, Displacement Compressors – Acceptance Tests
     26. ISO 8573-1, *Compressed air – Part 1: Contaminants and purity classes*
     27. MSS SP-25-[2013], *Standard Marking System for Valves, Fittings, Flanges, and Unions*
     28. MSS SP-72-[2010a], *Ball Valves with Flanged or Butt-Welding Ends for General Service*
     29. MSS SP-80-[2013], *Bronze Gate, Globe, Angle, and Check Valves*
     30. MSS SP-110-[2010], *Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends*
     31. MSS SP-136-[2020], *Ductile Iron Swing Check Valves*
     32. NMAC, New Mexico Administrative Code
     33. UL 404, *Gauges, Indicating Pressure, for Compressed Gas Service*
  2. SUBMITTALS
     1. Submit the following per Section 01 3300, *Submittal Procedures*:
     2. Action Submittals:
        1. Product data: Include the Manufacturer’s name, model number, parts list, and brief description of equipment and its basic operational features — i.e., data sheet, spec sheet, etc. Include air compressor performance data at 7,500 ft elevation (LANL site-specific condition).

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When offsite only, delete submittals below regarding onsite welding. When onsite only, delete submittals below for offsite welding. For high-risk applications such as ML-1 or ML-2, add submittals for “Weld Filler Material Control Procedures” and “Filler Material Certified Material Test Reports CMTRs” when required. Add “Post-Weld Heat Treatment Procedures” when required.

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* + - 1. Per the requirements of Section 01 4444, *Offsite Welding, Brazing and Joining Requirements* and​/or Section 01 4455, *Onsite Welding, Brazing and Joining Requirements*, submit:

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When offsite only, delete submittals below regarding Onsite welding. For high-risk applications such as ML‑1 or ML‑2, add submittals for "Weld Filler Material Control Procedures" and "Filler Material Certified Material Test Reports (CMTRs)" when required. Add "Post‑Weld Heat Treatment Procedures" when required.

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* 1. Welding Procedure Specification (WPS) and supporting Procedure Qualification Record (PQR). [Note: For Onsite welding use of LANL WPS​/PQR is the default; coordinate usage with the LANL CWI; no submittal required]
  2. Welder Performance Qualification Records (WPQR) including continuity [Note: For Onsite, welders are tested by LANL who will produce WPQR and track continuity; this includes brazing, bonding, and fusing; no submittal required]
     + 1. [Per the requirements of Section 01 4525, *Nondestructive Examination (NDE) Requirements,* submit:
       2. Written Practice or Procedure for Qualification and Certification of NDE Personnel
       3. NDE Personnel Qualification Records
       4. NDE Procedures
       5. NDE Procedure Qualification Records (Note: this is not required per ASME B31.9 unless requested by EOR)]
       6. NDE Report(s)
       7. NTIP submitted under Section 01 4525.]
       8. Before fabrication, submit:
          1. Proof of journeyman certificate of competence in accordance with NMAC 14.6.6.11
          2. Leak test plan submitted under Section 22 0813
          3. Cleaning procedures for joint assembly preparation
       9. After fabrication, submit examination records per ASME B31.9 para. 936.3
     1. Informational Submittals:
        1. Spare Parts and Maintenance Materials list
        2. Installation, Operation, & Maintenance Manual
        3. Warranties
        4. Manufacturer’s data report form for ASME pressure vessels (e.g., ASME Form U-1) showing National Board registration.
        5. At closeout: Maintenance Material Submittals
           1. Air compressor inlet air filters, two for each compressor
           2. Belts: [One] [Two] for each belt-driven compressor
  3. QUALITY ASSURANCE
     1. Material and Installation: Conform to ASME B31.9 for systems operating at pressure of 150 psig or less and at temperature of 200 degrees F or less.
     2. Performance of rotary air compressor shall be tested and rated per CAGI (Compressed Air and Gas Institute) rotary compressor performance verification program (ISO 1217).
     3. Air quality classification shall be Class [0],[1],[2],[3],[4] according to ISO 8573-1.
     4. Welders Certification and Qualified Procedure Standards shall be per Section IX of ASME Boiler and Pressure Vessel Code. Welding per Sections [01 4444, *Offsite Welding, Brazing and Joining Requirements* and/or 01 4455, *Onsite Welding, Brazing and Joining Requirements*].
     5. NDE Personnel Certification and NDE Procedures shall be per Section 01 4525, *Nondestructive Examination (NDE) Requirements*.
     6. Valve Identification: Each valve shall bear markings per MSS SP-25, including manufacturer’s name or trademark, the material of construction, and symbols to indicate the service conditions for which the manufacturer rates the valve.
     7. Component identification shall follow [ESM Chapter 1, Section 200, *Item Numbering and Labelling*](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm1). At existing facilities, component labeling conventions are to be continued to be used to avoid confusion.
     8. Design pressure and temperature of piping systems within this Section is provided in the Pressure Safety Implementation Plan, contained in [drawing or document number].
  4. WARRANTIES
     1. Provide a minimum of 1-year manufacturer’s warranty, parts and labor, for air compressor system.

