

Subpart D—Specific Machinery Requirements

§ 182.400 Applicability.

(a) This subpart applies to all propulsion and auxiliary machinery installations of the internal combustion piston type.

(b) Requirements of this subpart that are only applicable to engines that use gasoline or other fuels having a flashpoint of 43.3° C (110° F) or lower are specifically designated in each section.

(c) Requirements of this subpart that are only applicable to engines that use diesel fuel or other fuels having a flashpoint of more than 43.3° C (110° F) are specifically designated in each section.

(d) Where no specific gasoline, diesel, or other fuel designation exists, the requirements of this subpart are applicable to all types of fuels and machinery.

§ 182.405 Fuel restrictions.

The use of alternative fuels, other than diesel fuel or gasoline, as fuel for an internal combustion engine will be reviewed on a case by case basis by Commandant.

§ 182.410 General requirements.

(a) Starting motors, generators, and any spark producing device must be mounted as high above the bilges as practicable. Electrical equipment in spaces, compartments, or enclosures that contain machinery powered by, or fuel tanks for, gasoline or other fuels having a flashpoint of 43.3° C (110° F) or lower must be explosion-proof, intrinsically safe, or ignition protected for use in a gasoline atmosphere as required by § 183.530 of this chapter.

(b) Gauges to indicate engine revolutions per minute (RPM), jacket water discharge temperature, and lubricating oil pressure must be provided for all propulsion engines installed in the vessel. The gauges must be readily visible at the operating station.

(c) An enclosed space containing machinery powered by gasoline or other fuels having a flash point of 43.3° C (110° F) or lower must be equipped with a flammable vapor detection device in compliance with § 182.480.

(d) In systems and applications where flexible hoses are permitted to be clamped:

(1) Double hose clamping is required where practicable;

(2) The clamps must be of a corrosion resistant metallic material;

(3) The clamps must not depend on spring tension for their holding power; and

(4) Two clamps must be used on each end of the hose, or one hose clamp can be used if the pipe ends are expanded or beaded to provide a positive stop against hose slippage.

§ 182.415 Carburetors.

(a) All carburetors except the downdraft type must be equipped with integral or externally fitted drip collectors of adequate capacity and arranged so as to permit ready removal of fuel leakage. Externally fitted drip collectors, where practicable, should automatically drain back to engine air intakes.

(b) All gasoline engines installed in a vessel, except outboard engines, must be equipped with an acceptable means of backfire flame control. Installation of backfire flame arresters bearing basic Approval Numbers 162.015 or 162.041 or engine air and fuel induction systems bearing basic Approval Numbers 162.042 or 162.043 may be continued in use as long as they are serviceable and in good condition. New installations or replacements must meet the applicable requirements of this section.

(c) The following are acceptable means of backfire flame control for gasoline engines:

(1) A backfire flame arrester complying with Society of Automotive Engineers (SAE) J-1928, "Devices Providing Backfire Flame Control for Gasoline Engines in Marine Applications," or UL 1111, "Marine Carburetor Flame Arrestors," and marked accordingly. The flame arrester must be suitably secured to the air intake with a flamtight connection.

(2) An engine air and fuel induction system that provides adequate protection from propagation of backfire flame to the atmosphere equivalent to that provided by an acceptable backfire flame arrester. A gasoline engine

utilizing an air and fuel induction system, and operated without an approved backfire flame arrester, must either include a reed valve assembly or be installed in accordance with SAE J-1928, or other standard specified by the Commandant.

(3) An arrangement of the carburetor or engine air induction system that will disperse any flames caused by engine backfire. The flames must be dispersed to the atmosphere outside the vessel in such a manner that the flames will not endanger the vessel, persons on board, or nearby vessels and structures. Flame dispersion may be achieved by attachments to the carburetor or location of the engine air induction system. All attachments must be of metallic construction with flamtight connections and firmly secured to withstand vibration, shock, and engine backfire. Such installations do not require formal approval and labeling but must comply with this subpart.

(4) An engine air induction system on a vessel with an integrated engine-vessel design must be approved, marked, and tested under §162.043 in subchapter Q of this chapter, or other standard specified by the Commandant.

§ 182.420 Engine cooling.

(a) Except as otherwise provided in paragraphs (b), (c), (d), and (e) of this section, all engines must be water cooled and meet the requirements of this paragraph.

(1) The engine head, block, and exhaust manifold must be water-jacketed and cooled by water from a pump that operates whenever the engine is operating.

(2) A suitable hull strainer must be installed in the circulating raw water intake line of an engine cooling water system.

(3) A closed fresh water system may be used to cool the engine.

(b) An engine water cooling system on a vessel of not more than 19.8 meters (65 feet) in length carrying not more than 12 passengers, may comply with the requirements of ABYC Project P-4, "Marine Inboard Engines," instead of the requirements of paragraph (a) of this section.

(c) On a vessel of not more than 19.8 meters (65 feet) in length carrying not more than 12 passengers, a propulsion gasoline engine may be air cooled when in compliance with the requirements of ABYC Project P-4.

