REVIEW OF BILGE AND BALLAST SYSTEMS

Procedure Number: E1-02
Revision Date: July 10, 2020

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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 bilge and ballast piping 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 E1-02.

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1. Applicability

This Plan Review Guideline (PRG) is applicable to bilge and ballast water system installations on U.S. flagged vessels. Solid ballast installations are not part of this PRG and are reviewed separately by the Hull Division.

2. References

46 CFR 32.52-5
46 CFR 56.50-50 and 56.50-55
46 CFR Part 119, Subpart E
46 CFR 128.440
46 CFR Part 182, Subpart E
SOLAS Chapter II-1, Regulation 35-1
COMDT (CG-ENG) Policy Letter 03-12, "Policy on The Implementation of IMO Resolution A.673 (16), Guidelines for The Transport and Handling of Limited Amounts of Hazardous and Noxious Liquid Substances in Bulk on Offshore Support Vessels, for New and Existing U.S. Offshore Supply Vessels"
ASTM F1155-98, "Standard Practice for Selection and Application of Piping Systems"

3. Content

Vessels Subject to Subchapter F

Materials

a. Pipe and fittings shall conform to the material specifications listed in Table 56.60-1(a) of 46 CFR 56.60, Sections I or VIII of ASME Boiler and Pressure Vessel Code, or reference (h). (46 CFR 56.60(a) and MTN 02-10)

b. Fittings and valves shall conform to an appropriate design standard listed in Table 56.60-1(b) or other acceptable standard which provides an equivalent level of safety. Fitting class/pressure rating must be adequate for the application. (46 CFR 56.60(b) and 56.20)

c. Pressure containing components (strainers, filters and non-standard assemblies, etc) shall be constructed of acceptable materials and be designed to a 4:1 safety factor (MAWP/Burst pressure). (46 CFR 56.10 and 56.15)

d. Non-metallic piping, fittings and pressure containing components must be in accordance with reference IMO Resolution A.753.(18). Note that bilge and ballast system components constructed of non-metallic materials must meet the fire endurance requirements outlined in Appendix 4 of reference IMO Resolution A.753.(18). Generally, this precludes the use of pressure containing components (e.g. strainers with plastic or acrylic bowls).

e. Where bilge or ballast piping is led through tanks, except ballast piping in ballast tanks, means must be provided to minimize the risk of flooding of other spaces due to pipe failure within the tanks. Piping must either be installed in a watertight pipe tunnel or be schedule 80 pipe with expansion bends. All joints in the tanks shall be welded. (46 CFR 56.50-50(k))

f. All bilge pipes used in or under fuel storage tanks or in the boiler/ machinery space, including spaces in which oil settling tanks or oil pumping units are located, shall be of steel or other acceptable material. (46 CFR 56.50-50(m))

Application

a. All vessels except unmanned barges shall be provided with a bilge pumping plant capable of pumping from and draining any watertight compartment except for ballast, oil and water tanks. (46 CFR 56.50-50(a)(1))

b. Where piping is led through the forepeak; pipes shall be fitted with screwdown valves located inside the forepeak tanks that are remotely operable from above the bulkhead deck. (CFR 56.50-50(a)(2) and CFR 56.50-1(b)(1)) Resiliently seated valves that provide adequate shutoff integrity when exposed to a fire (USCG accepted positive shutoff, or Category A valves) are acceptable for cargo vessels, only. (CG 521 Policy letter)

c. Passenger vessels shall have provisions to prevent progressive flooding in the event a bilge branch pipe is severed. A check valve located at the end of the branch pipe in the compartment in which the branch pipe serves **or** location of the branch piping inside one-fifth of the beam of the side of the vessel is acceptable. (46 CFR 56.50-50(b))

d. Except for common rail systems, each bilge suction must lead from a manifold. Each manifold must be in, or be capable of remote operation from, the same space as the bilge pump that normally takes suction from the manifold. (46 CFR 56.50-50(c)(1))