1. PRODUCTS
   1. PRODUCT OPTIONS AND SUBSTITUTION
      1. Alternate products may be accepted; follow Sections 01 2500, *Substitution Procedures* and 01 4115, *Pressure Safety Submittals.*
      2. Proposal of unlisted components as substituted products is strongly discouraged and shall be evaluated per Section 01 2500, *Substitution Procedures*. Substitutions will be allowed only if the Subcontractor can demonstrate that the product can meet the same code requirements of the item specified in the design. Costs associated with evaluation of substituted unlisted components shall be the responsibility of the Subcontractor.
   2. SEISMIC PERFORMANCE REQUIREMENTS

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The seismic exemptions noted below are based on ASCE 7-16. If the Code of Record for the project refers to a different version of ASCE 7, the Designer is responsible to check the seismic design requirements per that applicable edition.

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* + 1. Piping systems with trapeze assemblies/rod hangers that meet the requirements per ASCE 7, Section 13.6.7.3 are seismically exempt.
    2. For piping systems not meeting the above exemption, Structural EOR shall design seismic supports per [ESM Chapter 5, Structural, Section II](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm5); ASCE 7, Chapter 13; and ASME B31.9.

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On Welding, brazing, soldering: When specifying joints, consider that welding, brazing, or soldering reduces the tube rating to the fully annealed condition. Welding, brazing, soldering shall meet Section 01 4631, *Welding, Brazing, and Soldering of ASME B31 Piping.*

On flanges: Use Section 01 4731, *Flange Assembly for ASME B31 Systems*. Use ASME PCC-1, *Pressure Boundary Bolted Flange Joint Assembly*, for ASME B16.5 flanges.

On copper tubing: Designer shall match ASTM spec and the tempers available within that spec to the allowable Conditions listed in ASME B31.9 Table I-1. For example, note that O50 (light annealed) and O60 (soft annealed) may not meet the ASME B31.9 callout for “Annealed” (O61).

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* 1. COPPER TUBING AND FITTINGS (UP TO 2 INCHES)
     1. Copper tubing ASTM [B68] [B75] [B88] [B280], Alloy [102] [122], Temper [O50] [O60] [O61] [O62] [H55] [H58] [H80].
        1. Braze Joints
           1. Fittings: ASME B16.22, wrought copper and copper alloy, solder-joint pressure fittings [and/or] ASME B16.18 cast-copper-alloy solder-joint pressure-fittings
           2. Unions: Copper Tube and Pipe: ASME B16.22, Class 150, bronze unions with soldered joints.
        2. Solder joints
           1. Fittings: ASME B16.22, wrought copper and copper alloy, solder-joint pressure fittings [and/or] ASME B16.18 cast-copper-alloy solder-joint pressure-fittings.

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The use of Nibco Press is only permitted when using oil-free or oil-less air compressors. Viega ProPress is permitted when using oiled compressors with FKM or HNBR sealing elements.

Nibco PressG are compatible regardless of oil content but may require additional approval prior to use. Consult the [ESM Ch. 17 Approved ASME Unlisted Material/Component List and Approval Process](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17) under Chapter References and Resources to see if it is pre-approved without additional evaluation.

* + - * 1. Application is restricted to ASTM B88 hard drawn tubing (Types K & L) or ASTM B280.
        2. Fittings: [Nibco PressG].

