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RECORD OF REVISIONS

Rev	Date	Description	POC	RM
0	9/17/2014	Initial issue. Revision of material formerly in Section I	Ari Ben Swartz,	Larry Goen,

		Rev. 3 Article 12.0.	*ES-EPD*	*ES-DO*

Contact the Standards POC for upkeep, interpretation, and variance issues.

Chapter 17	**Pressure Safety POC and Committee**

This document is online at http://engstandards.lanl.gov

Procurement, Fabrication, and Assembly

A. General

1. Vessels must be code-fabricated and code-stamped; however, if required design features prevent code compliance, then follow the Non-Code Vessels section of this document.
    a. LANL Master Specification 43 4113 *Gas and Liquid Pressure Vessels* must be used for design/build procurements of pressure vessels. This specification is applicable both to new acquisitions and to modification or repair work to existing pressure vessels.
2. In addition to meeting and citing all other applicable procurement requirements in this document, procured pressure systems and components must shall the following where applicable, and documentation must be received with documentation from the manufacturer (ideally) or supplier showing proof of compliance. Documentation must be maintained in the pressure system documentation package.
    a. Applicable ASME code inspection and testing documentation.
    b. Cleanliness level oxygen/oxidizer components must be 175A or cleaner as specified in this document and ASTM G93.
    c. Welding specification, including inspection, and testing, where applicable.
    d. Operating conditions
    e. Loadings (snow, wind, seismic, etc.) as found in ESM Chapter 5.
    f. Purchased systems and custom systems must be built to the most applicable ASME code

B. Procurement Review (ASM Form 410)[1]

1. If the CSPO or designee determines that his/her review of proposed procurements is necessary to ensure that requestors/TSMEs are aware of and properly execute this chapter's requirements, then LANL ASM Form 3041.00.0410 "Goods or Services Requiring Internal Review & Approval" shall contain such requirements at CPSO discretion.

2. Requestors of relief devices will normally be expected to provide all the information in attached Form ADMIN-3-FM01, Relief Device Procurement Pre-approval. *For relief devices, the CPSO review should check such things as:*

   a. the pressure system is in the database

   b. the relief device flow is greater than the regulator flow,

   c. the relief inlet size is equal to or larger than the connection to the system,

   d. the set pressure is less than or equal to the system MAWP, and

   e. bench stock relief devices are purchased as ASME-stamped valves.

3. For pressure vessel procurements, purchase must require (a) NBIC numbering and registration and (b) manufacturer's data reports (see Section ADMIN-2 for other pressure vessel requirements).

C. Fabrication of New System

1. Appendix M contains the Pressure System Owner Checklist to assist the System Owner, PSO, Owner's Inspector, and Examiner fabricate a new system and identify the required inspections and evaluations.

2. Special requirement exist to use thermoplastics with flammable materials, see ASME B31.3 A323.4.2(a)(1).

3. PVC or CPVC shall not be used in compressed air or other compressed gas services, see ASME B31.3 A323.4.2(a)(3).

[1] Procurement review was successfully used at SRS for decades to ensure that new systems meet pressure safety program requirements, and maintenance of existing systems maintains configuration control of certified systems. Form 410 (3041.00.0410) can be found at https://asmdocs.lanl.gov/docs/Forms%20%20General/Forms/AllItems.aspx, directly here. Rev 18, 6/20/14, stated: Pressure Vessels & Systems:
- Power Boilers
- Heating Boilers
- Commercial Water Heaters
- ASME Section VIII Stamped pressure vessels
- Non-ASME-code-stamped pressure vessels
- Manufactured pressure systems other than ASME code stamped boilers and heaters
- Leased LANL-operated air compressors with tanks greater than 6 inches in diameter
- DOT vessels intended for permanent installation in a pressure system
- Relief Devices: safety relief valves, relief valves, and rupture discs

D. Rupture Disk Procurement

1. Where reverse buckling rupture disks must be procured, procure only rupture disks that have a damage ratio ≤ 1.0.

E. Relief Valve Pre-Testing

1. Prior to installation, new pressure relief valves must be independently tested to ensure the set point is correct as specified when ordered[2]. Such testing is not required if:[3]
   a. PRV setpoint adjustment is sealed by supplier and seal is unbroken, or tamper-proof and supplier meets the code of construction requirements.
   b. The supplier is on the LANL qualified suppliers list (IESL, internal: here)[4] or approved by the CPSO.
      1) Guidance: CPSO approval listing is posted at ES-Division Pressure Protection Program homepage (internal here).
   c. If testing is required, it must be performed in accordance with this document, and the applicable portions of ASME PTC-25, and then sealed.

