



REVIEW OF FUEL OIL 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 fuel oil system arrangements on U.S. flag 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 E1-10.

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1. Applicability

This Plan Review Guideline (PRG) is applicable to fuel oil system installations on U.S. flag vessels, including helicopter refueling and boiler burner fuel installations. The scope of this PRG includes only those design aspects reviewed during the plan approval process; other design considerations (e.g., a requirement for piping to be readily observable) will be verified by the OCMI upon installation.

2. References

- a. 46 CFR 56.50 – Piping Systems and Appurtenances
- b. 46 CFR 108.237 and 108.239 Helo Deck Fueling Systems (Subchapter (I-A))
- c. 46 CFR 119.455 – Machinery Installation
- d. 46 CFR 182.455 – Machinery Installation
- e. MTN 01-10 Change 2, “Standard Practice for Selection and Application of Piping Systems”

3. Vessels Subject to Subchapter F

a. Materials

(1) Materials used in piping systems must be selected from the pipe, tubing and fitting specifications in table 1 of 46 CFR 56.60-1 and component specifications that appear in table 1 of 46 CFR 56.60-2, ASTM F1155-10, or the materials listed in Sections I or VIII of the ASME Boiler and Pressure Vessel Code. (46 CFR 56.60-1(a)(2))

(2) Fuel supply piping shall be of seamless steel, annealed seamless copper or brass, nickel copper, or copper nickel alloy. For diesel fuel, low carbon stainless steel is acceptable. Furnace welded ASTM A53 Type F pipe is prohibited for fuel piping in machinery spaces. (46 CFR 56.50-75 and 56.10-5(b))

(3) For vessels under 100 gross tons and tank barges utilizing copper, nickel copper or copper nickel tubing, wall thickness shall not be less than 0.035 inch. For vessels over 100 gross tons using copper, brass, nickel copper or copper nickel alloy pipe or tubing, wall thickness shall not be less than that listed in 46 CFR Table 56.50-70(a) or the minimum computed wall thickness, whichever is larger. (46 CFR 56.50-75(a) and (b))

(4) Nonferrous materials with melting point less than 1,700 °F are not acceptable. This precludes the use of B61 and B62 bronze materials. Documentation should be provided to indicate suitability of other nonferrous materials for the application. (46 CFR 56.60-20)

(5) Positive shutoff valves subject to internal head pressure from oil in the tank shall be made of steel, ductile cast iron (ASTM A395) or ductile nonferrous alloy

having a melting point (solidus) above 1,700 °F if installed on the outside of the tank. (46 CFR 56.50-60(d)(1))

(6) Copper tubing fittings shall be drawn or forged, flared type. Flareless fittings may be used with steel, nickel copper, copper nickel tubing. Swagelok type fittings are acceptable within the manufacturer's limitations. (46 CFR 56.50-75(a)(3))

(7) Power operated valves provided at the fuel tanks shall be capable of closing the valve in any condition except physical interruption of power system. Fluid power actuated valves other than those opened against spring pressure, must be provided with a means to cycle the valve once. This energy source must be protected from fire or collision. All actuators shall be capable of local power actuation and emergency operation (opening and closing). (46 CFR 56.50-60(d)(3))

(8) Flexible nonmetallic hoses and fittings shall conform to the SAE J1942 and J1475 specifications. The hoses shall be suitable for the system's maximum allowable working pressure and be fitted with fire sleeves if required. Hose applications (if suitable for the fuel system, pressure rating, and sleeve requirement) should be verified in the SAE J1942/1 listing. Hose length should not exceed 30 inches. (46 CFR 56.60-25(b))

(9) Fuel filters constructed in accordance with ASTM F1201, regardless of the material, may be used within the material, size, pressure and temperature limitations. (46 CFR 56.15-5(b))

b. Installations

(1) Oil piping passing through non-oil tanks without stop valves must be Schedule 80 with welded joints if it is not in an oiltight or watertight pipe tunnel. Oil piping must not run through feed or potable water tanks. (46 CFR 56.50-60(l) and 56.50-60(h))

(2) Oil piping systems must be separate from other piping systems as far as practicable. Pumps used to transfer oil must have no discharge connections to fire mains, boiler feed systems, or condensers. (46 CFR 56.50-60(a))

(3) Filling pipes must be fitted with shutoff valves at the filling ends. Filling pipes may pass directly to the tanks or through a manifold. Oil piping must not be led through accommodation spaces, except that low pressure fill piping not normally used at sea may pass through accommodation spaces if it is of steel construction and all welded. (46 CFR 56.50-60(c))

(4) Piping subject to internal head pressure from oil in the tank must be fitted with remotely operable positive shutoff valves located at the tank. Category A

resiliently seated valves are not acceptable. (46 CFR 56.20-15(b)(2) and 56.50-60(d))

(5) A short section of metallic or nonmetallic tubing or hose or a short loop of annealed copper tubing shall be installed at the connection of the fuel supply piping to the engine to prevent damage by vibration. (46 CFR 56.50-70(b)(2) and 46 CFR 56.50-75(a)(2))

(6) Independent fuel tanks shall be constructed, installed, and tested in accordance with 46 CFR 58.50. See Plan Review Guideline E1-16, Independent Fuel Tanks.