(d) An auxiliary gasoline engine may be air cooled when:

(1) It has a self-contained fuel system and it is installed on an open deck; or

(2) On a vessel of not more than 19.8 meters (65 feet) in length carrying not more than 12 passengers, it is in compliance with the requirements of ABYC P-4.

(e) A propulsion or auxiliary diesel engine may be air cooled or employ an air cooled jacket water radiator when:

(1) Installed on an open deck and sufficient ventilation for machinery cooling is available;

(2) Installed in an enclosed or partially enclosed space for which ventilation for machinery cooling is provided, which complies with the requirement of §182.465(b), and other necessary safeguards are taken so as not to endanger the vessel; or

(3) Installed on a vessel of not more than 19.8 meters (65 feet) in length carrying not more than 12 passengers, in compliance with the requirements of ABYC Project P-4.

§ 182.422 Keel and grid cooler installations.

(a) A keel or grid cooler installation used for engine cooling must be designed to prevent flooding.

(b) Except as provided in paragraph (e), a shutoff valve must be located where the cooler piping penetrates the shell, as near the shell as practicable, except where the penetration is forward of the collision bulkhead.

(c) The thickness of the inlet and discharge connections, outboard of the shutoff valves required by paragraph (b) of this section, must be at least Schedule 80.

(d) Short lengths of approved non-metallic flexible hose, fixed by two hose clamps at each end of the hose, may be used at machinery connections for a keel cooler installation.

(e) Shutoff valves are not required for keel or grid coolers that are integral to

§ 182.425

46 CFR Ch. I (10–1–96 Edition)

the hull. A keel cooler is considered integral to the hull if the following conditions are satisfied:

- (1) The cooler structure is fabricated from material of the same thickness and quality as the hull;
- (2) The flexible connections are located well above the deepest subdivision draft;
- (3) The end of the structure is faired to the hull with a slope no greater than 4 to 1; and
- (4) Full penetration welds are employed in the fabrication of the structure and its attachment to the hull.

§ 182.425 Engine exhaust cooling.

(a) Except as otherwise provided in this paragraph, all engine exhaust pipes must be water cooled.

(1) Vertical dry exhaust pipes are permissible if installed in compliance with §§ 177.405(b) and 177.970 of this chapter.

(2) Horizontal dry exhaust pipes are permitted only if:

- (i) They do not pass through living or berthing spaces;
- (ii) They terminate above the deepest load waterline;
- (iii) They are so arranged as to prevent entry of cold water from rough or boarding seas;
- (iv) They are constructed of corrosion resisting material at the hull penetration; and
- (v) They are installed in compliance with §§ 177.405(b) and 177.970 of this chapter.

(b) The exhaust pipe cooling water system must comply with the requirements of this paragraph.

(1) Water for cooling the exhaust pipe must be obtained from the engine cooling water system or a separate engine driven pump.

(2) Water for cooling the exhaust pipe, other than a vertical exhaust, must be injected into the exhaust system as near to the engine manifold as practicable. The water must pass through the entire length of the exhaust pipe.

(3) The part of the exhaust system between the point of cooling water injection and the engine manifold must be water-jacketed or effectively insulated and protected in compliance with §§ 177.405(b) and 177.970 of this chapter.

(4) Vertical exhaust pipes must be water-jacketed or suitably insulated as required by § 182.430(g).

(5) When the exhaust cooling water system is separate from the engine cooling water system, a suitable warning device, visual or audible, must be installed at the operating station to indicate any reduction in normal water flow in the exhaust cooling system.

(6) A suitable hull strainer must be installed in the circulating raw water intake line for the exhaust cooling system.

(c) Engine exhaust cooling system built in accordance with the requirements of ABYC Project P-1, "Installation of Exhaust Systems for Propulsion and Auxiliary Machinery," will be considered as meeting the requirements of this section.

[CGD 85-080, 61 FR 986, Jan. 10, 1996; 61 FR 20557, May 7, 1996]

§ 182.430 Engine exhaust pipe installation.

(a) The design of all exhaust systems must ensure minimum risk of injury to personnel. Protection must be provided in compliance with § 177.970 of this chapter at such locations where persons or equipment might come in contact with an exhaust pipe.

(b) Exhaust gas must not leak from the piping or any connections. The piping must be properly supported by non-combustible hangers or blocks.

(c) The exhaust piping must be so arranged as to prevent backflow of water from reaching engine exhaust ports under normal conditions.

(d) An exhaust pipe discharge located less than 75 millimeters (3 inches) above the deepest load waterline must be installed with a means to prevent the entrance of water.

(e) Pipes used for wet exhaust lines must be Schedule 80 or corrosion-resistant material and adequately protected from mechanical damage.

(f) Where flexibility is necessary, a section of flexible metallic hose may be used. Nonmetallic hose may be used for wet exhaust systems provided it is especially adapted to resist the action of oil, acid, and heat, has a wall thickness sufficient to prevent collapsing or panting, and is double clamped where practicable.