F. Rental Pressure Systems

1. Rental pressure systems must be maintained in accordance with the applicable laws and national consensus codes and standards by the vendor owner.[5] Documentation must be made available upon request.
2. Rental pressure systems must be verified maintained by the owner.

G. ASME Code-Stamped Boilers and Vessels

1. See Section ASME of this chapter.
2. Controls, safety devices, and gas train shall comply with CSD-1 *Controls and Safety Devices for Automatically Fired Boilers*.
3. Boilers with fuel input rating greater than or equal to 12,500,000 Btu/hr fall within the scope of NFPA 85, *Boiler and Combustion Systems Hazard Code*.

H. Non-Code Vessels

1. Procurements of non-code stamped vessels must be reviewed by CPSO.[6]
   a. Vessel MAWP and over pressure protection is sufficient to achieve code equivalent protection from over pressurization.
   b. Design, and inspection documentation is readily available (weld inspection, pressure tests, etc.).

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[2] This requirement became effective Sept 2010
[3] Contact MSS division for relief device testing capabilities. API recommended practice; experience of need at NASA, SRS, Y-12; and commercial nuclear practice.
[4] If the supplier is on the IESL, they have a quality pedigree for ML-1/2 nuclear safety and are therefore a trusted supplier; however, any PRV used for nuclear safety may warrant verification of setpoint and other attributes nevertheless.
[5] Captured by LANL ASM Form 410 (3041.00.0410) Goods and Services Requiring Internal Review and Approval, also see this topic higher in this Section.
[6] Ibid.

c. Have calculations and documentation generated indicating the minimum wall thickness requirements to justify the MAWP.

2. For on-site fabrication, calculations (weld, MAWP, wall thickness, etc.) must also be submitted to the CPSO prior to fabrication.

I. Flexible Hoses and Flexible Tubing Procurement

1. Flexible hoses must not be procured without end connectors attached by the manufacturer.

2. Flexible hoses must be procured from the manufacturer with the MAWP stamped, or etched, or tagged on the hose or end connectors indicating the maximum allowable working pressure of the assembly.

3. Flexible hoses must not be assembled or repaired, except by manufacturer.

J. Tagging and Labeling

1. Tag/label all piping and components as shown on the system schematic. Follow ESM Chapter 1, Section 200.

K. Welding, Brazing, and Soldering

1. Welding, brazing, or soldering on pressure systems, piping, and components that are within the scope of this program must comply with the applicable ASME BPV or B31 codes. Proof of ASME compliance must be accomplished by documenting the following:

   a. Welder qualifications as defined by the applicable code and ESM Chapter 13.

   b. Welding procedure specifications (WPS) as defined by the applicable code and ESM Chapter 13.

   c. Inspection, examination, and testing, (e.g. radiography, dye penetrant, or pressure qualification test) as defined by the applicable code of construction, to include other requirements defined in ESM Chapter 13.

2. Welding procedures and personnel must be certified for the application that they are performing through the LANL welding program, as defined by ESM Chapter 13. See also LANL Master Specification Sections 01 4444 and 01 4455 on welding.

3. Fabrication shops that do not possess an ASME "U" authorization, regardless of individual personal training, qualifications, and certifications, must not be considered equivalent to Code-certified shops and hence must only perform non-Code welding.

4. Welding on pressure systems or components must be inspected as mandated in the applicable ASME BPV or B31 codes by a certified inspector as defined in ESM Chapter 13.

5. Welding/brazing qualifications must conform to the ASME Section IX, "Welding and Brazing Qualifications," and the requirements of ESM Chapter 13.