(7) Shut off valves in a fuel return line pose the risk of significant pressure increase in the return piping if the valve is closed, exposing the piping to pressures greater than the intended maximum allowable working pressure. If a shut off valve is installed, risk should be mitigated by utilizing a pressure relief bypass or operational control measures. Recommended operational control measures include locking the valve in the open position or removing the valve handle to ensure the valve is not inadvertently closed during operation. Shutoff valves with an integrated bypass must meet 46 CFR 56.20-20. (46 CFR 56.01-1(b))

(8) When oil needs to be heated to lower its viscosity, heating coils must be properly installed in each tank. (46 CFR 56.50-60(b))

(9) For gasoline fuel systems, if shown on the fuel oil piping drawing rather than the independent tank plan, outlets in fuel lines and valve openings on the tank bottom for drawing gasoline for any purpose are prohibited. However, openings fitted with threaded plug or cap can be used for cleaning purposes. (46 CFR 56.50-70(e))

Note: Vessels of 100 gross tons and less have exceptions listed in 46 CFR 56.50-75(b)

4. Vessels Subject to Subchapters T and K

a. Novel Fuels: The use of fuel, other than diesel fuel aboard Subchapter K vessels and diesel fuel or gasoline aboard Subchapter T vessels, as an alternative fuel for internal combustion engine will be reviewed on a case-by-case basis by the Commandant. (46 CFR 119.405 and 182.405)

b. Materials

(1) Fuel lines may be seamless steel or stainless steel pipe or tubing or annealed copper, copper nickel or nickel copper tubing having a minimum wall thickness of .035 inches. Schedule 80 aluminum piping is permissible on wood, fiberglass, and aluminum hull vessels. (46 CFR 119.455(a)(1)(ii) and 182.455(a)(1)(ii))

(2) Developments in gasoline technology that have occurred since the small passenger vessel regulations were revised in 1996 have prompted the Coast Guard Office of Design and Engineering Standards to apply new interpretations to Subchapter T. Stainless steel tubing, piping, fittings, and valves may be considered acceptable for gasoline fuel service on Subchapter T vessels, if the risk of sparking is removed and the system is appropriately designed for its maximum pressure and is galvanically compatible with other piping materials. An acceptable method for mitigating the sparking hazard is the use of a resilient seat and disc on the valve.

(3) Similarly, the EPA has created specific requirements for gasoline fuel systems to meet evaporative emissions standards, which came into force after 1996. To resolve potential conflicts between USCG and EPA regulations, certain fill or vent line components intended to meet EPA requirements may be constructed from plastic materials, provided they are EPA certified.

(4) Nonferrous materials with melting point less than 1,700 °F are not acceptable on steel-hull vessels. This precludes the use of B61 and B62 bronze materials. Documentation should be provided to indicate suitability of other nonferrous materials for the application. Aluminum, wooden, and fiberglass hulls may use these materials. (46 CFR 119.730 and 182.730).

(5) Flexible non-metallic hoses and fittings shall conform to the SAE J1942 and J1475 specifications. The hoses shall be suitable for the system's maximum allowable working pressure and be fitted with fire sleeves if required. Hose applications (if suitable for the fuel system, pressure rating, and sleeve requirement) should be verified in the SAE J1942/1 listing. (46 CFR 56.60-25 via 46 CFR 119.455(a) and 182.720(e))

(6) For Subchapter K vessels, flexible hose length shall not exceed 30 inches. For Subchapter T vessels, SAE J1942 flexible nonmetallic hoses with attached fittings may be used without length limitations provided the hoses do not penetrate watertight bulkheads or decks. (46 CFR 56.60-25(b)(2))

(7) Copper tubing fittings shall be drawn or forged, flared type. Flareless fittings may be used with steel, nickel copper, copper nickel tubing. Swagelok type fittings are acceptable within the manufacturer's limitations. (46 CFR 119.455(a)(2) and 182.455(a)(2))

c. Installations

(1) Gasoline fuel (Subchapter T only) lines must be connected at the tank top unless fitted with anti-siphon protection. Diesel fuel supply piping may be connected at the bottom of the tank. (46 CFR 182.455(b)(1))

(2) Shutoff valves shall be provided in the fuel supply piping at the fuel tank and engine connections. The valve located at the tank shall be capable of remote operation from outside the space in which the valve is located (preferably from the weather deck). Alternatively, the valve may be located in the machinery space if the valve can be operated from no more than 12 inches outside the space and the valve is shielded from flames. Solenoid valves are not acceptable unless provided in addition to a manual valve. (46 CFR 119.455(b)(3) and 46 CFR 182.455(b)(4))