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* + - 1. Press joints
         1. Application is restricted to ASTM B88 hard drawn tubing (Types K and L) between ½ and 4 inches nominal.
         2. Fittings: [Viega ProPress with [FKM][HNBR] sealing elements][Nibco Press].
  1. STEEL PIPE AND FITTINGS (UP TO 2 INCHES)

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* + 1. Pipe: Black steel, ASTM A53, Type [E, F, S] grade [A or B], wall thickness [standard wall].
    2. Threaded Joints:
       1. Fittings: ASTM A197 malleable iron, ASME B16.3 threaded type ASME B1.20.1 Class [150] [300].
       2. Unions: Ferrous Pipe: ASME B16.39, malleable iron, threaded unions type ASME B1.20.1 Class [150] [250] [300].
  1. STEEL PIPE AND FITTINGS (GREATER THAN 2 INCHES, UP TO 4 INCHES)
     1. Pipe: Black steel, ASTM A53, Type [E, F, S], Schedule 40 grade [A or B], standard wall.
     2. [Welded Joints: Steel, ASTM A234, Grade WPB, Schedule 40, butt-welding type, ASME B16.9.]
     3. [Bolted Joints: ASME B16.5 forged carbon steel, ASTM A105, Class 150.] Flange hardware per Section 01 4731*, Flange Assembly for ASME B31 Systems.*

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All the following components (disregarding ASME BPVC items) are either standard piping components (listed items) per ASME B31.9 para. 926 or have previously LANL approved unlisted component evaluations in accordance with ASME B31.9 para. 904.7.

The types of components shown may be a non-exhaustive list. Any substitutions or additions shall be ASME B31.9 compliant. All previously LANL approved ASME B31.9 components are available in [ESM Ch. 17 Approved ASME Unlisted Material/Component List and Approval Process](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17) under Chapter References and Resources.

Provide safe access or remote operators where valves and fittings are not exposed or installed over 7 feet in height above finished floor.

Provide ball valves at low points of piping system. Provide ball valves on strainer drain ports.

**Information on valves below are provided for soldered/brazed/threaded/flanged connections. If using press joints, replace applicable entries with information on press joint valves.**

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* 1. VALVES
     1. Ball Valves up to 2 inches.
        1. Manufacturer: Nibco, Series 585-70.
        2. MSS SP-110, [600][250] psi non-shock cold working pressure (CWP) pressure rating.
        3. Bronze, two-piece body, chrome-plated brass ball, full port, Teflon seats and stuffing box ring, blowout proof stem, lever handle, [solder][threaded][press] ends.
     2. Ball Valves above 2 inches.
        1. Manufacturer: Nibco, Series F-510-CS-R-66-FS.
        2. MSS SP-72, one piece carbon steel body, full port ball, ASME B16.5 class 150 flange, 285 psig non-shock cold working pressure (CWP) pressure rating.

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Swing check valves may not be used in reciprocating air compressor service. Swing-type check valves NPS 4 or larger are not recommended for vertical installation.

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* + 1. Swing Check Valves up to 3 inches.
       1. Manufacturer: Nibco 413 Series.
       2. MSS SP-80, Type [1, 2] bronze, horizontal swing, Y-pattern, renewable seat and disc, 200 psig non-shock cold working pressure (CWP) pressure rating, [solder][threaded][press] ends.
    2. Swing Check Valves above 3 inches.
       1. Manufacturer: Nibco F-938-31.
       2. MSS SP-136, Class 150 raised face flanges, ductile iron body, 235 psig pressure rating at 200 degrees F, bolted bonnet, bronze trim.
  1. STRAINER

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Nibco 221 series wye strainers may require additional approval prior to use. Consult the [ESM Ch. 17 Approved ASME Unlisted Material/Component List and Approval Process](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17) under Chapter References and Resources to see if it is pre-approved without additional evaluation.

* + - 1. Manufacturer: Nibco
      2. Model number: [T-221][S-221][PF-221]
      3. Size: [½][\_\_\_\_\_] inch
      4. End connections: [threaded type ASME B1.20.1][solder type][press type]
      5. Mesh perforations: 20-mesh stainless steel wire screen
      6. Pressure rating: minimum 200 psig non-shock cold working pressure (CWP) rating.

