

BOATBUILDER'S HANDBOOK

[REVISED NOVEMBER, 2003]



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SUBPART J

FUEL SYSTEMS

Revised November, 2003

Title 33 CFR, Sections 183.501–183.590

WARNING:

This guide only addresses provisions of the Federal Regulations.
It is NOT a complete engineering manual for the design of boat systems.
It is the manufacturer's responsibility to ensure Federal Regulations
cited in this guide have not been updated or revised.

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Introduction

There are many requirements for the fuel system of gasoline powered inboard boats. They may be found in Title 33 CFR Part 183 Subpart J.

Some of these requirements may be specifically applied but many are dependent on other requirements. Some of the requirements should be complied with only if certain conditions of installation are selected or if certain types of fuel system products or components are used. This many faceted approach may lead to confusion.

Regulations are typically written in concise terms, the words and arrangements chosen to be enforceable and in some cases to be legally interpreted. A regulatory format does not allow for explanations, recommendations and easily detected alternate solutions. A regulation provides an outline about which a great deal of further information, interpretation, explanation, clarification and some helpful hints are needed in order to provide a good understanding and compliance with its intent.

This fuel system guideline assists the designer, boat builder, surveyor and repairer to achieve compliance with the regulation. The guideline explains, interprets, clarifies, provides alternatives, diagrams, tabulates, makes recommendations, and in general, compliments the regulation to improve the user's understanding.

CAUTION

This guideline only addresses provisions of the Federal Regulations. It is not a complete engineering manual for the design of electrical systems on boats. There are other manuals and standards available for this purpose.

FORMAT

The format of this guideline has been chosen to follow the sequence of presentation in the fuel system regulation. Other arrangements could have been chosen; however, this format provides the user with a sequence of information, which reduces confusion.

A portion of the regulation is stated, preceded by the title FEDERAL LAW, followed by the effective date of that portion of the regulation. Then a discussion follows which explains, interprets, clarifies, and identifies interdependence of requirements and is designed to improve the understanding of the intent of the regulatory requirement. Diagrams are freely used and tables included wherever they can be helpful.

The discussion, diagrams and tables are followed by a box identified by the title TO COMPLY WITH THE LAW, which asks questions to which the answer must be YES if compliance is achieved. This is a checklist for each regulatory requirement.

General

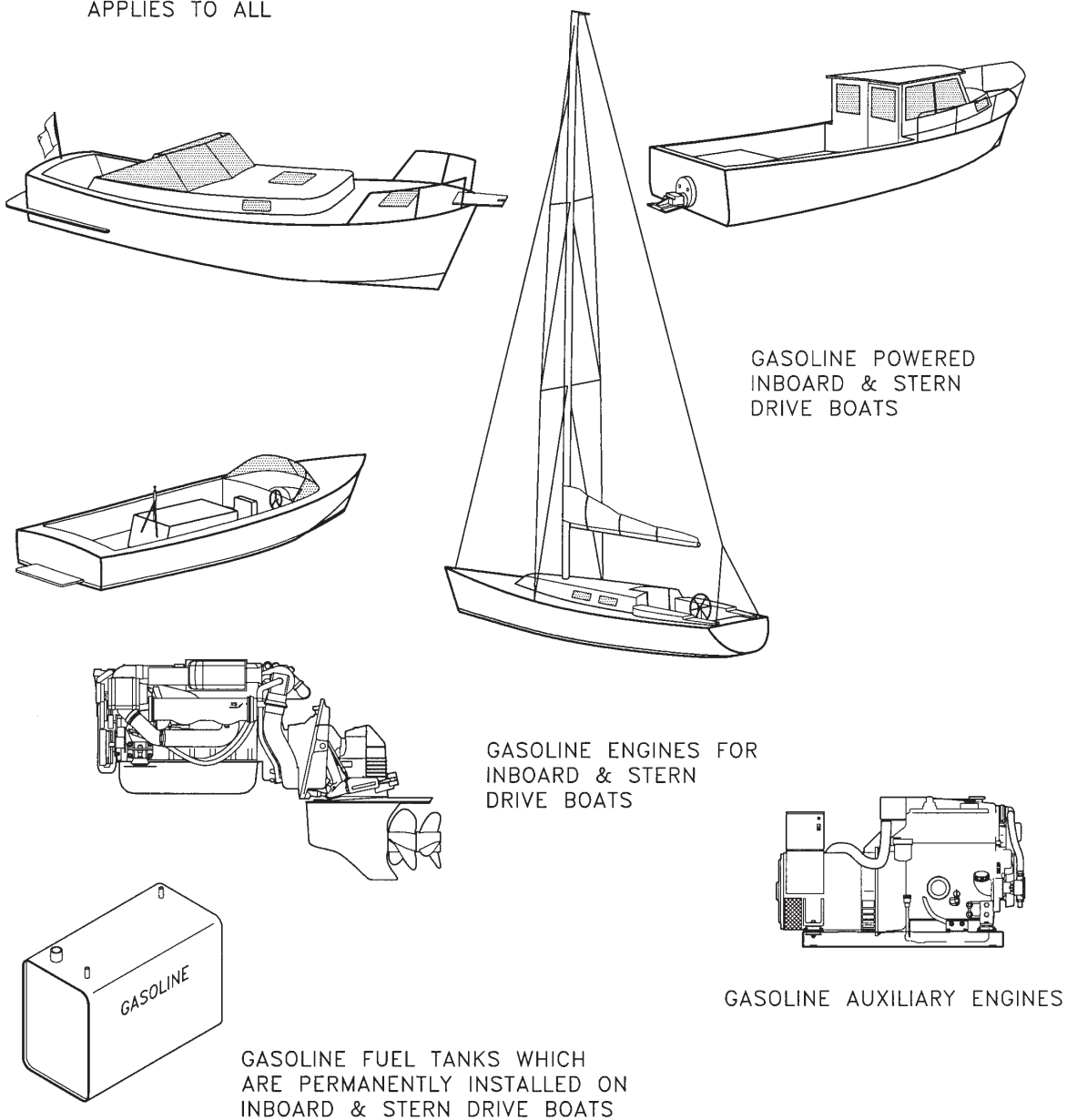
FEDERAL LAW:

183.501 Applicability.

- (a) This subpart applies to all boats that have gasoline engines, except outboard engines, for electrical generation, mechanical power, or propulsion.

Figure 1 Applicability

APPLIES TO ALL



FEDERAL LAW:

183.505 Definitions.
As used in this subpart:

Flame arrestor means a device or assembly that prevents passage of flame through a fuel vent.

A flame arrestor for a fuel tank may be a specially designed fitting with flame arresting elements, such as screens, or the vent tubing may itself be effective. Air flows in both directions in the fuel tank vent. Outside air goes into the tank to equalize the pressure when gasoline is used in the engine and fuel vapor-laden air flows out of the tank through the vent when the tank is being filled. Ambient temperature changes also cause air flow in both directions. If the fuel vapor-laden air is ignited outside the fuel tank fittings or discharge point, the flame arrestor is to prevent the flame from being propagated through the fuel tank vent into the fuel tank.

If it is intended to qualify a vent system without a specially designed fitting containing flame arresting elements, it is recommended that extreme caution be exercised to assure safe conduct of any qualifying test.

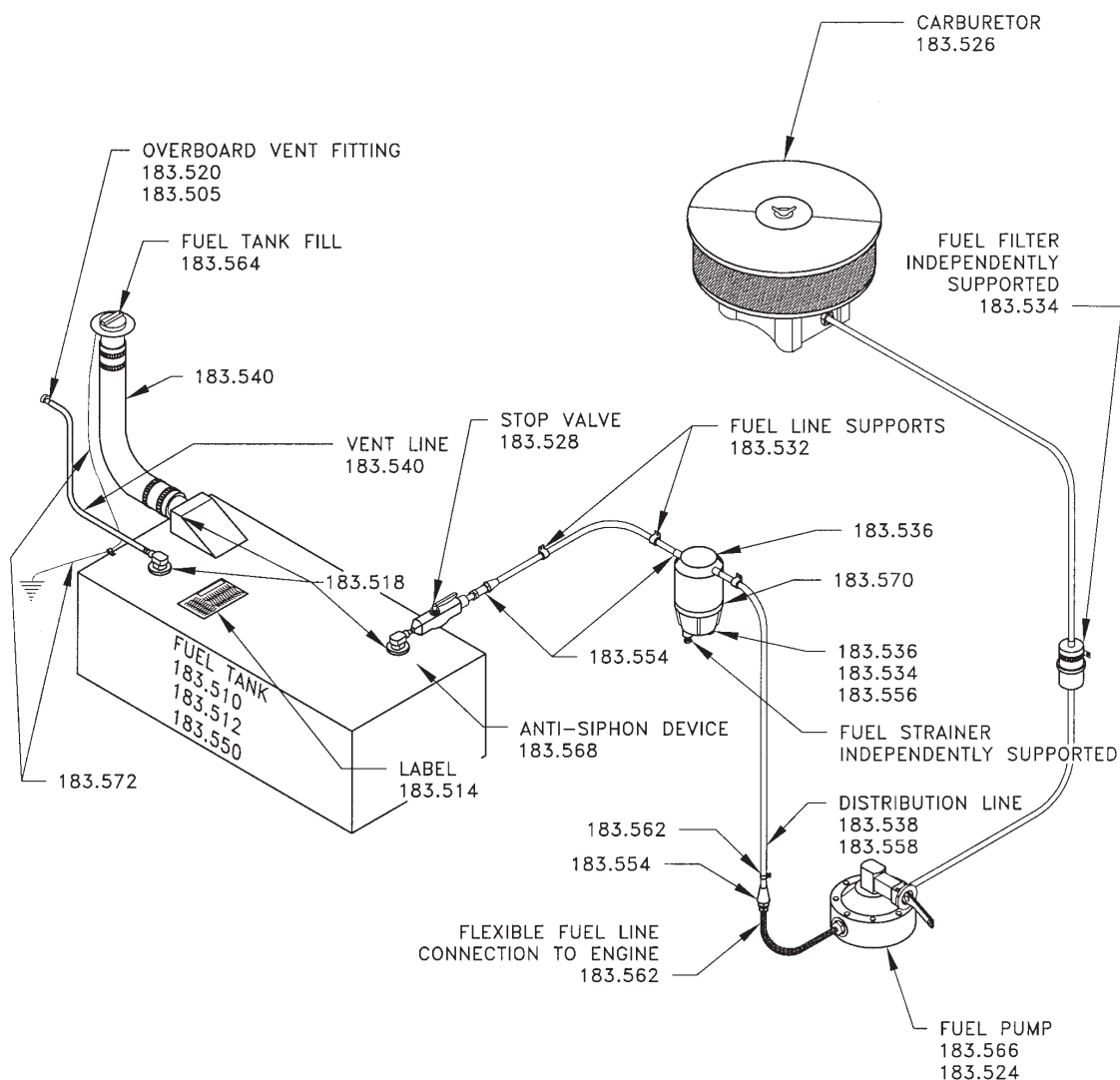
FEDERAL LAW:

183.505 Definitions.
As used in this subpart:

Fuel system means the entire assembly of the fuel fill, vent, tank, and distribution components, including pumps, valves, strainers, carburetors and filters.

A typical fuel system is diagrammed in Figure 2. Other fuel systems may contain more or fewer components, and may be of other materials as permitted under these conditions. Two or more engines in a boat will necessitate a more complicated system, which may include a number of fuel tanks with possible provisions for interconnection. Fuel transfer pumps may also be included in the fuel system.

FIGURE 2 A Typical Fuel System



FEDERAL LAW:

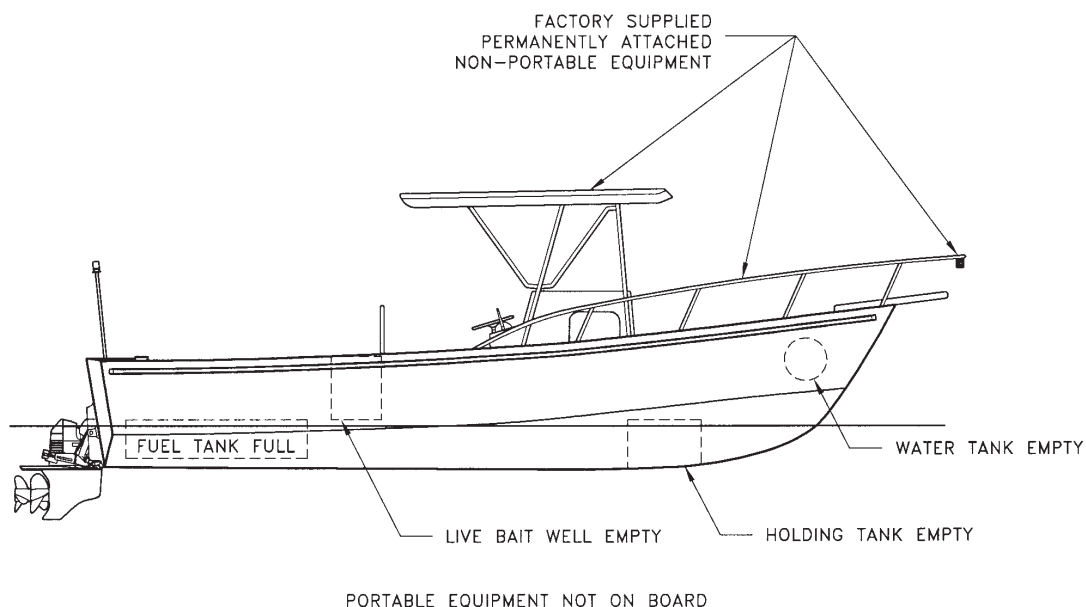
183.505 Definitions.
As used in this subpart:

Static floating position means the attitude in which a boat floats in calm water, with each fuel tank filled to its rated capacity, but with no person or item of portable equipment on board.