e. Except for common-rail bilge systems, each bilge-manifold valve controlling a bilge suction from any compartment must be of the stop-check type. A separate stop valve and check valve located at the manifold is acceptable. (46 CFR 56.50-50(c)(1))

f. Each bilge suction shall be fitted with a strainer located in each compartment served. The strainer shall have an open area not less than three times the area of the suction pipe. (46 CFR 56.50-50(g))

g. A mud box or basket strainer shall be provided between the bilge suction manifold and the pump. (46 CFR 56.50-50(g))

h. Each overboard discharge valve shall be in the same space as the bilge pump or be capable of remote operation from the same space as the bilge pump. (46 CFR 56.50-50(c)(1)).

i. Overboard discharge connections shall be fitted with a stop valve at the hull penetration and be fitted with a bend or an elbow between the shell at the first rigid connection inboard. Piping outboard of the required valve shall have a thickness not less than schedule 80 for pipe sizes through 8 inch nominal pipe size (NPS). (46 CFR 56.50-95(d) and (e))

j. Resiliently seated valves (RSV) located at shell penetrations must be category A or positive shut off. RSVs certified as complying with the API 607 fire test are acceptable as Category A. (46 CFR 56.20-15)

k. A common-rail bilge system may be installed as an acceptable alternative to a manifold type system provided that it meets all of the following criteria (46 CFR 56.50-50(c)(3)):

(1) The common-rail main runs inboard at least one-fifth of the beam of the vessel,
(2) A stop-check valve or both a stop valve and a check valve are provided in each branch line and located inboard at least one-fifth of the beam of the vessel,
(3) The stop valve or the stop-check valve is capable of remote operation from the space where the pump is, and is capable of manual operation to both open and close the valve,
(4) The stop valve or the stop-check valve is accessible for both manual operation and repair,
(5) A port and a starboard suction serve each space protected,
(6) For each vessel designed for the carriage of combinations of both liquid and dry bulk cargoes, no bilge pump or piping is located in a machinery space other than in a pump room for cargo, and no liquid and other cargoes are carried simultaneously, and
(7) For each cargo vessel in Great Lakes service, each common-rail piping installed for the bilge and ballast system serving cargo spaces must lead separately from a valved manifold located at the pump.

l. Bilge and ballast manifolds and piping must be separate and be so arranged as to prevent oil or water from the sea or ballast spaces from passing into cargo holds or machinery spaces, or from passing from one compartment to another, whether from the sea, water ballast, or oil tanks, by the appropriate installation of stop **and** non-return valves. The bilge and ballast mains must be fitted with separate control valves at the pumps. (46 CFR 56.50-50(h))

m. Ballast piping shall not be installed to any hull compartment of a wooden vessel. Where the carriage of liquid ballast in such vessels is necessary, suitable ballast tanks, structurally independent of the hull, shall be provided. (46 CFR 56.50-50(i))

n. When dry cargo is to be carried in deep tanks, arrangement shall be made for disconnecting or blanketing-off the ballast lines. Blind flanges or reversible pipe fittings may be employed for this purpose. (46 CFR 56.50-50(j))

o. Vessels that comply with the ballast water discharge standards listed in 33 CFR 151 Subpart D by using a treatment system must install a USCG type approved system or USCG accepted AMS. (33 CFR 151.2025)

p. Each ballast water management system (BWMS) must be designed with stop valves at the connection to the ballast piping system and a by-pass valve or suitable override function to protect safety of vessel/personnel in case of emergency. (46 CFR 162.060-20(c))

q. If a BWMS is intended to be installed in a hazardous location, it must comply with relevant requirements in 46 CFR 111.105. (46 CFR 162.060-20(d))

r. Supply piping, other than the ballast main, may not be connected to the treatment system piping to allow for dilution of ballast water. Flushing/washing water may be connected to filters and treatment units in accordance with the type approval manual. (46 CFR 162.060-20(f))

s. Any arrangement to lock any bilge discharge valve must be approved by the OCMI.

t. Oily water separators must be Coast Guard type approved and plans must include sufficient information to verify that status.