(g) Where an exhaust pipe passes through a watertight bulkhead, the watertight integrity of the bulkhead must be maintained. Noncombustible packing must be used in bulkhead penetration glands for dry exhaust systems. A wet exhaust pipe may be welded to a steel or equivalent bulkhead in way of a penetration and a fiberglass wet exhaust pipe may be fibreglassed to a fiberglass reinforced plastic bulkhead if suitable arrangements are provided to relieve the stresses resulting from the expansion of the exhaust piping.

(h) A dry exhaust pipe must:

(1) If it passes through a combustible bulkhead or partition, be kept clear of, and suitably insulated or shielded from, combustible material.

(2) Be provided with noncombustible hangers and blocks for support.

(i) An exhaust pipe discharge terminating in a transom must be located as far outboard as practicable so that exhaust gases cannot reenter the vessel.

(j) Arrangements must be made to provide access to allow complete inspection of the exhaust piping throughout its length.

(k) An exhaust installation subject to pressures in excess of 105 kPa (15 psig) gauge or having exhaust pipes passing through living or working spaces must meet the material requirements of part 56 of subchapter F (Marine Engineering) of this chapter.

(l) Engine exhaust installations built in accordance with the requirements of ABYC Project P-1, will be considered as meeting the requirements of this section.

[CGD 85-080, 61 FR 986, Jan. 10, 1996; 61 FR 20557, May 7, 1996; 61 FR 24464, May 15, 1996]

§ 182.435 Integral fuel tanks.

(a) Gasoline fuel tanks must be independent of the hull.

(b) Diesel fuel tanks may not be built integral with the hull of a vessel unless the hull is made of:

(1) Steel;

(2) Aluminum; or

(3) Fiber reinforced plastic when:

(i) Sandwich construction is not used; or

(ii) Sandwich construction is used with only a core material of closed cell polyvinyl chloride.

(c) During the initial inspection for certification of a vessel, integral fuel tanks must withstand a hydrostatic pressure test of 35 kPa (5 psig), or the maximum pressure head to that they may be subjected in service, whichever is greater. A standpipe of 3.5 meters (11.5 feet) in height attached to the tank may be filled with water to accomplish the 35 kPa (5 psig) test.

§ 182.440 Independent fuel tanks.

(a) *Materials and construction.* Independent fuel tanks must be designed and constructed of materials in compliance with the requirements of this paragraph.

(1) The material used and the minimum thickness allowed must be as indicated in Table 182.440(a)(1), except that other materials that provide equivalent safety may be approved for use under paragraph (a)(3) of this section. Tanks having a capacity of more than 570 liters (150 gallons) must be designed to withstand the maximum head to which they may be subjected in service, but in no case may the thickness be less than that specified in Table 182.440(a)(1).

TABLE 182.440(a)(1)

Material	ASTM specification (latest edition)	Thickness in millimeters (inches) and [gauge number] ¹ vs. tank capacities for:		
		4 to 300 liter (1 to 80 gal) tanks	More than 300 liter (80 gal) and not more than 570 liter (150 gal) tanks	Over 570 liter (150 gal) ² tanks
Nickel-cooper	B127, hot rolled sheet or plate	0.94 (0.037) [USSG 20] ³	1.27 (0.050) [USSG 18]	2.72 (0.107) [USSG 12]
Copper-nickel ⁴	B122, UNS alloy C71500	1.14 (0.045) [AWG 17]	1.45 (0.057) [AWG 15]	3.25 (0.128) [AWG 8]
Copper ⁴	B152, UNS alloy C11000	1.45 (0.057) [AWG 15]	2.06 (0.081) [AWG 12]	4.62 (0.182) [AWG 5]
Copper-silicon ⁴	B97 alloys A, B, and C	1.29 (0.051) [AWG 16]	1.63 (0.064) [AWG 14]	3.66 (0.144) [AWG 7]
Steel or iron ^{5,6}	*****	1.90 (0.0747) [MSG 14]	2.66 (0.1046) [MSG 12]	4.55 (0.1793) [MSG 7]
Aluminum ⁷	B209 alloy 5052, 5083, 5086	6.35 (0.250) [USSG 3]	6.35 (0.250) [USSG 3]	6.35 (0.250) [USSG 3]
Fiber reinforced plastic	*****	As required ⁸	As required ⁸	As required ⁸

¹ The gauge numbers used in this table may be found in many standard engineering reference books. The letters "USSG" stand for "U.S. Standard Gauge," which was established by the act of March 3, 1892 (15 U.S.C. 206), for sheet and plate iron and steel. The letters "AWG" stand for "American Wire Gauge" (or Brown and Sharpe Gauge) for nonferrous sheet thicknesses. The letters "MSG" stand for "Manufacturers' Standard Gauge" for sheet steel thickness.

² Tanks over 1514 liters (400 gallons) shall be designed with a factor of safety of four on the ultimate strength of the material used with a design head of not less than 1220 millimeters (4 feet) of liquid above the top of the tank.

