

# MSC Guidelines for Fluid Power and Control Systems

Procedure Number: E1-12

Revision Date: 07/28/2010



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## References

- a. 46 CFR Part 56.60 Piping Systems and Appurtenances (Subchapter F)
- b. 46 CFR 58.30 Fluid Power and Control Systems (Subchapter F)
- c. 46 CFR 119.700 - 119.730 Piping Systems (Subchapter K)
- d. 46 CFR 182.700 - 182.730 Piping Systems (Subchapter T)
- e. 46 CFR 128.240 Hydraulic or Pneumatic Power and Control (Subchapter L)
- f. G-MSE Policy Letter dated April 9, 2002, "Use of Nonmetallic Flexible Hose on Subchapter T Small Passenger Vessels"

## Contact Information

If you have any questions or comments concerning this document, please contact the Marine Safety Center (MSC) by e-mail or phone. Please refer to the Procedure Number: **E1-12**

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## Applicable to All Vessels

## General Guidance

- Documentation must be provided for the pressure containing components (directional control valves, manifold assemblies, cylinders, etc) to indicate that the components are suitable for the system design pressure. Test documentation or manufacturer's documentation is suitable for this purpose.
- Provide details of the deck and bulkhead penetrations to indicate the arrangements maintain the integrity of the structures.
- Demonstrate that the system will perform its intended function. This can be done by submitting system information, such as an operator's manual, or by providing an analysis of the hydraulic schematic and valve alignment table.
- Provide calculations for pins, linkages and other mechanical components as warranted indicating the mechanical components will withstand and/or transmit the forces generated at maximum allowable working pressure (MAWP) without damage.

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## General Guidance (continued):

### Vessels Subject to 46 CFR Subchapter F (Marine Engineering)

- ❑ Fluid power and control systems listed in 46 CFR 58.30-1(a) must comply with the requirements of 46 CFR 58.30-5 through 58.30-40, as addressed by this document.
- ❑ Tubing, piping, valves, flanges, and fittings shall conform to the material specifications and design standards listed in 46 CFR Table 56.60-1(a) or Table 56.60-2(a) or they may be selected from the applicable material specifications of sections I, III, and VIII of the American Society of Mechanical Engineers (ASME) Code. The bill of materials shall include pipe size, wall thickness, material specifications, design standards and pressure class, as appropriate. (46 CFR 58.30-15(b))
- ❑ Flexible nonmetallic hose and fittings shall conform to the Society of Automotive Engineers (SAE) J-1942 and J1475 specifications. Hoses shall be used only where flexibility is required and shall not exceed 30 inches in length, except where otherwise necessary for proper operation. Provide documentation demonstrating that any lengths exceeding 30 inches are required to facilitate proper operation of machinery. Hoses must be of adequate pressure rating for the installation. (56.60-25(b))
- ❑ Piping MAWP or wall thickness shall be determined in accordance with the following : (58.30-15(d))

1) Calculate:  $\frac{\text{Outside Diameter}}{\text{Wall Thickness}}$

- a) If this value is greater than 6, the MAWP and minimum thickness shall be calculated per ASME Boiler and Pressure Code B31.1 as modified by 56.07-10(e).
- b) If less than 6, the wall thickness may be established with a thick-wall cylinder formula using the allowable stress values found in the ASME Boiler and Pressure Code B31.1.

2) Calculate MAWP or wall thickness:

$$t_m = \frac{PD_o}{2(SE + Py)} + A \quad \text{or} \quad t_m = \frac{Pd + 2SEA + 2yPA}{2(SE + Py - P)}$$

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## General Guidance (continued):

$$P = \frac{2SE(t_m - A)}{D_o - 2y(t_m - A)} \quad \text{or} \quad P = \frac{2SE(t_m - A)}{d - 2y(t_m - A) + 2t_m}$$

Where:

$t_m$  = minimum required wall thickness, in.

P = internal design pressure, psig

$D_o$  = outside diameter of pipe, in.

A = additional thickness for grooving, threading, etc.

SE = maximum allowable stress x joint efficiency or

d = inside diameter of pipe, in.

y = coefficient from B31.1-1986, Table 104.1.2(A)