This is to establish a standard measurement condition. It is not related to freeboard or other safety considerations, but is an attitude of the boat which can be obtained on a repeatable basis for use in testing certain criteria of the regulation. The requirements which will be checked with the boat in a "static floating position" are:

- (1) Water accumulation on the top of the fuel tank (183.550)
- (2) Anti-siphon protection (183.568)
- (3) 5-ounce fuel leakage (183.558)
- (4) Fuel fill overflow (183.564)

FIGURE 3 Static Floating Position



183.505 *Static Floating Position (continued)***Examples of portable equipment:**

- Mattresses
- Portable fire extinguishers, except brackets
- Lines
- Fenders
- Personal flotation devices
- Chairs
- Tables
- Anchors and chains

A boat builder should record what equipment the test sample has on board during the test in order that a compliance test may be conducted in the same manner.

FEDERAL LAW:**183.507 General.**

Each fuel system component on a boat to which this subpart applies must meet the requirements of this subpart unless the component is part of an outboard engine or is part of portable equipment.

The boat manufacturer, not the manufacturer of each component, is required to certify each boat as complying with this regulation. Component parts of outboard engines and portable equipment, such as a self-contained gasoline engine generator unit, are not covered by these regulations.

The Equipment Standards of this regulation appear to impose requirements, and consequently certification responsibilities, on component manufacturers including inboard engine manufacturers. This is not the case. The boat manufacturer is responsible under these regulations and must certify compliance. Purchase orders can stipulate that component manufacturers provide affidavits of compliance which a boat manufacturer may choose to recognize as supporting evidence in certifying the entire fuel system.

Equipment Standards

FEDERAL LAW:

183.510 Fuel tanks.

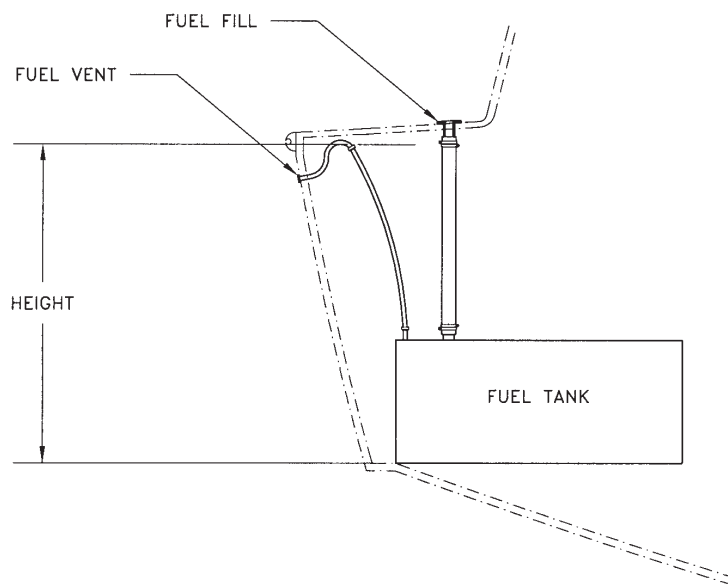
- (a) Each fuel tank in a boat must have been tested by its manufacturer under Sec. 183.580 and not leak when subjected to the pressure marked on the tank label under Sec. 183.514(b)(5).

Each fuel tank must be tested to see if it leaks. This leakage test includes all fittings supplied as part of the tank.

