



Review of Steering Gear Piping Systems

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Purpose

This Plan Review Guideline (PRG) provides guidance regarding the information required to be submitted to the Marine Safety Center (MSC) for review of steering gear system arrangements on U.S. flagged inspected 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 Procedure Number E1-26.

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1. Applicability

This Plan Review Guideline (PRG) is applicable to steering gear system installations on U.S. flagged vessels. Further information regarding the design of pressure piping for steering systems can be found in PRG E1-12, Fluid Power and Control Systems.

2. References

46 CFR 58.25 (Subchapter D, H, I and K vessels)
46 CFR 130.130 (Subchapter L vessels < 100 gross tons)
46 CFR 130.140 (Subchapter L vessels ≥ 100 gross)
46 CFR 182.600 (Subchapter T vessels)
SOLAS, Consolidated Edition, 1997, Chapter II-1, Regulation 29
Marine Technical Note (MTN) 02-10, “Material Selection for Vital Piping Systems”
ABS Rules for Building and Classing Steel Vessels under 90 Meters (295 feet) in Length
MTN 01-09, “Hydraulic Helm Steering Systems for Subchapter K Vessels”

3. Definitions

- a. Hydraulic Helm Steering System – a hydraulically actuated and controlled steering system

4. Content

Vessels subject to Title 46 CFR Subchapter F

- a. Materials shall conform to the specifications/standards listed in 56.60 (46 CFR Subchapter F). Alternatively, the materials may be selected from the specifications listed in Section II of the American Society of Mechanical Engineers (ASME) Code. (46 CFR 58.30-15(b))
 - (1) Material selection in accordance with MTN 02-10 is considered to be equivalent to the Subchapter F requirements.
- b. Maximum allowable working pressure (MAWP) and minimum wall thickness should be calculated using 80% allowable stress as outlined in 46 CFR 56.07-10, unless dynamic effects have been considered.
- c. Materials used for the transmission of power to the rudders stocks (hydraulic cylinders) shall be constructed of materials having an elongation of not less than 12% in 2 inches. (46 CFR 58.25-75(a))
- d. Materials with low melting points (aluminum and nonmetallic seals) are prohibited in control or actuating systems unless installed in areas of low fire risk, or due to redundancy in the system, steering may be immediately restored after component failure. (46 CFR 58.25-75(b))

e. Non-standard fluid conditioner fittings and pressure containing components (directional control valves, manifolds, relief valves, etc.) for Class 1 systems (pressure >225 psi) shall be constructed of materials listed in 46 CFR 56.60, or equivalent materials. The components must be designed to a 4:1 safety factor* for Class II systems and for all Class I, I-L and II-L systems receiving ship motion dynamic analysis and non-destructive examination testing; otherwise a 5:1 design factor is required (46 CFR 56.15-5). This may be demonstrated by:

- (1) Calculations similar to that in ASME B31.1
- (2) Proof test or stress analysis
- (3) Other means acceptable to MSC (manufacturer's documentation)

* The 4:1 safety factor is determined by one of the following:

Burst Pressure $\geq 4 \times$ MAWP

Ultimate Tensile Strength of the Material $\geq 4 \times$ Primary Stress
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f. Hydraulic cylinders shall be designed to have a burst pressure ≥ 4 times MAWP. A certified burst test report is acceptable in lieu of calculations. (46 CFR 58.30-30(c))

g. Flexible non-metallic hoses and fittings shall conform to the Society of Automotive Engineers (SAE) J-1942 and J-1475 specifications and have adequate pressure rating for MAWP. Hose length should not exceed 30 inches, except where necessary for proper operation or flexibility. Use of hoses longer than 30 inches should be substantiated in the submittal. (46 CFR 56.60-25(b) & 58.30-20)

h. SAE J518 Code 61 and Code 62 split flanges and flareless fittings are prohibited. (46 CFR 58.25-20(d))

i. Two separate, independent systems (main and auxiliary) shall be provided, except that an auxiliary steering system is not required if: (46 CFR 58.25-10(e))

(1) In a passenger vessel, the main steering gear has duplicate power units **and** the main steering gear is capable of meeting the performance requirements listed in 58.25-10(b)(2) with any **one** of the power units not operating.

(2) In a cargo vessel, the main steering gear has duplicate power units **and** the main steering gear is capable of meeting the performance requirements listed in 58.25-10(b)(2) with **all** of the power units operating.