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* + 1. Bronze wye-type strainers up to 2 inches.
       1. Manufacturer: Watts
       2. Model number: [LF777][LFS777]
       3. Size: [½][\_\_\_\_\_] inch
       4. Body: Lead Free cast copper silicon
       5. End connections: [threaded][solder]
       6. Mesh/Perforations: [[20][ ]-mesh stainless steel wire mesh liner] [[1/32][ ] inch stainless steel perforated screens]
       7. Pressure rating: minimum 200 psig non-shock cold working pressure (CWP) rating.
    2. Steel wye-type strainers.
       1. Specification: ASME B16.34
       2. Manufacturer: [ANIX][Spirax Sarco]
       3. Model Number: [YS41H5F Series][Fig 34HP]
       4. Size: [1/2][8][ ] inch
       5. Body: ASTM A216 Gr. WCB cast carbon steel
       6. End connections: [butt weld][ASME B16.5 Class 600 flange]
       7. Mesh/Perforations: [ ]
       8. Pressure rating: ASME B16.34 Class [150][300][600]
       9. Temperature range: up to 302 degrees F minimum.
  1. FLEXIBLE CONNECTOR
     1. Manufacturer: [Universal Hose & Braid] [Swagelok]
     2. Model: [Anaconda [model number]] [FM][FJ][FL]
     3. Material: [[Bronze] [Stainless Steel]] braided hose
     4. End connections: [Copper ends conforming to ASME B16.18 and ASME B16.22] [Male pipe thread ends]
     5. Diameter: [ ] inch
     6. Length: [ ] inch
     7. Pressure rating: [ ] psig

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If individual components listed below (Articles *Prefilter, High-Efficiency Coalescing; Afterfilter, High-Efficiency Particulate; Automatic Drain Valve (Zero Air Loss); Oil/Water Separator; Regenerative Air Dryer; Refrigerated Air Dryer (Air Cooled)*) are furnished by the compressor manufacturer as part of a packaged system, those components should be listed in paragraph Compressor Accessories in article *Air Compressor or Packaged System (1/4 to 30 HP)*. The manufacturer (not the vendor) is to provide any line sets required to link the compressor system items.

When selecting filter and housing (Articles *Prefilter, High-Efficiency Coalescing* and *Afterfilter, High-Efficiency Particulate*), assume maximum flow conditions at the minimum operating pressure. Match inlet and outlet connections to system pipe size.

Filters are restricted to bowl-type housings less than 6” diameter without additional approval (up to approx. 3” NPS inlet/outlet connections). Filters larger than 6” diameter shall be ASME Section VIII Division 1 pressure vessels or obtain approval via code-equivalency evaluation.

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* 1. PREFILTER, HIGH-EFFICIENCY COALESCING
     1. Manufacturers:
        1. [Van Air, Housing Series F200, Filter Grade C]
        2. [Pneumatics Products, Housing Series P2001, Filter Grade SU]
     2. High-efficiency coalescing filter efficiency 99.99 percent at 0.6 microns, maximum oil carryover 0.008 ppm by weight, maximum inlet temperature 125 degrees F, maximum clean dry pressure drop 1.50 psid. Housing maximum working pressure 250 psig at 225 degrees F, furnish with optional two-sided color-coded pressure differential indicator, and without internal float drain.
        1. In/Out Connection: [ ] inches [NPT]
        2. Flow Capacity: [ ] scfm at [ ] psig
  2. AFTERFILTER, HIGH-EFFICIENCY PARTICULATE
     1. Manufacturers:
        1. [Van Air, Housing Series F200, Filter Grade RC]
        2. [Pneumatics Products, Housing Series P2001, Filter Grade AF]
     2. High-efficiency particulate filter efficiency 99.99 percent at 0.9 microns, maximum inlet temperature 150 degrees F, maximum clean dry pressure drop 1.50 psid. Housing maximum working pressure 250 psig at 225 degrees F, furnish with optional two-sided color-coded pressure differential indicator, and without internal float drain.
        1. In/Out Connection: [ ] inches [NPT]
        2. Flow Capacity: [ ] scfm at [ ] psig

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Automatic Drain Valves: Gardner Denver AED series and Zeks 2702 series automatic drain valves may require additional approve prior to use. Consult the [ESM Ch. 17 Approved ASME Unlisted Material/Component List and Approval Process](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17) under Chapter References and Resources to see if it is pre-approved without additional evaluation.