Internal Diameter of Bilge Suction Pipes

a. For vessels of 150 tons and over, no main suction piping shall be less than 2½ inches internal diameter. Branch piping need not be more than 4 inches and shall be not less than 2 inches in diameter except for drainage of small spaces in which case a 1½ inch diameter can be used. (46 CFR 56.50-50(d)(3))

b. For vessels less than 150 gross tons no bilge suction shall be less than 1½ inches internal diameter and no branch piping shall be less than 1 inch nominal pipe size. (46 CFR 56.50-50(d)(3))

c. For vessels of 65 feet in length or less and not engaged on an international voyage, the bilge pipe sizes computed by the above formulas are not mandatory, but in no case shall the size be less than 1 inch nominal pipe size. (46 CFR 56.50-50(d)(4))

d. Minimum internal diameter of bilge main, including strainers, and branch lines shall be in accordance with the following formulas (to nearest size, not less than ¼" under required diameter.) (46 CFR 56.50-50(d) and SOLAS Chapter II-1, Regulation 35-1, 3.9)

(1) Suction for Each Main Bilge Pump: $d = 1 + \sqrt{\frac{L(B+D)}{2500}}$

(2) Suction for Cargo and Machinery Space Branch Lines: $d = 1 + \sqrt{\frac{c(B+D)}{1500}}$

where:

(i) d = Required internal diameter of suction pipe, in inches (in millimeters)
(ii) L = Length of vessel at loadwater line, in feet (in meters)
(iii) B = Breadth of vessel, in feet (in meters)
(iv) D = Molded depth to the bulkhead deck, in feet (in meters)
(v) c = Length of compartment, in feet
(vi) 1 inch = 25.4 millimeters; 1 foot = 0.3048 meters

Independent Bilge Suction (46 CFR 56.50-50(e))

a. One of the bilge pumps must have a suction of a diameter not less than the formula given for *Suction for Cargo and Machinery Space Branch Lines* that is led directly from the engine room bilge entirely independent of the bilge main.

b. On passenger vessels each independent bilge pump located in the machinery space must have such direct suctions from these spaces, except that not more than two pumps are required to have direct suctions from any one space.

c. In a vessel with more than one hull, there must be one bilge pump that has an independent bilge suction in each hull.

Emergency Bilge Suction (46 CFR 56.50-50(f))

a. On passenger vessels propelled by internal combustion engines, the largest available pump in the engine room is to be fitted with the direct bilge suction in the machinery space, except that a required bilge pump may not be used. The discharge shall exceed the capacity of the required main bilge pump.

b. Vessels over 180 feet in length which are not passenger vessels must be provided with a direct emergency bilge suction from any pump in the machinery space, except that a required bilge pump may not be used. The discharge shall exceed the capacity of the required main bilge pump

c. Vessels under 180 feet in length which are not passenger vessels need not provide an emergency bilge suction.

d. Each vessel with more than one hull must have an emergency bilge suction in each hull.

Bilge Pumps

a. For self-propelled vessels with engines or boilers located in two or more spaces, bilge pumps must be distributed throughout these compartments. For other vessels where two or more bilge pumps are prescribed, the bilge pumps must be located in separate watertight compartments to the extent practicable, as specified in 46 CFR 56.50-55(e).