(3) The systems are arranged such that with a single point failure in the piping system or one of the power units, steering can be regained in less than ten minutes. See regulations for exemptions.

j. Auxiliary steering is not required on a double ended ferryboat with independent steering at each end of the vessel. (46 CFR 58.25-10(d))

k. In vessels > 70,000 gross tons, the main steering gear must have two or more identical power units. (46 CFR 58.25-10(f) and 58.25-85(b))

l. Vessels on ocean, coastwise, Great Lakes routes shall have a hydraulic storage tank with sufficient capacity to recharge at least one power actuating system, including the reservoir. (46 CFR 58.25-20(c)(2))

(1) The hydraulic storage tank, if required, shall be permanently attached to the reservoir and must be fitted with a sounding tube or level indicator. (46 CFR 58.25-20(c)(2))

m. Arrangements for steadying the rudder during an emergency or for shifting of the steering gear shall be provided. A suitable valve arrangement, including a cylinder bypass, is acceptable. (46 CFR 58.25-5(h))

n. Relief valves shall be fitted in any part of the hydraulic system that can be isolated and in which pressure generated from the power units or from external forces on the rudder (i.e. wave motion). This includes relief valves on the power units and at the individual steering cylinders. (46 CFR 58.25-20(b))

(1) In some cases a vessel meeting the requirements of ASME B31.3 Part 6, 322.6 Pressure Relieving Systems, for pressure relief piping may be considered as offering an equivalent level of safety to ASME B31.1 and 46 CFR 58.25-20. The following sections of ASME B31.3 should be met to demonstrate an equivalent level of safety.

(i) ASME B31.3 301.2.2(a): Piping that can be isolated from a pressure-relieving device, shall be designed for at least the highest expected pressure.

(ii) ASME B31.3 322.6.1 and 322.6.2: Stop valves are allowed if closing the valves does not limit the relief capacity, or the valves can be sealed or locked open. The method of sealing or locking open valves shall be at the discretion of the OCMI.

(iii) ASME B31.3 F322.6: "If stop valves are located in pressure relief piping in accordance with 322.6.1(a), and if any of these stop valves are to be closed while the equipment is in operation, an authorized person should be present."

o. A filtering device is required. (46 CFR 58.25-20(c)(1))

p. Electric or mechanical rudder stops shall be provided. (46 CFR 58.25-50)

q. Fluid power motors and pumps shall be certified by the manufacturer as suitable for use. (46 CFR 58.30-15(f))

r. Non-pressurized components (rudder post, rudder, etc) shall be designed to standards equivalent to reference (g), rule 4/8.3

s. Additional requirements for tank vessels > 10,000 gross tons are listed in 46 CFR 58.25-85

Alternate Requirements for Vessels Subject to Title 46 CFR Subchapter K - Hydraulic Helm Installations

Subchapter K vessels carrying not more than 600 passengers or having overnight accommodations for not more than 49 passengers may utilize a hydraulic helm system complying with Subchapter F, as amended by reference (h).

- a. The requirements for Subchapter F such as materials, piping design, reservoir redundancy, performance, etc. apply. See the section of this guide applicable to Subchapter F vessels.
- b. The hydraulic system must be dedicated to the steering system. A single sump with a replacement supply of oil or duplicate sumps, each with a capacity adequate to operate the system, are required.
- c. From point of connection to the switchboard, the electrical system must be dedicated to the steering system
- d. Two separate and independent control systems must be provided (two helm pumps or a helm pump and a jog lever)
 - (1) Where the second control is not in the pilothouse, a means of communication between the two stations shall be provided.
- e. For electrically controlled systems (use of a jog lever, autopilot, dynamic positioning, etc) rudder travel limit switches shall be provided.
- f. Upon loss of power pumps, if provided, a manual means of steering must be immediately available.

Alternate Requirements for Vessels Subject to Title 46 CFR Subchapter L - Hydraulic Helm Installations

- a. The vessel must have multiple screw propulsion capable of pilothouse control. Control of the steering gear system must be provided on the bridge. (46 CFR 130.140(b)(8))
- b. The MAWP shall not exceed 1800 psi. (46 CFR 130.140(b)(2))
- c. Piping materials shall conform to the specifications listed in 56.60; alternatively, the materials may be selected from the specifications listed in sections II of the ASME code. (46 CFR 130.140(b)(3))
- d. Piping wall thickness shall not be less than schedule 80. (46 CFR 130.140(b)(3))

e. Piping runs shall be located as far inboard as possible. Redundancy in piping is not required. (46 CFR 130.140(b)(3))

f. Two steering pumps with individual reservoirs capable of meeting the performance requirements of 46 CFR 130.130(c), **or** a single pump with a cascading overflow reservoir, are/is required.