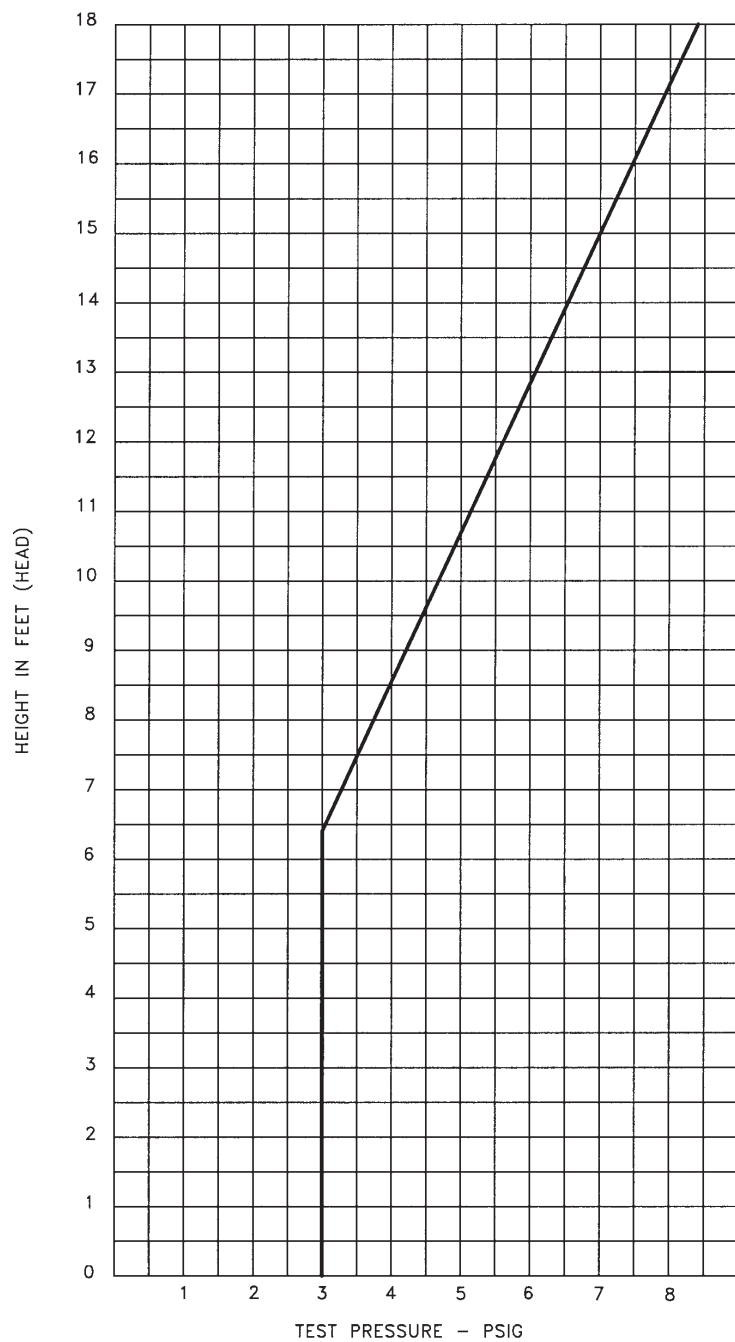
TEST PRESSURE

The test pressure must be the greater of 3 Pounds per square inch gauge (psig) or 1-1/2 times the pressure created at the lowest point in the fuel system when the fill or vent line, whichever is lower in height, is filled to its top with fuel, as indicated in 183.542. A 3 psig test will cover installations whose height from the lowest point in the fuel system is 6.4 feet to the lower of the fill or vent. See Figure 5 for height covered by various pressures. These heights refer to a head of gasoline and take into account the one and one-half times the head. The determined pressure is the minimum pressure that must appear on the fuel tank label. For the test procedure, refer to 183.580. Normally, the test is conducted by the tank manufacturer who applies the tank label. The boat manufacturer is responsible for determining that this test has been performed on the tank, in addition to the fuel system pressure test required by 183.542.

FIGURE 4 Fuel Tank Pressure



183.510 Fuel Tanks (continued)

FIGURE 5 Pressure versus Height

FEDERAL LAW:

183.510 Fuel tanks.

- (b) Each fuel tank must not leak if subjected to the fire test under Sec. 183.590. Leakage is determined by the static pressure test under Sec. 183.580, except that the test pressure must be at least one-fourth PSIG.

Each fuel tank must be designed and constructed so that if selected to be fire tested according to one of the procedures of 183.590, it will not leak following the fire test when pressure tested to 0.25 pounds per square inch gauge (psig) in accordance with the test procedure described in 183.580.

Selection for a fire test may be made by the USCG in order to conduct a compliance check. A manufacturer may also select a representative tank and subject it to a fire test in order to assure compliance. Note that 183.590 permits the subject tank to be tested for fire resistance in an actual or simulated hull section. This may be less a severe test for the tank.

TO COMPLY WITH THE LAW

The fuel tank will withstand at least one of the following fire tests:

- *Fire chamber test — 183.590(a)(3), (b) & (c), or*
- *Actual or simulated hull section — 183.590(a)(3), (b) & (e); or*
- *The fuel tank does not leak following the fire test — see 183.510(b). For this test, the tank is only subjected to 0.25 psig.*

FEDERAL LAW:

183.510 Fuel tanks.

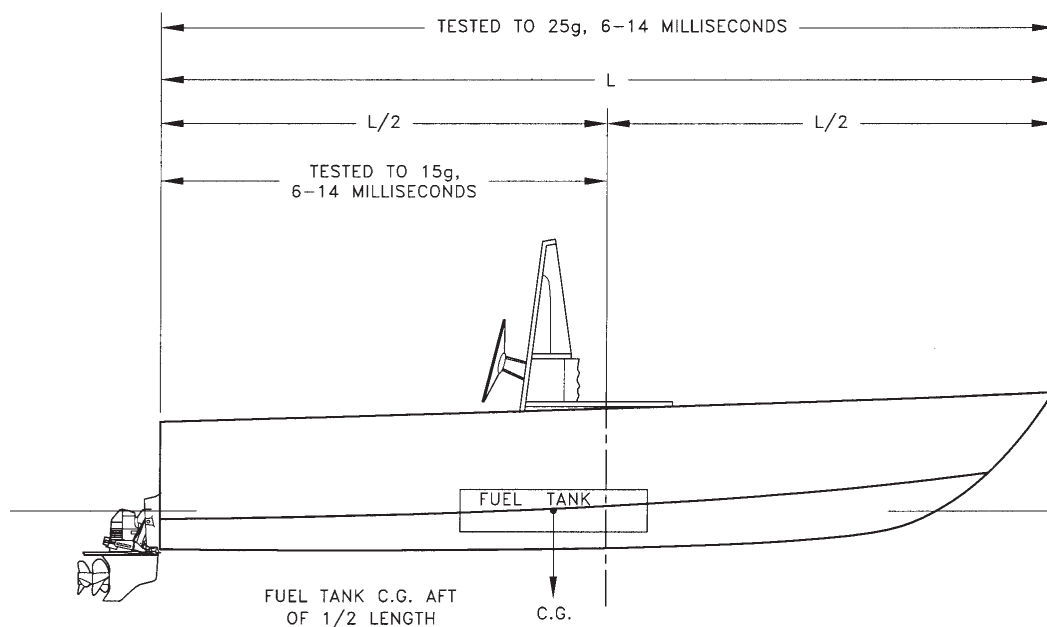
(c) Each fuel tank of less than 25 gallons capacity must not leak if tested under Sec. 183.584.

Each fuel tank less than 25 gallons capacity must be designed and constructed so that if selected to be shock tested according to the procedures of 183.584, it will not leak following the shock test when pressure tested to the pressure marked on its label, using the procedure described in 183.580.

Tanks tested at 25g. vertical accelerations, between 6 and 14 milliseconds duration, may be installed anywhere in the boat. Tanks tested at 15g., between 6 and 14 milliseconds, must be marked according to 183.514(b)(8):

"MUST BE INSTALLED AFT OF THE BOAT'S HALF LENGTH"

FIGURE 6 Fuel Tank Shock Test



TO COMPLY WITH THE LAW

- The fuel tank's capacity is less than 25 gallons.
- The fuel tank will withstand the shock of the test described in 183.584.
- The fuel tank does not leak following the shock test. Use procedures described in 183.580. Use pressure marked on the tank label.

FEDERAL LAW:**183.510 Fuel tanks.**

(d) Each fuel tank with a capacity of 25 to 199 gallons must not leak if tested under Sec.183.586.

Each fuel tank with a capacity of 25 to 199 gallons must be designed and constructed so that if selected to be pressure-impulse tested according to the procedures of 183.586, it will not leak. To determine if it leaks, it shall be pressure tested to the pressure marked on its label, using the procedure described in 183.580.

Selection of a tank for a pressure-impulse test may be made by the USCG in order to conduct a compliance check. A manufacturer may also select a representative tank and subject it to a pressure-impulse test in order to assure compliance. This test has proven to be quite effective in finding weak spots in the tanks. It has been found to be effective for plastic tanks.

TO COMPLY WITH THE LAW

- *The fuel tank's capacity is from 25 to 199 gallons.*
- *The fuel tank will withstand the pressure-impulse test described in 183.586.*
- *The fuel tank does not leak following the pressure-impulse test. Use procedures described in 183.580. Use pressure marked on tank label.*

FEDERAL LAW:**183.510 Fuel tanks.**

(e) Each fuel tank of 200 gallons capacity or more must not leak if tested under Secs. 183.586 and 183.588.

Each fuel tank with a capacity of 200 gallons or more must be designed and constructed so that it will not fail if subjected to both the pressure-impulse and slosh tests according to procedures of 183.586 and 183.588 respectively. It will not leak when pressure tested to the pressure marked on its label following the pressure-impulse test and the slosh test.

Selection of a tank for the pressure-impulse and slosh tests may be made by the USCG in order to conduct a compliance check. A manufacturer may also select a representative tank and subject it to the pressure-impulse and slosh tests in order to assure compliance.