* + 1. Manufacturer: [Gardner Denver] [Zeks]
    2. Model number: [ ]
    3. Size: [½][\_\_\_\_\_] inch
    4. Valve Type: [Direct Acting][Internal Pilot Operated Diaphragm][External Pilot Operated Diaphragm]
    5. Electrical connections: [115][230] VAC, NEMA 4 enclosure

For drain valve listed by Van Air below, although approved for use, is not energy efficient.

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* 1. AUTOMATIC DRAIN VALVE
     1. Manufacturer: Van Air
     2. Model: EDV-115
     3. Size: [1/4 inch female NPT] [1/2 inch male NPT]
     4. Valve Type: Solenoid ball valve with integral strainer
     5. Electrical Connections: 115 VAC, Lexan enclosure

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Consult with manufacturers’ representative for application and sizing information.

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* 1. OIL/WATER SEPARATOR
     1. Provide a commercial oil/water separator that will treat condensate waste to discharge no more than 10 ppm of residual oil. Operates at ambient pressure.
     2. Manufacturers:
        1. Atlas Copco, Model OSC
        2. Sullair, SP Series.
  2. REGENERATIVE AIR DRYER
     1. Manufacturers:
        1. Van Air, [Model HLS- ], [HL- ].
        2. Pneumatic Products, DHA/CDA Series, Model [\_\_\_\_\_\_\_\_].
     2. Heatless, regenerative dryer, minus 40 degrees F pressure dew point, solid state controller, twin towers, with adsorbent desiccant, purge exhaust valve and muffler, drain connection and cycle saver control option that adjusts dryer purge to actual moisture load condition and includes failure to switch (FTS) alarm. ASME Section VIII, Division 1 Pressure Vessel Code, “U” stamped. NBIC numbered and registered.
        1. Capacity: [ ] scfm at [ ]psig
        2. Power Voltage: [ ] V, [ ] phase, 60 Hz.

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If specified air compressor is furnished with an integral refrigerated dryer, delete Article *Refrigerated Air Dryer* and specify requirements under Article *Air Compressor or Packaged System (1/4 to 30 HP)*, in paragraph *Compressor Accessories.*

ASME B31.5 does not apply to any self-contained or unit systems subject to the requirements of Underwriters Laboratories or other nationally recognized testing laboratory. Selection outside of this exclusion may require ASME B31.5 piping.

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* 1. REFRIGERATED AIR DRYER (AIR-COOLED)
     1. Manufacturers:
        1. Van Air, [Model RD ].
        2. Hankison, Model [HPR ][HPRN ].
     2. Refrigerated air dryer, air cooled condenser, 35‑38 degrees F pressure dew point, indoor installation (ambient temperature 40‑100 degrees F), automatic drain valve, and charged with [R-134A].
        1. Capacity: [ ] scfm at [ ] degrees F inlet temperature and [ ] psig inlet pressure.
        2. Power Voltage: [ ] V, [ ] phase, 60 Hz.
        3. Inlet/Outlet Connection Size: [ ] inch

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Overpressure relief protection must be provided on Bourdon-tube, dial-indicating pressure gauges that operate at pressures greater than 15 psig by one of the following means:

* Pressure gauges approved per UL 404*.*
* Tempered safety glass, plastic, or shielded face, AND a blowout back or plug.

Pressure gauges that serve primarily a pressure indication for over pressure protection (i.e., not used for process data collection) should have a range of at least 1.25 times, but no more than twice the set pressure of the relief device as recommended in ASME Section VIII, Div. 1, Nonmandatory Appendix M, Para. M-14.

Refer to manufacturer’s recommendations for pressure ranges. Generally, a range of twice the expected normal operating pressure is recommended, with a maximum working pressure not exceeding 75 percent of the range.

Provide pressure gage on discharge piping from each air compressor and on each receiver tank. Consider the need for temperature measuring devices during design as well.