³ Nickel-copper not less than 0.79 millimeter (0.031 inch) [USSG 22] may be used for tanks up to 114-liter (30-gallon) capacity.

⁴ Acceptable only for gasoline service.

⁵ Gasoline fuel tanks constructed of iron or steel, which are less than 5 millimeter (0.1875 inch) thick, shall be galvanized inside and outside by the hot dip process. Tanks intended for use with diesel oil shall not be internally galvanized.

⁶ Stainless steel tanks are not included in this category.

⁷ Anodic to most common metals. Avoid dissimilar metal contact with tank body.

⁸ The requirements of § 182.440(a)(2) apply.

(2) Fiber reinforced plastic may be used for diesel fuel tanks under the following provisions:

(i) The materials must be fire retardant. Flammability of the material must be determined by the standard test methods in American Society for Testing and Materials (ASTM) D635, "Rate of Burning and/or Extent and Time of Burning of Self-supporting Plastics in a Horizontal Position," and ASTM D2863, "Measuring the Minimum Oxygen Concentration to Support Candle-like Combustion of Plastics (Oxygen Index)," or other standard specified by the Commandant. The results of these tests must show that the average extent of burning is less than 10 millimeters (0.394 inches), the average time of burning is less than 50 seconds, and the limiting oxygen index is greater than 21.

(ii) Tanks must meet UL 1102, "Non integral Marine Fuel Tanks," or other standard specified by the Commandant. Testing may be accomplished by an independent laboratory or by the fabricator to the satisfaction of the OCMI.

(iii) Tanks must be designed to withstand the maximum head to which they may be subjected to in service.

(iv) Installation of nozzles, flanges or other fittings for pipe connections to the tanks must be acceptable to the cognizant OCMI.

(v) Baffle plates, if installed, must be of the same material and not less than the minimum thickness of the tank walls. Limber holes at the bottom and air holes at the top of all baffles must be provided. Baffle plates must be installed at the time the tests required by UL Standard 1102, or other standard specified by the Commandant, are conducted.

(3) Materials other than those listed in Table 182.440(a)(1) must be approved by the Commandant. An independent tank using material approved by the Commandant under this paragraph must meet the testing requirements of UL Standard 1102, or other standard specified by the Commandant. Testing may be accomplished by an independent laboratory or by the fabricator to the satisfaction of the OCMI.

(4) Tanks with flanged-up top edges that may trap and hold moisture are prohibited.

(5) Openings for fill pipes, vent pipes, and machinery fuel supply pipes, and openings for fuel level gauges, where used, must be on the topmost surfaces of tanks. Tanks may not have any openings in bottoms, sides, or ends, except for:

(i) An opening fitted with a threaded plug or cap installed for tank cleaning purposes; and

(ii) In a diesel fuel tank, openings for supply piping and tubular gauge glasses.

(6) All tank joints must be welded or brazed. Lap joints may not be used.

(7) Nozzles, flanges, or other fittings for pipe connections to a metal tank must be welded or brazed to the tank. Tank openings in way of pipe connections must be properly reinforced where necessary. Where fuel level gauges are used on a metal tank, the flanges to which gauge fittings are attached must be welded or brazed to the tank. No tubular gauge glasses may be fitted to gasoline fuel tanks. Tubular gauge glasses, if fitted to diesel fuel tanks, must be of heat resistant materials, adequately protected from mechanical damage, and provided at the tank connections with devices that will automatically close in the event of rupture of the gauge or gauge lines.

(8) A metal tank exceeding 760 millimeters (30 inches) in any horizontal dimension must:

(i) Be fitted with vertical baffle plates, which meet subparagraph (a)(9) of this section, at intervals not exceeding 760 millimeters (30 inches) to provide strength and to control the excessive surge of fuel; or

(ii) The owner shall submit calculations to the cognizant OCMI demonstrating the structural adequacy of the tank in a fully loaded static condition and in a worst case dynamic (sloshing) condition.

(9) Baffle plates, where required in metal tanks, must be of the same material and not less than the minimum thickness required in the tank walls and must be connected to the tank walls by welding or brazing. Limber holes at the bottom and air holes at the top of all baffles must be provided.

(10) Iron or steel diesel fuel tanks must not be galvanized on the interior. Galvanizing, paint, or other suitable

coating must be used to protect the outside of iron and steel diesel fuel tanks and the inside and outside of iron and steel gasoline fuel tanks.

(b) *Location and installation.* Independent fuel tanks must be located and installed in compliance with the requirements of this paragraph.

(1) Fuel tanks must be located in, or as close as practicable to, machinery spaces.

(2) Fuel tanks and fittings must be so installed as to permit examination, testing, or removal for cleaning with minimum disturbance to the hull structure.

(3) Fuel tanks must be adequately supported and braced to prevent movement. The supports and braces must be insulated from contact with the tank surfaces with a nonabrasive and non-absorbent material.

(4) All fuel tanks must be electrically bonded to a common ground.