(1) If a split, cascading reservoir is used, each side must have the capacity to operate the system. (46 CFR 130.140(b)(6))

g. Dual hydraulic cylinders, capable of being isolated and operating separately, are required. (46 CFR 130.140(b)(9))

h. Rudder stops are required. (46 CFR 130.140(b)(5))

i. A means to manually center and steady the rudder is required. (46 CFR 130.140(b)(15))

j. The electrical/control/alarm requirements listed in 46 CFR 130.140(b)(10) through (13) should be addressed in the submittal and will be reviewed by the MSC electrical branch.

Vessels subject to Title 46 CFR Subchapter L and less than 100 Gross Tons

As an alternate design standard to 46 CFR 58.25 and 46 CFR 130.140, offshore supply vessels of **less than 100 gross tons** may comply with the following as outlined in 46 CFR 130.130

a. Except as noted, a separate and independent main and auxiliary means of steering the vessel must be provided. An auxiliary system is not required if any one of the following conditions are satisfied: (130.130(h))

(1) The main gear, including power units, is duplicated

(2) The vessel has multiple screw propulsion with independent propulsion control systems, a means to center and restrain the rudder in center position is provided and the propulsion system is capable of steering the vessel.

b. The main steering gear must be of adequate strength for, and capable of steering the vessel at all service speeds, designed to operate at maximum astern speed, and capable of shifting the rudder from 35 degrees on one side to 30 degrees on the other side with the vessel at maximum service speed. (46 CFR 130.130(c))

c. Control of the main steering gear, including pumps, control valves etc, shall be from the pilothouse. (130.130(d))

(1) If power driven pumps are provided, power unit operation of is to be indicated in the pilothouse.

- d. The auxiliary steering gear must be of adequate strength for steering the vessel at navigable speed. (130.130(e))
- e. Control/operation of the auxiliary steering gear must be from a location provided with communication to the pilothouse or at which the master can safely maneuver the vessel. (130.130(e))
- f. Design of the steering gear shall provide for rapid transfer from main to auxiliary steering. Required tools must be readily available. Transfer instructions must be posted. (130.130(f))
- g. Where duplicate, cross connected systems are provided, one of the systems may be used for ancillary purposes provided all of the following conditions are satisfied:
130.130(j))
 - (1) Control of the subordinate system is located in the pilothouse
 - (2) Full power is available to the steering system when the subordinate system is not in operation
 - (3) The subordinate system can be readily isolated from the steering system and instruction for isolating are provided
 - (4) The subordinate system is materially equivalent to the main system.

Vessels subject to Title 46 CFR Subchapter T

- a. For pressures greater than 150 psi, piping and components shall be constructed of materials listed in ANSI B31.1 or equivalent materials. In addition, MAWP and minimum wall thickness shall be calculated IAW ANSI B31.1. (46 CFR 182.710)
- b. Piping subject to less than 150 psig shall be suitable for expected pressure. Materials for piping and components shall meet the general requirements of 46 CFR 182.710(c)(1).
- c. Flexible non-metallic hoses and fittings shall conform to the SAE J-1942 and J1475 specifications and have adequate pressure rating for MAWP. Hose lengths are not restricted provided the hoses do not penetrate watertight boundaries. (46 CFR 182.720 and MSE-2 Policy letter dated April 09, 2002)
- d. Control of the steering gear shall be provided at the operating station. (46 CFR 182.610(a)(3))
- e. An auxiliary means of steering shall be provided except for vessels meeting one of the following: (46 CFR 182.620(c))
 - (1) Steering gear and its controls are provided in duplicate
 - (2) Multiple screw propulsion with pilothouse control
 - (3) No regular rudder is fitted
 - (4) A rudder and tiller are the main steering gear

- f. Structural or internal rudder stops are required. (46 CFR 182.610(e))
- g. A means for manually centering the steering gear shall be provided. (46 CFR 182.610(f)(4))
- h. Vessels > 65 feet in length must have a visual indication of steering gear power unit operation located at the operating station. (46 CFR 182.610(g)(1))
- i. Vessels > 65 feet in length must have steering gear transfer instructions posted at the location where the transfer is carried out. (46 CFR 182.610(g)(2))

5. 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 MSC, the unit responsible for implementing this guidance.