- ❑ Cylinders shall be designed for a bursting pressure of not less than 4 times the MAWP. Drawings and calculations or a certified burst test report shall be submitted to show compliance with this requirement. (46 CFR 58.30-30(c))
- ❑ Piston rods, except steering gear rams, shall either be of corrosion resistant material or shall be of steel protected by a plating system acceptable to the Commandant. (46 CFR 58.30-30(d))
- ❑ Pneumatic systems with an operating pressure in excess of 150 psi shall be designed with a surge tank or means for pulsation dampening. (58.30-5(c))
- ❑ Pneumatic systems must be provided with a means to minimize the entry of oil and drain liquids from the system (58.30-(5)(c))
- ❑ Hydraulic fluids shall have a flashpoint not less than 200°F for pressures below 150 psi and 315°F for pressures above 150 psi. (58.30-10)
- ❑ Accumulators are unfired pressure vessels in which energy is stored under high pressure in the form of a gas or a gas and hydraulic fluid. Accumulators must meet the applicable requirements in 46 CFR 54.01-5(c)(3), (c)(4), and (d) or the remaining requirements in part 54. (46 CFR 58.30-25(a))
- ❑ Accumulators of the gas and fluid type shall be provided with suitable separators between the two media if their mixture would be dangerous, or would result in contamination of the hydraulic fluid and loss of gas through absorption. (46 CFR 58.30-25(b))
- ❑ Each accumulator which may be isolated shall be protected on the gas and fluid sides by relief valves set to relieve at pressures not exceeding the

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## General Guidance (continued):

maximum allowable working pressures. When an accumulator forms an integral part of systems having relief valves, the accumulator need not have individual relief valves. (46 CFR 58.30-25(c))

- ❑ MAWP of SAE J518 Code 61 and Code 62 split flanges shall not exceed those pressures listed in SAE J1475, 'Fittings for Marine Applications.' Note that these MAWPs are typically less than that recommended by the fitting manufacturer.
- ❑ Bolting shall meet the requirements of 46 CFR 56.25-20 except that regular hexagon bolts conforming to SAE J429, Grades 2 through 8, or ASTM A-193 may be used in sizes not exceeding 1 ½ inches. (46 CFR 58.30-15(c))

## Vessels Subject to Subchapter L (Offshore Supply Vessels)

- ❑ Class I piping must conform to the material specifications and design standards of 46 CFR 56.60. Class II vital system piping materials must provide a level of safety equivalent to that required by 56.60. Class II non-vital system piping system may be accepted by MSC based on certification "as suitable for service" by the builder. (128.240(a))
- ❑ Non-standard hydraulic or pneumatic pressure containing components (control valves, check valves, relief valves, manifolds, etc) may be accepted by the Officer in Charge, Marine Inspection (OCMI) or the Commanding Officer, MSC, if the component is certified by the manufacturer as suitable for marine service and if:
  - 1) The component meets each of the requirements for materials and pressure design of subparts 56.60 and 58.30 of this chapter and if its service is limited to the manufacturer's rated pressure; or
  - 2) The service of the component is limited to 1/2 the manufacturer's recommended maximum allowable working pressure (MAWP) or 1/10 the component's burst pressure. (46 CFR 128.240(b))

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## Vessels Subject to Subchapter K (Small Passenger Vessels)

- ❑ For Subchapter K vessels, vital piping systems must meet the requirements of 46 CFR 56.60 with exception that nonferrous piping may be acceptable. See requirements for "Vessels Subject to 46 CFR Subchapter F (Marine Engineering)" on page 2 of these guidelines.

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## **General Guidance (continued):**

- ❑ Flexible nonmetallic hose and fittings shall conform to the SAE J-1942 and J1475 specifications. Hoses shall be used only where flexibility is required and shall not exceed 30 inches in length, except where otherwise necessary for proper operation. Provide documentation demonstrating that any lengths exceeding 30 inches are required to facilitate proper operation of machinery. Hoses must be of adequate pressure rating for the installation.
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## **Vessels Subject to Subchapter T (Small Passenger Vessels)**

- ❑ Piping subject to more than 150 psi shall be designed, constructed, and inspected in accordance with ANSI B31.1 or other industry standard acceptable to the Commandant. See equations for calculation of minimum wall thickness and MAWP on pages (2) and (3) of this document. (46 CFR 182.710(c)(2))
  - ❑ In accordance with reference (f), flexible nonmetallic hose and fittings shall conform to the SAE J-1942 and J1475 specifications and be of adequate pressure rating for the installation. Hoses may exceed 30 inches in length subject to the following criteria:
    - (1) The hose remains visible and is readily accessible;
    - (2) The hose is protected from mechanical damage; and,
    - (3) The hose does not penetrate a watertight deck or bulkhead.
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## **Disclaimer:**

This guidance is not a substitute for applicable legal requirements, nor is it itself a rule. It is not intended to nor does it impose legally-binding requirements on any party. It represents the Coast Guard's current thinking on this topic and may assist industry, mariners, the general public, and the Coast Guard, as well as other federal and state regulators, in applying statutory and regulatory requirements. You can use an alternative approach for complying with these requirements if the approach satisfies the requirements of the applicable statutes and regulations. If you want to discuss an alternative, you may contact the Marine Safety Center (MSC), the unit responsible for implementing this guidance.

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