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* 1. PRESSURE GAUGE
     1. Manufacturer: Ashcroft, Type 1009
     2. Gauge: ASME B40.100, Accuracy Grade 1A, minimum 2-1/2 inch dial, 1/4 inch NPT brass bottom connection, phosphor bronze bourdon tube, maximum plus or minus 1 percent accuracy full scale, stainless steel case, process temperature limit of -40 degrees F to 250 degrees F, and with stainless steel tube.
     3. Required options: Dry gauge, pressure relief blowout plug, acrylic or shatter-proof glass
        1. Range: [ psi] [per drawings].
        2. Required options: Dry gauge, pressure relief blowout plug, acrylic or shatter-proof glass
        3. [Isolation Valve: ¼ inch brass plug, minimum 250 psi working pressure valve. Manufacturer: \_\_\_\_\_\_\_Part No.\_\_\_\_\_\_\_\_]
  2. PRESSURE REGULATORS
     1. Manufacturer/Model: [Norgren [11-002 series], Part Number: [ ] ] [Swagelok K Series, Part Number: [KPR‑AGJA415C2000]
        1. Design Description: Maximum [500] psig inlet, 0- maximum [45] psig outlet
        2. Inlet Size: [¼ in]
        3. Outlet Size: [¼ in]
        4. Cv: [0.20]
        5. Maximum Inlet Pressure: [500 psig]
        6. Outlet Control Range: [0 to 250] psig
        7. Location: Above grade
        8. Assembly Methods: ASME B1.20.1 NPT threads
  3. DEW POINT TEST FITTING
     1. Manufacturer: Pete’s Plug
        1. 316 stainless steel, ¼ inch, suitable for use in 150 psig systems. Provide extra-long (XL) plug when pipe insulation exceeds 1 in. thickness.

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Overpressure protection shall meet the requirements of [ESM Ch. 17, Section PS-REQUIREMENTS](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17), 8.5 and 8.6. See also Attachment GUIDE-1 for guidance on performing overpressure protection evaluations for compressed air systems.

Note that if a compressed air receiver is included as part of an off-the-shelf compressed air package, there will be a manufacturer-specified and installed relief device and the piping system designer is not responsible for the sizing of this valve. However, the designer is responsible for ensuring this relief valve (1) would limit system pressure with ASME code scope limits (150 psig for ASME B31.9) and (2) would sufficiently protect any downstream piping components from exceeding their pressure rating. Supplemental overpressure protection on the downstream piping is often necessary to stay within ASME B31.9 code scope because it is common for compressed air packages with air receivers to include a relief valve set in the 165-200 psig range.

Common relief device manufacturers for compressed air service include Kingston, Control Devices, Conrader, and Aquatrol.

Relief device shall be installed in a location that relieves away from personnel.  
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* 1. COMPRESSED AIR RELIEF VALVES
     + 1. Manufacturer/Model: [Kingston Valves KSV25-2-45][Control Devices SW10]
       2. Description: [stainless steel][brass] ASME Section XIII “UV” stamped relief device
       3. System Application(s): Compressed Air
       4. Inlet Size: [¼ inch][1 inch]
       5. Set Pressure: [45 psig]
       6. Location: Above grade. Installation location shall be indicated on design drawings.
       7. End connections: [NPT]
       8. Manufacturers rating: [69] SCFM air
  2. AIR RECEIVER
     1. Manufacturer: [Hanson Tank] [Compressor Manufacturer]
     2. Carbon steel tank built and tested to ASME Section VIII, Division 1 Pressure Vessel Code, “U” stamped. NBIC numbered and registered.
        1. Configuration: [Vertical] [Horizontal] tank with ring base and standard, screw or flange inlet and outlet connections with factory exterior prime coat.
        2. Size: [ ] gallons, rated at [ ] psi, [ ] diameter x [ ] long.
        3. [Seismic Design Category [D]]

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Consult with manufacturer’s representative, commercial guide specs, and the [LANL ESM Chapter 6 Mechanical](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm6) when editing the article below. Verify compressor capacity (discharge pressure and flow rate) can meet the pressure and flow demands at LANL elevation of 7,500 ft. Furnish compressors with an after cooler, mechanical separator and an intake air filter silencer. If sound control is a factor, an intake filter silencer, muffler or sound enclosure may be required. Furnish duplex compressors with hour meters. For air compressors of greater than 30HP, a separate section for air compressors may be used.   
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* 1. AIR COMPRESSOR OR PACKAGED SYSTEM (1/4 THROUGH 30 HP)
     1. Manufacturer:
        1. [Atlas Copco]
        2. [Sullair]
        3. [Ingersoll Rand]
        4. [Quincy]
        5. [other]
     2. Compressor:
        1. Types:

[Reciprocating single or two stage] [rocking piston type] [diaphragm type] [lubricated, non-lubricated or oil less].