6. On-site welding must be performed by welders that are currently certified, having completed testing and qualification in accordance with ESM Chapter 13, GWS 1-05, *Welder Performance Qualification/Certification*.

7. When welded joints (e.g., orbital, butt welding) are used, all welds must have examination records as required by "Inspection, Examination, and Testing" Chapter VI of ASME B31.3 or ASME B31.1 as appropriate, and must be traceable by one of the two following methods:
   a. A weld number referenced on the system drawing or sketch and pertinent information for each weld (weld map).
   b. A stamp traceable to the welder along with examination records.
8. Welding inspection, examination, and testing records must be maintained in the pressure system documentation package.

L. Piping and Tubing

1. Bending of tubing/piping must be performed such that there is no wrinkling, stretching, or ovaling of the tubing. Use of tubing mandrels for thin walled tubing is mandatory.
2. Sand, beads, or other abrasive material must not be used to accomplish uniform bends for pressure system tubing/piping.
3. Tubing that is anchored to beams of dissimilar material properties in temperature varying environments (e.g., stainless steel tubing braced to a carbon steel I-beam on the exterior of a building) must have the flexibility needed for thermal expansion/contraction.
4. Use of tube cutting wheels is discouraged (but not prohibited) for stainless steel tubing.
5. Tubing must be prepped by interior and exterior reaming prior to fitting makeup. The end face of the tubing must be flat as possible and without sharp edges after reaming.
6. For such installations, follow LANL Master Spec Sections 40 0511 and 40 0527.

M. Cleaning

1. Components, piping and tubing specified for oxygen or oxidizer service must be cleaned as specified in this document, prior to assembly, and must be assembled in a manner that maintains cleanliness.
2. Pressure systems must be considered for cleanliness requirements. All components must be cleaned to an acceptable level which removes contaminants that could lead to system failure or contamination.

N. Alignment

1. Twisting or distortion of piping or components, to bring into alignment, which introduces strain in the equipment, is strictly prohibited.
2. For flanges, faces and bolt holes must be aligned per B31.3, paragraph 335.
3. Prior to assembling any joints to be cold sprung, supports and anchors must be examined to ensure that required movement is allowed by the supports, and that undesired movement is controlled.

O. Flanged joint assemblies:[7]

1. Flanges must be replaced whenever any damage has been caused to the sealing surface that prevents the gasket from sealing. Excessive torque beyond torque specifications to achieve a leak free seal is strictly prohibited.
2. Torque up of flange bolts must be that which is defined by calculation or as determined by industry torque-table values, and must be defined in assembly instructions.
3. Bolted flanges must be re-torqued no less than 24 hours after initial torque following assembly, and prior to any leak checks or pressure verification tests.[8]
4. Nuts must have full thread engagement on the bolts or studs. One to two exposed threads is the preferable amount that defines full thread engagement. The minimum acceptable engagement is the outer edge of the nut being not less than flush with the end of the bolt or stud.[9]

P. Threaded Joints

1. Threaded fittings must be lubricated with lubricant that is compatible with the system fluid (e.g., halocarbon, hydrocarbon, fluorocarbon, etc.) prior to assembly to prevent galling and friction welding.

Q. Tubing Joints

1. Flareless and compression tubing joints must be assembled per the manufacturer's instructions. Where the manufacturer specifies a specific number of turns for the nut, these must be counted from the point at which the nut becomes finger tight.
2. For Swagelok installations, follow LANL Master Spec Sections 40 0511 and 40 0527.
3. Flared tubing must be visually inspected for surface pits, and splits prior to assembly. Use of a "Go, No-Go" gauge for flare sizing is highly recommended.
4. Flared tubing with imperfections in the flare must be rejected.