TO COMPLY WITH THE LAW

- *The fuel tank's capacity is 200 or more gallons.*
- *The fuel tank will withstand the pressure-impulse test described in 183.586. Be sure to pre-condition non-metallic tanks per 183.586(b).*
- *The fuel tank does not leak following the pressure impulse test. Use procedures described in 183.580. Use pressure marked on tank label.*
- *The fuel tank will withstand the slosh test described in 183.588.*
- *The fuel tank does not leak following the slosh test. Use procedures described in 183.580. Use pressure marked on tank label.*

FEDERAL LAW:

183.512 Fuel tanks: Prohibited materials.

(a) A fuel tank must not be constructed from terneplate.

Terneplate is a steel that has been coated with a lead-tin alloy. Since the lead-tin alloy is cathodic relative to steel, the steel, in the presence of an electrolyte such as salt water, can corrode galvanically, weakening the tank's structure.

Permanently installed terneplate fuel tanks are prohibited for use as fuel tanks on boats with inboard gasoline engines.

TO COMPLY WITH THE LAW

- *The fuel tank is constructed from a material other than terneplate.*

FEDERAL LAW:

183.512 Fuel tanks: Prohibited materials.

- (b) Unless it has an inorganic sacrificial galvanic coating on the inside and outside of the tank, a fuel tank must not be constructed from black iron or carbon steel.

An inorganic sacrificial galvanic coating is a treatment applied to steel that combines the steel base metal with a surface of another metal, such as zinc and aluminum, which are anodic to the base metal. Such materials are known as “hot-dipped galvanized steel” and “aluminized steel.”

Organic materials may not be used. Organic materials include paints, resins, epoxy coatings, metallic paints, etc.

TO COMPLY WITH THE LAW

If the fuel tank is constructed of black iron or carbon steel:

- *Has it been hot-dipped galvanized inside and out?*
- *Has it been constructed of aluminized steel?*

FEDERAL LAW:

183.512 Fuel tanks: Prohibited materials.

- (c) A fuel tank encased in cellular plastic or in fiber reinforced plastic must not be constructed from a ferrous alloy.**

A ferrous alloy is a metal containing the chemical element iron as one of its major components. Materials such as black iron, carbon steel, galvanized steel, aluminized steel, terneplate and stainless steel are all examples of ferrous alloys.

Cellular plastic (foam) and/or fiber-reinforced plastic (fiberglass) may not be used to coat or encase ferrous alloy tanks.

TO COMPLY WITH THE LAW

Is the tank constructed of a ferrous alloy?

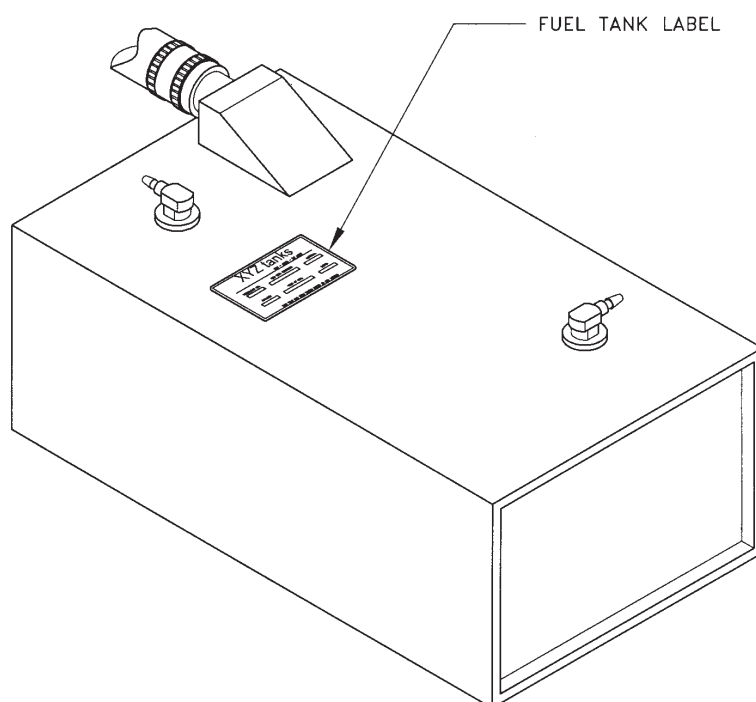
- *If YES, it may not be encased in foam or fiberglass.*
- *If NO, you may encase it with foam or fiberglass, so long as you comply with Section 183.552 which requires that water must not be held or trapped next to the metallic tank surfaces.*

FEDERAL LAW:

183.514 Fuel tanks: Labels.

- (a) Each fuel tank must have a label that meets the requirements of paragraphs (b) through (d) of this section.

FIGURE 7 Fuel Tank Label

**TO COMPLY WITH THE LAW**

Is there a label on the fuel tank?