(3) A short section of metallic or nonmetallic tubing or hose, or a short loop of annealed copper tubing shall be installed at the connection of the fuel supply piping to the engine. (46 CFR 119.455(b)(4) and 46 CFR 182.455(b)(5))

(4) A metal strainer or filter shall be provided in the fuel supply line. Strainers must be of the top opening type. Strainer and filter bowls should be metal unless approved by the Commandant. (46 CFR 119.455(b)(5) and 46 CFR 182.455(b)(6))

(5) The Marine Safety Center interprets ASTM F1201's incorporation by reference into 46 CFR 56 as approval for use on smaller vessels; therefore, fuel filters constructed in accordance with ASTM F1201, regardless of the material, may be used within the material, size, pressure, and temperature limitations. Further, the following Racor base fuel filter models have received approval by the Commandant for diesel service with a maximum working pressure of 15 psig: 500MA, 900MA, 75/900MA, 900MAM, 75/900MAM, 1000MA, 73/1000MA, 75/1000MA, 77/1000MA, 79/1000MA, 1000MAM, 73/1000MAM, 75/1000MAM, 77/1000MAM, and 79/1000MAM.

(6) Fill, sounding, and vent pipes must be installed in accordance with 46 CFR 119.445 and 119.450 or 46 CFR 182.445 and 182.450. See Plan Review Guideline E1-29, Vents and Sounds, for details.

(7) Independent fuel tanks shall be constructed, installed, and tested in accordance with 46 CFR 119.440 and 182.440. See Plan Review Guideline E1-16, Independent Fuel Tanks, for details.

(8) Fuel lines shall be protected with close fitting ferules or stuffing boxes at penetrations. (46 CFR 119.455(b)(2) and 46 CFR 182.455(b)(3))

(9) Drain valves with caps or plugs are permitted on diesel fuel strainers. (46 CFR 119.455(b)(7) and 46 CFR 182.455(b)(9))

(10) Shut off valves in a fuel return line pose a hazard if inadvertently closed because the piping may be exposed to pressures greater than the intended maximum allowable working pressure. If a shut off valve is installed, risk should be mitigated by utilizing a pressure relief bypass or operational control measures.

Recommended operational control measures include locking the valve in the open position or removing the valve handle to ensure the valve is not inadvertently closed during operation. (46 CFR 182.100 and 46 CFR 56.60-2(b) as required by 46 CFR 119.455(b)(3))

5. Vessels Subject to Subchapter L

- a. The design, installation, testing, and inspection of materials, machinery, and piping must comply with subchapter F unless otherwise specified. See section 3 of this document for details on compliance with subchapter F. Note that transfer of excess fuel oil from the fuel supply tanks of OSVs of at least 500 GT to an offshore drilling or production facility will not cause 46 Subchapter D to apply provided the OSV is not a tankship and not in the service of oil exploitation. (46 CFR 128.110 and 46 CFR 125.115)
- b. Materials used in Class II vital piping systems may be accepted by the cognizant OCMI or the Commanding Officer, Marine Safety Center, if shown to provide a level of safety equivalent to 56.60. Currently, there is no list of accepted materials, and each installation is reviewed on a case-by-case basis. (46 CFR 128.210)

6. Burner Fuel Oil Service

- a. Piping from fuel transfer pumps to burner must seamless steel with a wall thickness of at least schedule 80. (46 CFR 56.50-65(a))
- b. Burners for main propulsion boilers require at least two fuel service pumps with sufficient capacity to supply the boiler and duplex strainers. Auxiliary boilers may have a single service pump; strainers are not required. (46 CFR 56.50-65(b))
- c. Unions shall not be used on piping larger than 1 inch NPS. Bushings and street elbows are prohibited in fuel oil supply piping. (46 CFR 56.50-65(e) and (g))
- d. Pump and heater relief valves shall be ported back to the fuel tank or pump suction. (46 CFR 56.50-65(c))
- e. Threaded bonnet valves shall be the union-bonnet type that can be repacked under pressure. (46 CFR 56.50-65(d))
- f. Boiler header valves of the quick acting type shall be installed in the fuel supply line as close to the boiler front as possible. The valves must be readily accessible or remotely operable. (46 CFR 56.50-65(f))

7. Helicopter Deck Fueling Arrangements

- a. Independent fuel tanks shall be designed in accordance with 46 CFR 58.50. Marine portable fuel stowage tanks shall be in accordance with 46 CFR Part 64. (46 CFR 108.237)

b. DOT certified IM101 and IM 102 tanks constructed prior to January 2003 are acceptable in accordance with the DOT documentation. DOT certified “UN” tanks are acceptable in accordance with the DOT documentation. (46 CFR 98.30)

c. Fueling stations shall be equipped as follows: (46 CFR 108.239)

- (1) Fueling nozzles must be deadman type (failsafe).
- (2) Hose reels must be provided for each hose.
- (3) Fuel pumps must be provided with a pump operation indicator light located at the pump.
- (4) Remote fuel pump shutoffs must be provided at both helideck access routes.

8. 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.