(c) *Tests.* Independent fuel tanks must be tested in compliance with the requirements of this part prior to being used to carry fuel.

(1) Prior to installation, tanks vented to the atmosphere must be hydrostatically tested to, and must withstand, a pressure of 35 kPa (5 psig) or 1½ times the maximum pressure head to which they may be subjected in service, whichever is greater. A stand-pipe of 3.5 meters (11.5 feet) in height attached to the tank may be filled with water to accomplish the 35 kPa (5 psig) test. Permanent deformation of the tank will not be cause for rejection unless accompanied by leakage.

(2) After installation of the fuel tank on a vessel, the complete installation must be tested in the presence of a marine inspector, or individual specified by the cognizant OCM, to a head not less than that to which the tank may be subjected in service. Fuel may be used as the testing medium.

(3) All tanks not vented to the atmosphere must be constructed and tested in accordance with § 182.330 of this part.

(d) *Alternative procedures.* A vessel of not more than 19.8 meters (65 feet) in length carrying not more than 12 passengers, with independent gasoline fuel tanks built in accordance with ABYC Project H-24, or 33 CFR 183, subpart J,

or with independent diesel fuel tanks built in accordance with ABYC Project H-33, will be considered as meeting the requirements of this section. However, tanks must not be fabricated from any material not listed in Table 182.440(a)(1) without approval by the Commandant under paragraph (a)(3) of this section.

§ 182.445 Fill and sounding pipes for fuel tanks.

(a) Fill pipes for fuel tanks must be not less than 40 millimeters (1.5 inches) nominal pipe size.

(b) There must be a means of accurately determining the amount of fuel in each fuel tank either by sounding, through a separate sounding pipe or a fill pipe, or by an installed marine type fuel gauge.

(c) Where sounding pipes are used, their openings must be at least as high as the opening of the fill pipe and they must be kept closed at all times except during sounding.

(d) Fill pipes and sounding pipes must be so arranged that overflow of liquid or vapor cannot escape to the inside of the vessel.

(e) Fill pipes and sounding pipes must run as directly as possible, preferably in a straight line, from the deck connection to the top of the tank. Such pipes must terminate on the weather deck and must be fitted with shutoff valves, watertight deck plates, or screw caps, suitably marked for identification. Gasoline fill pipes and sounding pipes must extend to within one-half of their diameter from the bottom of the tank. Diesel fill pipes and sounding pipes may terminate at the top of the tank.

(f) A vessel of not more than 19.8 meters (65 feet) carrying not more than 12 passengers, with a gasoline fuel system built in accordance with ABYC Project H-24, or 33 CFR 183, subpart J, or with a diesel fuel system built in accordance with ABYC Project H-33, will be considered as meeting the requirements of this section.

(g) Where a flexible fill pipe section is necessary, suitable flexible tubing or hose having high resistance to salt water, petroleum oils, heat and vibration, may be used. Such hose must overlap metallic pipe ends at the least

1½ times the pipe diameter and must be secured at each end by clamps. The flexible section must be accessible and as near the upper end of the fill pipe as practicable. When the flexible section is a nonconductor of electricity, the metallic sections of the fill pipe separated thereby must be joined by a conductor for protection against generation of a static charge when filling with fuel.

§ 182.450 Vent pipes for fuel tanks.

(a) Each unpressurized fuel tank must be fitted with a vent pipe connected to the highest point of the tank.

(b) The net cross sectional area of the vent pipe for a gasoline fuel tank must not be less than that of 19 millimeters (0.75 inches) outer diameter (O.D.) tubing (0.9 millimeter (0.035 Inch) wall thickness, 20 gauge), except that, where the tank is filled under pressure, the net cross sectional area of the vent pipe must be not less than that of the fill pipe.

(c) The minimum net cross sectional area of the vent pipe for diesel fuel tanks must be as follows:

(1) Not less than the cross sectional area of 16 millimeters (0.625 inches) outer diameter (O.D.) tubing (0.9 millimeter (0.035-inch) wall thickness, 20 gauge), if the fill pipe terminates at the top of the tank;

(2) Not less than the cross sectional area of 19 millimeters (0.75 inches) O.D. tubing (0.9 millimeter (0.035-inch) wall thickness, 20 gauge), if the fill pipe extends into the tank; and

(3) Not less than the cross sectional area of the fill pipe if the tank is filled under pressure.

(d) The discharge ends of fuel tank vent pipes must terminate on the hull exterior as high above the waterline as practicable and remote from any hull openings, or they must terminate in U-bends as high above the weather deck as practicable and as far as practicable from openings into any enclosed spaces. Vent pipes terminating on the hull exterior must be installed or equipped to prevent the accidental contamination of the fuel by water under normal operating conditions.

(e) The discharge ends of fuel tank vent pipes must be fitted with removable flame screens or flame arresters.

The flame screens must consist of a single screen of corrosion resistant wire of at least 30x30 mesh. The flame screens or flame arresters must be of such size and design as to prevent reduction in the net cross sectional area of the vent pipe and permit cleaning or renewal of the flame screens or arrester elements.