[Rotary vane type- oil lubricated] [rotary screw type- oil lubricated or oil less],[rotary scroll type-oil lubricated or oil less].

* + - 1. Controls: [Constant speed- start stop controls] [variable speed controls].
      2. Drives: [Electric motor-V belt drive or gear drive or direct drive] [diesel engine- V belt drive or direct drive] or [ ]
      3. Mounting: [Base mounted] [tank mounted] [portable].
      4. HP: [ ] HP, [ V/phase].
      5. Discharge pressure: [ ] psig rated for 7,500 ft elevation.
      6. Delivery capacity: [ ] scfm (14.5 psia, 68 degrees F and 0 percent relative humidity).
    1. Others: [Diagnostic control devices-high air temperature shutdown, low oil level shutdown], [belt guard], [intake filter], [after cooler], [motor starter].
    2. Compressor Accessories (components furnished by the compressor manufacturer):
       1. [Refrigerated air dryer]
       2. [Filters]
       3. [other]

1. EXECUTION
   1. PREPARATION
      1. Square, ream pipe and tube ends. Remove burrs.

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Consult manufacturer’s recommendation for the use of acids and cleaning agents to prevent damage.

Ensure safeguards are taken to protect personnel from hazards of cleaning, which may include but not be limited to flying particulates, corrosive chemicals, and harmful vapors.

A suitable chemical and/or mechanical cleaning method shall be used, if necessary, to clean all surfaces to be fabricated.