R. Oxygen and Oxidizing media components cleanliness requirements10

1. General requirement
   a. This section is applicable to both liquid oxygen (LOX) and gaseous oxygen (GOX) systems and other similar oxidizing agents (e.g. N_2O_4, HNO_3, etc.)
   b. Oxygen systems shall be designed (including materials selection), tested, cleaned, and assembled in accordance with ASTM G128 and other referenced ASTM standards. The design, testing, cleaning, and assembly shall be documented as an oxygen hazards analysis and shall be approved by the CPSO. The system shall be evaluated to reduce the likely hood of fire.
   c. If no oxygen hazards analysis is performed then components installed into oxygen or oxidizer fluid systems must be cleaned to a level equal to or better

[7] Ibid.
[8] Accommodate material relaxation. Industry good practice.
[9] LANL ASME B31.3 Process Piping Guide ESM Chapter 17 Section REF-3
[10] ASTM G 93

than 175A as defined in ASTM G93 para. 11.4.3, where the nonvolatile residue remaining after cleaning is less than 1 mg/ft^2, and the particulate count is less than the following where "X" is the size of the particles counted:

Number of Particles Allowed	Size Range (µm/100 mL)*
0	X > 175
1	100 < X < 175
5	50 ≤ X < 175
20	X < 50
5	Fibers
**100 mL refers to the amount of solvent fluid (e.g. de-ionized water, isopropyl alcohol, HFE 7100, etc) that is used to flow through, or around the components (or tubing and fittings) to collect the particulate and non-volatile residue (or total carbon) samples described in ASTM G93.*	

d. Oxygen/oxidizer pressure systems must be disassembled for cleaning. Each component must be cleaned prior to assembly. Non-volatile cleaning agents may remain in trapped spaces, which could react with oxygen. Cleaning solutions may degrade non-metals in an assembly. Caustic and acid cleaning solutions may cause crevice corrosion in assemblies.

e. Any method of cleaning may be utilized provided that cleaning method meets, or exceeds the requirements as defined in ASTM G93 for level 175A.[11] Components may be cleaned by the manufacturer.

f. Components must be maintained clean during the assembly/construction process.

g. Oxygen-compatible lubricants should be applied after component cleaning

h. Components cleaned for oxygen service must not be left in the open, unprotected. Care should be taken to avoid contamination of particulate and oil deposits on surfaces that will be in direct oxygen service.

i. Components cleaned for oxygen service must be handled with clean gloves or handling devices to maintain oil-free cleanliness of component.

2. If no oxygen hazards analysis is performed, then the following cleaning procedures are required:

a. The cleaning method used must incorporate three cleaning steps as defined in ASTM G93 as follows:

1) Precleaning – removal of gross contaminants

[11] Refer to ASTM A 380 which describes cleaning, descaling, and passivation of stainless steel parts, equipment and systems.

2) Intermediate cleaning – use of alkaline salts, detergents, acids, or caustics to remove solvent residues and residual contaminants.

3) Final cleaning- removal of minute contaminants, in a clean room environment. Includes drying/purging and packaging to protect components from re-contamination.

b. Cleanliness verification must be documented and maintained in the pressure system documentation package.

3. If no oxygen hazards analysis is prepared the following packaging is required:

a. All packaging used to for cleaned components must be as clean as, or cleaner than the clean level specified for the component. Packaging must be clearly marked in accordance with ASTM G93 para 12.2, "Package Marking."

b. Cleaned components that are not bagged/wrapped must be plugged/capped with plugs/caps that are as clean or cleaner than 175A.

4. If no oxygen hazards analysis is prepared the following assembly is required:

a. Where applicable, all components cleaned for oxygen service must be handled with clean, lint free gloves to prevent contamination to the fluid surfaces of the component.

b. Components must be maintained clean to the maximum extent possible during the assembly process.

c. Care must be taken to minimize the potential for contamination

d. Only use of oxygen compatible grease is authorized for thread lubrication. A listing of tested materials is available in ASTM G63.

e. PTFE tape is authorized for NPT fittings cleaned for oxygen service. Ensure that the tape is applied so that it does not extend into the flow path[12].

f. Ensure all tubing has been pre-fabricated, properly de-burred and cleaned prior to assembly.

g. Ensure all weld slag has been removed from interior of lines.

h. After assembly and before wetting the system with oxygen, purge the system using clean, dry gaseous nitrogen to remove assembly generated contaminants through the system or to a benign location.

FORMS

Form ADMIN-3-FM01, Relief Device Procurement Pre-approval

[12] ASTM G93