(f) A vessel of not more than 19.8 meters (65 feet) in length carrying not more than 12 passengers, with fuel gasoline tank vents built in accordance with ABYC Project H-24, or 33 CFR 183, subpart J, or with diesel fuel tank vents built in accordance with ABYC Project H-33, will be considered as meeting the requirements of this section.

(g) Where a flexible vent pipe section is necessary, suitable flexible tubing or hose having high resistance to salt water, petroleum oils, heat and vibration, may be used. Such hose must overlap metallic pipe ends at least 1½ times the pipe diameter and must be secured at each end by clamps. The flexible section must be accessible and as near the upper end of the vent pipe as practicable.

(h) Fuel tank vent pipes shall be installed to gradient upward to prevent fuel from being trapped in the line.

§ 182.455 Fuel piping.

(a) *Materials and workmanship.* The materials and construction of fuel lines, including pipe, tube, and hose, must comply with the requirements of this paragraph.

(1) Fuel lines must be annealed tubing of copper, nickel-copper, or copper-nickel having a minimum wall thickness of 9 millimeters (0.035 inch) except that:

(i) Diesel fuel piping of other materials, such as seamless steel pipe or tubing, which provide equivalent safety may be used;

(ii) Diesel fuel piping of aluminum is acceptable on aluminum hull vessels provided it is a minimum of Schedule 80 wall thickness; and

(iii) when used, flexible hose must meet the requirements of § 182.720(e) of this part.

(2) Tubing connections and fittings must be of nonferrous drawn or forged metal of the flared type except that

flareless fittings of the non-bite type may be used when the tubing system is of nickel-copper or copper-nickel. When making tube connections, the tubing must be cut square and flared by suitable tools. Tube ends must be annealed before flaring.

(3) Cocks are prohibited except for the solid bottom type with tapered plugs and union bonnets.

(4) Valves for gasoline fuel must be of a suitable nonferrous type.

(b) *Installation.* The installation of fuel lines, including pipe, tube, and hose, must comply with the requirements of this paragraph.

(1) Gasoline fuel lines must be connected at the top of the fuel tank and run at or above the level of the tank top to a point as close to the engine connection as practicable, except that lines below the level of the tank top are permitted if equipped with anti-siphon protection.

(2) Diesel fuel lines may be connected to the fuel tank at or near the bottom of the tank.

(3) Fuel lines must be accessible, protected from mechanical injury, and effectively secured against excessive movement and vibration by the use of soft nonferrous metal straps which have no sharp edges and are insulated to protect against corrosion. Where passing through bulkheads, fuel lines must be protected by close fitting ferrules or stuffing boxes. All fuel lines and fittings must be accessible for inspection.

(4) Shutoff valves, installed so as to close against the fuel flow, must be fitted in the fuel supply lines, one at the tank connection and one at the engine end of the fuel line to stop fuel flow when servicing accessories. The shutoff valve at the tank must be manually operable from outside the compartment in which the valve is located, preferably from an accessible position on the weather deck. If the handle to the shutoff valve at the tank is located inside the machinery space, it must be located so that the operator does not have to reach more than 300 millimeters (12 inches) into the machinery space and the valve handle must be shielded from flames by the same material the hull is constructed of, or some noncombustible material.

Electric solenoid valves must not be used, unless used in addition to the manual valve.

(5) A loop of copper tubing or a short length of flexible hose must be installed in the fuel supply line at or near the engines. The flexible hose must meet the requirements of § 182.720(e).

(6) A suitable metal marine type strainer, meeting the requirements of the engine manufacturer, must be fitted in the fuel supply line in the engine compartment. Strainers must be leak free. Strainers must be the type of opening on top for cleaning screens. A drip pan fitted with flame screen must be installed under gasoline strainers. Fuel filter and strainer bowls must be highly resistant to shattering due to mechanical impact and resistant to failure due to thermal shock. Fuel filters fitted with bowls of other than steel construction must be approved by the Commandant and be protected from mechanical damage. Approval of bowls of other than steel construction will specify if a flame shield is required.

(7) All accessories installed in the fuel line must be independently supported.

(8) Outlets in gasoline fuel lines that would permit drawing fuel below deck, for any purpose, are prohibited.

(9) Valves for removing water or impurities from diesel fuel in water traps or strainers are permitted. These valves must be provided with caps or plugs to prevent fuel leakage.

(c) *Alternative procedures.* A vessel of not more than 19.8 meters (65 feet) carrying no more than 12 passengers, with machinery powered by gasoline and a fuel system built in accordance with ABYC Project H-24, or 33 CFR 193, subpart J, or with machinery powered by diesel fuel and a fuel system built in accordance with ABYC Project H-33, will be considered as meeting the requirements of this section.

§ 182.458 Portable fuel systems.

(a) Portable fuel systems, including portable tanks and related fuel lines and accessories, are prohibited except where used for outboard motor installations.