Alternative arrangements that would prevent failure of both pumps in the event of flooding in a single space are considered on a case by case basis (Example: One pump being located above deck plate level).

b. Subchapter K vessels over 65 feet meeting any of the following criteria, must have bilge pumps in separate watertight compartments: (Bilge Pump Policy Files)

(1) Greater than 49 overnight accommodations
(2) Greater than 600 passengers
(3) Multiple main spaces/separate engine rooms; for example, that which would be found on a double-ended ferry

c. Each self-propelled vessel must be provided with a power-driven pump or pumps in accordance with Table 56.50-55(a).

d. For a Subchapter K vessel, the fire pump may serve as a required bilge pumps provided the arrangement allows pumping of the bilges to overboard and charging of the firemain, simultaneously (46 CFR 118.300(d)).

e. For Subchapter H and Subchapter L vessels having a single fire pump, the fire pump may **not** serve as a required bilge pump. If two fire pumps are provided, a fire pump may serve as a required bilge pump provided the arrangement allows pumping of the bilges to overboard and charging of the firemain, simultaneously.

f. When bilge pumps are being utilized for other services, the piping shall be so arranged that under any condition at least one pump will be available for drainage of the vessel through an overboard discharge.

g. Each power bilge pump must have the capacity to develop a suction velocity of not less than 400 feet per minute through the size of the bilge main piping required for suctions to each main bilge pump per §56.50-50(d)(1) (46 CFR 56.50-55(c))

Additional SOLAS Requirements

a. All vessels seeking SOLAS approval must meet the regulations outlined in both the CFRs and SOLAS. When the relevant CFR section and SOLAS cite differ, the more stringent requirement is applied. The regulations in this section apply in addition to the regulations in the CFRs.

For Passenger Ships and Cargo Ships (SOLAS Chapter II-1, Regulation 12)

a. The collision bulkhead may be pierced below the bulkhead deck by not more than one pipe for dealing with fluid in the forepeak tank. If the forepeak is divided to hold two different kinds of liquids, the collision bulkhead may be pierced by two pipes.

b. Each pipe must be fitted with a screw-down valve capable of being operated from above the bulkhead deck, the valve chest being secured inside the forepeak to the collision bulkhead. The valve may be fitted on the after side of the collision bulkhead provided that the valve is ready accessible and the space in which it is located is not a cargo space.

c. All valves must be of steel, bronze, or other approved ductile material. Cast iron or similar material is not acceptable.

For Passenger Ships and Cargo Ships (SOLAS Chapter II-1, Regulation 35-1)

a. An efficient pump shall be provided, capable of pumping from and draining any watertight compartment other than water/oil/liquid cargo tanks and for which other means of pumping are provided.

b. Sanitary, ballast and general service pumps may be accepted as independent power bilge pumps if fitted with the necessary connections to the bilge pumping system.

c. Provisions shall be made for the drainage of enclosed cargo spaces situated on the bulkhead deck of a passenger ship and on the freeboard deck of a cargo ship.

For Passenger Ships (SOLAS Chapter II-1, Regulation 35-1)

a. The bilge pumping system requirements shall be capable of operation under all practical conditions after a casualty whether the ship is upright or listed. For this purpose, wing suctions shall be generally fitted except in narrow compartments at the end of the ship where one suction may be sufficient.

b. At least three power pumps shall be placed in separate watertight compartments and so arranged or situated that these compartments will not be damaged by the same damage.

c. On a ship of 91.5m (300 feet) in length and upwards or having a criterion numeral (provided by owner) of 30 or more, the arrangements shall be such that at least one power bilge pump shall be available for use in all flooding conditions which the ship is required to withstand, as follows:

(1) One of the required bilge pumps shall be an emergency pump of a reliable submersible type having a source of power above the bulkhead deck; or
(2) The bilge pumps and their sources of power shall be so distributed throughout the length of the ship that at least one pump in an undamaged compartment will be available.
(3) In addition to the direct bilge suction or suctions required, a direct suction from the main circulating pump leading to the drainage level of the machinery space and fitted with a non-return valve shall be provided in the machinery space. The diameter of this direct suction pipe shall be of the same diameter as the pump inlet (two thirds in case of steamships).

(4) The spindles of the sea inlet and direct suction valves shall extend well above the engine-room platform.
(5) All bilge suction piping up to the connection to the pumps shall be independent of other piping.