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* + 1. Cleaning:
       1. Remove scale and dirt on inside and outside before assembly.
       2. Cleaning will consist of removing all non-adhering material such as loose scale, sand, weld spatter particles, rust, cutting chips, grinding residue, etc. from the inside of the piping assembly by suitable means. This level of cleaning will allow the presence of mill scale and surface rust.
       3. [specify any special cleaning requirement]
    2. Prepare piping connections to equipment with flanges or unions.
    3. Fastener materials shall be free of nicks, burrs, chips, dirt, and damage (inspect threads, shank, and nuts). All damaged fasteners must be replaced.
  1. INSTALLATION
     1. General:
        1. Install piping in conformance with ASME B31.9.
        2. Follow the equipment manufacturer’s installation requirements.
        3. [Install compressor unit on concrete housekeeping pad.]
        4. [Install compressor unit on vibration isolators. Level and bolt in place. See [Section 05 0520, *Post-Installed Concrete and Grouted-Masonry Anchors – Normal Confidence*] [drawings] for anchors.]
        5. Install air piping/tubing with a slope of at least 1 inch per 100 feet or less downward in direction of flow.
        6. Install piping to maintain headroom and neither interfere with use of space nor take more space than necessary.
        7. Group piping whenever practical at common elevations.
        8. Label piping system per Section 22 0554, Identification for Plumbing, HVAC and *Fire Piping and Equipment*.
        9. [Insulate piping system per Section 22 0713, *Plumbing and HVAC Insulation.* Provide clearance for installation of insulation and access to valves and fittings.]
        10. Install piping hangers and supports per Section 22 0529, *Hangers and Supports for Plumbing Piping and Equipment.*
        11. [Sleeve and caulk pipes penetrating exterior walls or interior bearing walls. Provide waterproof installation for exterior walls. Provide UL/FM approved through-penetration firestop system when penetrating fire rated barriers (e.g., walls, floors, etc.). See Section 07 8400, Firestopping.]
        12. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
        13. Provide clearance for installation of insulation and access to valves and fittings.
        14. Provide access where valves and other equipment are not exposed.
        15. Install valves with stems upright or horizontal, not inverted.
        16. Install gauges vertically.
        17. Install branch take-offs to outlets from top of main, with shutoff valve after take-off.
        18. Provide drip legs and drain traps at end of each main and branch and at low points of piping system.
        19. Keep open ends of pipe free from scale and dirt. Whenever work is suspended during construction, protect open ends with temporary plugs, caps, or residue-free tape.
        20. Route condensate drains to the oil/water separator. Route drain from the oil/water separator to the nearest floor drain.
        21. Install compressed air couplings, female quick connectors, and pressure gages [where branch outlets are indicated] [as indicated on drawings].
        22. Install flexible connections for [\_\_\_\_\_\_\_\_\_] where shown on drawings.
     2. Welding, brazed, or soldered joints:
        1. Welded, brazed, or soldered joining of piping/tubing and components shall be per Section 01 4631, *Welding, Brazing and Soldering of ASME B31 Piping*.
        2. When brazing/welding or soldering piping/tubing to a valve, follow manufacturer’s instructions to prevent heat damage to valve internals.
     3. Press joints:
        1. Assemble press joints per manufacturer installation instructions using the tooling required by the manufacturer.
           1. [Installation Manual Viega ProPress®, www.viega.us, latest edition]
           2. [NIBCO® Press System ® — Installation Instructions, www.nibco.com, latest edition]
     4. Threaded joints:
        1. Assemble ASME B1.20.1 threaded pipe joints as follows:
           1. No more than six and no less than two threads visible after makeup of the joint.
           2. No severe chipping or tearing of visible threads.
     5. Bolted joints:
        1. Assemble flanges per Section 01 4731, *Flange Assembly for ASME B31 Systems.*
  2. EXAMINATION, INSPECTION, AND TESTING
     1. All welding, brazing, and soldering: Inspected, examined, and tested in accordance with Section 01 4631 *Welding, Brazing, and Soldering of ASME B31 Piping* [and Section 01 4525 *Nondestructive Examination* (*NDE) Requirements*].
     2. Externally the pressure system will be free of weld slag, flux, and weld spatter.
     3. Contact the LANL Owners’ Inspector to determine the initial inspection points (minimum hold points).
     4. LANL Owner’s Inspector shall have access to any and all design, fabrication, manufacture, fabrication, heat treatment, assembly, erection, examination, testing, records, documentation and other project information or activities to verify that all required examinations and testing have been completed and to inspect the piping to the extent necessary to be satisfied that it conforms to all applicable examination requirements of the Code and of the engineering design and to perform the role defined in ASME B31.3.
     5. LANL Owner’s Inspector is the final authority on acceptance of the project examination or test.
     6. Examination activities to verify the quality of the work must be performed by persons other than those who performed the activity being examined. Such persons must not report directly to the immediate supervisors responsible for work being examined.
     7. The fabrication documentation must have evidence of the examination, the evidence must be maintained in the pressure system documentation package submitted to the pressure safety officer.

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ASME B31.9 does not specify a minimum test pressure beyond the “not more than 10 psig” preliminary test pressure required by para. 937.4.3. See ASME B31.9 Interpretations B31.9-18-01 and B31.9-18-02 for more information.

However, LANL requires that the test pressure be, at minimum, the normal operating pressure for the system.

Leak testing of the connections between existing piping and new piping defined below are based in [ESM Ch. 17](https://engstandards.lanl.gov/ESM_Chapters.shtml#esm17) Section PS-REQUIREMENTS 10.3, *Pressure and Leak Testing*.

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* + 1. Pressure test piping system per Section 22 0813, *Testing Piping Systems,* at the test pressures and durations listed below.
       1. Compressed Air (Less than 150 psig design pressure)
          1. Test with air at [ ] psig per ASME B31.9, paragraph 937.4, holding test pressure for at least [10] minutes. After [10] minutes, reduce to the lower of operating or design pressure before checking for leaks.
       2. [Instrument Air (Less than 150 psig design pressure)]
          1. [Test with air at [ ] psig per ASME B31.9, paragraph 937.4, holding test pressure for at least [10] minutes. After [10] minutes, reduce to the lower of operating or design pressure before checking for leaks.]
       3. For modifications to existing piping test the connection between new and existing at normal operating pressure. Bring system up to operating pressure gradually. Visually examine the piping for leaks at one-half the system operating pressure. Perform a final examination at the system operating pressure. No leaking from the piping indicates that the system meets the requirement of the project.

END OF SECTION

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Do not delete the following reference information:

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THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification Section 22 1500 Rev. 6, dated January 8, 2025.