(b) The design, construction and stowage of portable tanks and related fuel lines and accessories must meet the requirements of ABYC Projected H-25, "Portable Gasoline Fuel systems for Flammable Liquids," or other standard specified by the Commandant.

§ 182.460 Ventilation of spaces containing machinery powered by, or fuel tanks for, gasoline.

(a) A space containing machinery powered by, or fuel tanks for, gasoline must have a ventilation system that complies with this section and consists of:

(1) For an enclosed space:

(i) At least two natural ventilation supply ducts located at one end of the space and that extend to the lowest part of the space or to the bilge on each side of the space; and

(ii) A mechanical exhaust system consisting of at least two ventilation exhaust ducts located at the end of the space opposite from where the supply ducts are fitted, which extend to the lowest part or the bilge of the space on each side of the space, and which are led to one or more powered exhaust blowers; and

(2) For a partially enclosed space, at least one ventilation duct installed in the forward part of the space and one ventilation duct installed in the after part of the space, or as otherwise required by the cognizant OCMI. Ducts for partially enclosed spaces must have cowls or scoops as required by paragraph (i) of this section.

(b) A mechanical exhaust system required by paragraph (a)(1)(ii) of this section must be such as to assure the air changes as noted in Table 182.460(b) depending upon the size of the space.

TABLE 182.460(b)

Size of space in cubic meters (feet)		Minutes per air change
Over	Not over	
0	14 (500)	2
14 (500)	28.50 (1000)	3
28.50 (1000)	43 (1500)	4
43 (1500)	5

(c) An exhaust blower motor may not be installed in a duct, and if mounted in any space required to be ventilated by this section, must be located as high above the bilge as practicable. Blower

blades must be nonsparking with reference to their housings.

(d) Where a fixed gas fire extinguishing system is installed in a space, all powered exhaust blowers for the space must automatically shut down upon release of the extinguishing agent.

(e) Exhaust blower switches must be located outside of any space required to be ventilated by this section, and must be of the type interlocked with the starting switch and the ignition switch so that the blowers are started before the engine starter motor circuit or the engine ignition is energized. A red warning sign at the switch must state that the blowers must be operated prior to starting the engines for the time sufficient to insure at least one complete change of air in the space served.

(f) The area of the ventilation ducts must be sufficient to limit the air velocity to a maximum of 10 meters per second (2,000 feet per minute). A duct may be of any shape, provided that in no case will one cross sectional dimension exceed twice the other.

(g) A duct must be so installed that ordinary collection of water in the bilge will not block vapor flow.

(h) A duct must be of rigid permanent construction, which does not allow any appreciable vapor flow except through normal openings, and made of the same material as the hull or of noncombustible material. The duct must lead as directly as possible from its intake opening to its terminus and be securely fastened and supported.

(i) A supply duct must be provided at its intake opening with a cowl or scoop having a free area not less than twice the required duct area. When the cowl or scoop is screened, the mouth area must be increased to compensate for the area of the screen wire. A cowl or scoop must be kept open at all times except when the weather is such as to endanger the vessel if the openings are not temporarily closed.

(j) Dampers may not be fitted in a supply duct.

(k) A duct opening may not be located where the natural flow of air is unduly obstructed, adjacent to possible sources of vapor ignition, or where exhaust air may be taken into a supply duct.

(l) Provision must be made for closing all supply duct cowls or scoops and exhaust duct discharge openings for a space protected by a fixed gas extinguishing system. All closure devices must be readily available and mounted in the vicinity of the vent.

(m) A vessel of not more than 19.8 meters (65 feet) in length carrying not more than 12 passengers, with ventilation installations in accordance with ABYC Project H-2, "Ventilation of Boats Using Gasoline," or 33 CFR 183, subpart K, "Ventilation," will be considered as meeting the requirements of this section.

§ 182.465 Ventilation of spaces containing diesel machinery.

(a) A space containing diesel machinery must be fitted with adequate means such as dripproof ventilators, ducts, or louvers, to provide sufficient air for proper operation of main engines and auxiliary engines.

(b) Air-cooled propulsion and auxiliary diesel engines installed below deck, as permitted by § 182.420, must be fitted with air supply ducts or piping from the weather deck. The ducts or piping must be so arranged and supported to be capable of safely sustaining stresses induced by weight and engine vibration and to minimize transfer of vibration to the supporting structure. Prior to installation of ventilation system for such engines, plans or sketches showing machinery arrangement including air supplies, exhaust stack, method of attachment of ventilation ducts to the engine, location of spark arresting mufflers and capacity of ventilation blowers must be submitted to the cognizant OCMI for approval.

(c) A space containing diesel machinery must be fitted with at least two ducts to furnish natural or powered supply and exhaust ventilation. The total inlet area and the total outlet area of each ventilation duct may not be less than one square inch for each foot of beam of the vessel. These minimum areas must be increased as necessary when the ducts are considered as part of the air supply to the engines.