For Cargo Ships (SOLAS Chapter II-1, Regulation 35-1)

a. At least two power pumps connected to the main bilge system shall be provided, one of which may be driven by the propulsion machinery.

Vessels Subject to Subchapter L

a. Bilge system shall be in accordance with Subchapter F.

b. For vessels having only the steering gear room, engine room, centerline passageway and space containing the mud tanks fitted with bilge suctions, an emergency bilge suction located in the engine room is not required.

c. Any arrangement to lock any bilge discharge valve must be approved by the OCMI.

d. Oily water separators must be Coast Guard type approved and plans must include sufficient information to verify that status.

For OSV's that carry certain hazardous and NLS Cargoes

Note: The bilge piping system servicing the machinery spaces, voids and other watertight spaces may be used to service the cargo spaces containing "Pollution Hazard Only Substances" as defined by chapter 17 of IBC Code.

a. With exception noted above, an independent bilge system must be provided for the cargo pump rooms and hold spaces containing independent cargo tanks. The arrangements shall

(1) be situated entirely within the cargo area; piping shall not pass through the machinery spaces;
(2) be independent from the ships primary bilge piping system;
(3) provide duplicate pumping arrangements sized in accordance with 46 CFR 56.50-55;
(4) provide a manifold or common rail piping arrangement operable from the same space as the pumps are located; and,
(5) provide a separate tank for retention of slops and provide a deck discharge connection.

Vessels Subject to Subchapter T

General

a. Ferrous piping is acceptable. Aluminum piping is acceptable on aluminum, wood or fiberglass hulls.

b. Nonferrous metallic piping materials (pipe, fittings and valves) having a solidus melting temperature of below 1,700 degrees F are acceptable provided that the piping material has the same or higher melting temperature as that demonstrated by the hull.

c. Material selection in accordance with ASTM F1155 is acceptable.

d. Flexible nonmetallic hoses with attached fittings that conform to the SAE J-1942, may be used throughout the bilge piping system provided the hoses do not penetrate water tight bulkheads or decks. The SAE J-1942/1 hose list shall be checked for proper application, allowable working pressure, and fire sleeve requirement. (MSE-2 Policy letter dated April 9, 2002)

e. Further information regarding acceptable materials can be found in MSC Marine Technical Note (MTN) 02-10, Material Selection for Vital Piping Systems.

f. Any arrangement to lock any bilge discharge valve must be approved by the OCMI.

g. Oily water separators must be Coast Guard type approved and plans must include sufficient information to verify that status.

Piping Arrangement

a. For vessels greater than 26 feet in length, each watertight compartment, with exception of the space forward of the collision bulkhead, must be provided with an individual bilge suction. (46 CFR 182.510(a))

b. Minimum bilge pipe size for vessels less than 65 feet is 1 inch NPS; for vessels greater than 65 feet in length, minimum bilge pipe size is 1.5 inch NPS. (46 CFR 182.510(b))

c. Each bilge suction pipe shall be fitted with a strainer having an internal area not less than three times the internal area of the bilge pipe. (46 CFR 182.510(b))

d. The individual bilge suctions shall be led to a central manifold and a stop valve and check valve shall be provided for each suction. A stop-check valve located at the manifold is acceptable. (46 CFR 182.510(c))

e. The bilge suction line that pierces the collision bulkhead shall be fitted with a screw-down stop. If the valve is located forward of the bulkhead, the valve shall be remotely

operable form the weather deck. If the valve is located aft of the bulkhead and is readily accessible, remote operation is not required. (46 CFR 182.510(d))

Bilge Pumps

a. The number and capacity of bilge pumps is dependent on vessel length and number of allowable passengers (46 CFR 182.520 (a)):