(d) A duct must be of rigid permanent construction, which does not allow any appreciable vapor flow except through

normal openings, and made of the same material as the hull or of noncombustible material. The duct must lead as directly as possible from its intake opening to its terminus and be securely fastened and supported.

(e) A supply duct must be provided with a cowl or scoop having a free area not less than twice the required duct area. When the cowl or scoop is screened, the mouth area must be increased to compensate for the area of the screen wire. A cowl or scoop must be kept open at all times except when the weather is such as to endanger the vessel if the openings are not temporarily closed.

(f) Dampers may not be fitted in a supply duct.

(g) A duct opening may not be located where the natural flow of air is unduly obstructed, adjacent to possible sources of vapor ignition, or where exhaust air may be taken into a supply duct.

(h) provision must be made for closing all supply duct cowls or scoops and exhaust duct discharge openings for a space protected by a fixed gas extinguishing system. All closure devices must be readily available and mounted in the vicinity of the vent.

(i) A vessel of not more than 19.8 meters (65 feet) in length carrying not more than 12 passengers, with ventilation installations in accordance with ABYC Project H-32, "Ventilation of Boats Using Diesel Fuel," will be considered as meeting the requirements of this section.

§ 182.470 Ventilation of spaces containing diesel fuel tanks.

(a) Unless provided with ventilation that complies with § 182.465, a space containing a diesel fuel tank and no machinery must meet the requirements of this section.

(1) A space of 14 cubic meters (500 cubic feet) or more in volume must have a gooseneck vent of not less than 65 millimeters (2.5 inches) in diameter.

(2) A space of less than 14 cubic meters (500 cubic feet) in volume must have a gooseneck vent of not less than 40 millimeters (1.5 inches) in diameter.

(b) Vent openings may not be located adjacent to possible sources of vapor ignition.

(c) A vessel of not more than 19.8 meters (65 feet) in length carrying not more than 12 passengers, with ventilation installations in accordance with ABYC Project H-32, "Ventilation of Boats Using Diesel Fuel," will be considered as meeting the requirements of this section.

§ 182.480 Flammable vapor detection systems.

(a) A flammable vapor detection system required by § 182.410(c) must meet UL Standard 1110, "Marine Combustible Gas Indicators," or be approved by an independent laboratory.

(b) Procedures for checking the proper operation of a flammable vapor detection system must be posted at the primary operating station. The system must be self-monitoring and include a ground fault indication alarm.

(c) A flammable vapor detection system must be operational for 30 seconds prior to engine startup and continue sensing the entire time the engine is running.

(d) A flammable vapor detection system must provide a visual and audible alarm at the operating station.

(e) A sensor must be located above the expected bilge water level in the following locations:

(1) The lowest part of a machinery space;

(2) The lowest part of a space containing a fuel tank when separate from the machinery space; and

(3) Any other location when required by the cognizant OCMI.

(f) A flammable vapor detection system must be installed so as to permit calibration in a vapor free atmosphere.

(g) Electrical connections, wiring, and components for a flammable vapor detection system must comply with part 183 of this chapter.

(h) An operation and maintenance manual for the flammable vapor detection system must be kept onboard.

Subpart E—Bilge and Ballast Systems

§ 182.500 General.

(a) A vessel must be provided with a satisfactory arrangement for draining any watertight compartment, other than small buoyancy compartments,

under all practicable conditions. Sluice valves are not permitted in watertight bulkheads.

(b) A vessel of not more than 19.8 meters (65 feet) in length carrying not more than 12 passengers may meet the requirements of ABYC Project H-22, "DC Electric Bilge Pumps Operating Under 50 Volts," in lieu of the requirements of this subpart, provided that each watertight compartment, other than small buoyancy compartments and the compartment forward of the collision bulkhead, is provided with a means for dewatering.

(c) Special consideration may be given to vessels, such as high speed craft, which have a high degree of subdivision and utilize numerous small buoyancy compartments. Where the probability of flooding of the space is limited to external hull damage, compartment drainage may be omitted provided it can be shown by stability calculations, submitted to the cognizant OCMI, that the safety of the vessel will not be impaired.

§ 182.510 Bilge piping system.

(a) A vessel of at least 7.9 meters (26 feet) in length must be provided with individual bilge lines and bilge suction for each watertight compartment, except that the space forward of the collision bulkhead need not be fitted with a bilge suction line when the arrangement of the vessel is such that ordinary leakage may be removed from this compartment by the use of a hand portable bilge pump or other equipment, and such equipment is provided.

(b) A bilge pipe in a vessel of not more than 19.8 meters (65 feet) in length must be not less than 25 millimeters (1 inch) nominal pipe size. A bilge pipe in a vessel of more than 19.8 meters (65 feet) in length must be not less than 40 millimeters (1.5 inches) nominal pipe size. A bilge suction must be fitted with a suitable strainer having an open area not less than three times the area of the bilge pipe.

(c) Except when individual pumps are provided for separate spaces, individual bilge suction lines must be led to a central control point or manifold and provided with a stop valve at the control point or manifold and a check