Vessel Length	Passengers	Number/Type of Pumps	Minimum Capacity
L > 65 feet	Any	2 Fixed Power	50 gpm
L ≤ 65 feet	P > 49; all ferries	1 Fixed Power 1 Portable Hand	25 gpm 10 gpm
26 feet < L ≤ 65 feet	P < 49	1 Fixed (Power or Hand) 1 Portable Hand	10 gpm 5 gpm
26 feet < L	Any	1 Portable Hand	5 gpm

b. Portable pumps must be sufficient to dewater all compartments and shall be provided with adequate lengths of suction and overboard discharge hoses. (46 CFR 182.520 (a))

c. Fixed power pumps must be of the self-priming type. In a single main engine application, two fixed power pumps must not be driven by the main engine. (46 CFR 182.520 (d))

d. On a vessel less than 65 feet in length, a bilge pump may serve as a fire pump provided the pump meets the required minimum flow rate for the fire pump. (46 CFR 182.520 (h))

e. On a vessel less greater than 65 feet in length, a required bilge pump may serve as a fire pump provided the bilges can be dewatered and the firemain can be charged at the require flow rate, simultaneously. (46 CFR 182.520(i))

f. A catamaran must be equipped with the required number of bilge pumps in each hull unless one pump is provided in each hull and the bilge systems in the separate hulls are permanently cross connected. (46 CFR 182.520(j))

Electric Submersible Pump Installations (46 CFR 182.520(e))

a. Submersible electric bilge pumps may be used as a power bilge pumps required by Table 182.520(a) as follows :

(1) For vessels **under 65 feet** in length carrying not more than 12 passengers, arrangements may be in accordance with ABYC H-22 or the following requirements and the pumps must be UL 1113 or ISO 8846 and ISO 8849 listed.
(2) For vessels of not more than 65 feet in length, carrying not more than 49 passengers, other than a ferry, and not otherwise applying the requirements

permitted by the previous paragraph, the pumps must be listed by an independent laboratory as meeting the requirements in UL 1113.
(3) The pump is used to dewater not more than one watertight compartment.
(4) The pump is permanently mounted.
(5) The pump is equipped with a strainer that can be readily inspected and cleaned without removal.
(6) The pump discharge line is suitably supported.
(7) The opening in the hull for the pump discharge is placed as high above the waterline as possible.
(8) A positive shutoff valve is installed at the hull penetration.
(9) The capacity of the electrical system, including wiring, and size and number of batteries, is designed to allow all bilge pumps to be operated simultaneously.
(10) A flexible tube or hose may be used instead of fixed pipe for the discharge line of a submersible electric bilge pump provided the hose or tube does not penetrate any required watertight bulkheads and is suitable for the installation and is highly resistant to salt water, petroleum oil, heat, and vibration.

Rigid-Hull Inflatable Vessels (RHI)

a. RHIs with sealed (unvented) hull compartments which comply with the swamped condition stability requirements, specified in Enclosure (1), paragraph 4.4 of MTN 01-08, CH-2, are exempt from the fixed bilge pumping requirements in accordance with 46 CFR 182.500(c).

b. Vented void hull compartments fitted with internal buoyancy components which occupy more than 90 percent of the compartment volume can similarly be exempted from fixed bilge system requirements.

c. Both vented and sealed hull compartments must have openings, fitted with watertight/air tight covers, which will permit internal inspection and provide access for a portable bilge pump suction hose.

d. Although bilge pumping systems are not required on certain RHIs, these systems may be fitted provided that they comply with the guidance in MTN 01-08, CH-2 and 46 CFR 182, Subpart E-Bilge and Ballast Systems. If bilge system piping passes through a longitudinal or transverse watertight bulkhead needed for compliance with the internal buoyancy requirements of MTN 01-08, CH-2, watertight bulkhead penetrations shall meet 46 CFR 179.320(c). Bulkheads needed for internal buoyancy should be clearly identified on all bilge system plans.

e. All required fixed mechanical and/or portable bilge pumps must comply with 46 CFR 182.500 through 182.530, insofar as reasonable and practicable, to the satisfaction of the OCMI.

4. **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.