- *While the law only requires that there be a label on the tank, the boat builder and tank builder should work together to ensure that the label will be visible for inspection after the tank has been installed.*

FEDERAL LAW:

183.514 Fuel tanks: Labels.

(b) Each label required by paragraph (a) of this section must contain the following information:

- (1) Fuel tank manufacturer's name (or logo) and address.
- (2) Month (or lot number) and year of manufacture.
- (3) Capacity in U.S. gallons.
- (4) Material of construction.
- (5) The pressure the tank is designed to withstand without leaking.
- (6) Model number, if applicable.
- (7) The statement, "This tank has been tested under 33 CFR 183.510(a)."
- (8) If the tank is tested under Sec. 183.584 at less than 25g vertical accelerations, the statement, "Must be installed aft of the boat's half-length."

FIGURE 8 Fuel Tank Label

xyz tanks

CITY – STATE – ZIP CODE

MONTH/LOT NO. 	MAX TEST PRESSURE 	MATERIAL
CAPACITY 	YEAR OF MFG. 	MODEL

THIS TANK HAS BEEN TESTED UNDER 33 CFR 510(a)

TO COMPLY WITH THE LAW

Does the fuel tank label have all the following information?

- *Manufacturer's name or logo*
- *Manufacturer's address*
- *Month or lot number*
- *Year of manufacture*
- *Capacity in U.S. gallons*
- *Material of construction*
- *Maximum test pressure*
- *The statement "This tank has been tested under 33 CFR 183.510(a)" if applicable*
- *Model number*
- *The statement "Must be installed aft of the boat's half-length," if applicable*

FEDERAL LAW:

183.514 Fuel tanks: Labels.

(c) Each letter and each number on a label must:

- (1) Be at least 1/16 inch high and
- (2) Contrast with the basic color of the label or be embossed on the label.

The minimum letter and number size has been established at one-sixteenth inch in height for the required information. Additional information may be displayed in smaller lettering. This is equivalent to 8 point upper case (capitals) lettering in printer's terminology.

THIS IS A SAMPLE OF 8 POINT LETTERING

Dark colored letters on a light colored background or light colored letters on a dark colored background will be easier to read. For example, black letters on a white or yellow background, or white letters on a black, blue or red background may be used to satisfy the contrast requirement.

Raised letters that are stamped into the label are also permitted. Embossing, debossing, stamping, engraving, molding and etching are examples of ways to raise or lower the lettering from the background surface of the label. Care must be taken not to damage the tank if the label is embossed while attached to the tank.

TO COMPLY WITH THE LAW

- *Are all letters and numbers eight point type or larger?*
- *Do all letters and numbers contrast in color or texture with the background of the label?*

FEDERAL LAW:

183.514 Fuel tanks: Labels.

(d) Each label must:

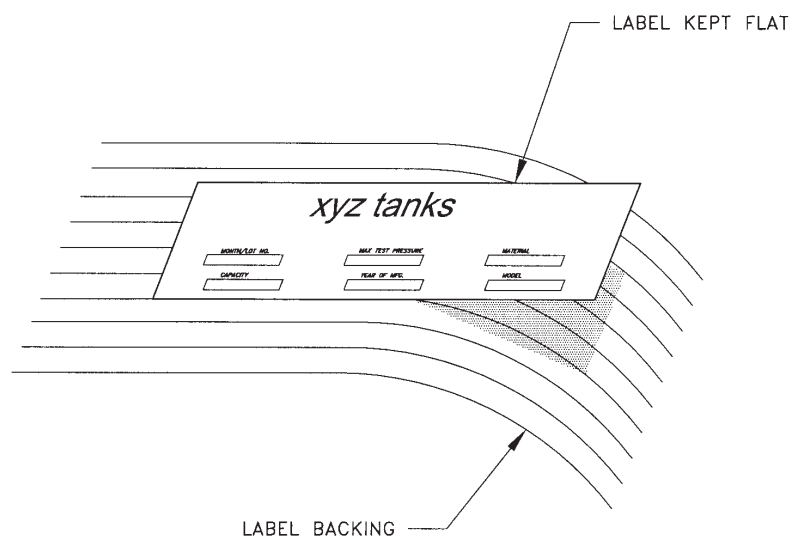
- (1) Withstand the combined effects of exposure to water, oil, salt spray, direct sunlight, heat, cold, and wear expected in normal operation of the boat, without loss of legibility; and
- (2) Resist efforts to remove or alter the information on the label without leaving some obvious sign of such efforts.

Labels are required to be durable so they may be used to identify a fuel tank and provide the information required in 183.514(b). Labels should be used that have demonstrated durability, either by experience in service or by test, considering all the listed exposure items.

Labels shall be designed, manufactured or installed so that any effort to remove or change the information thereon is apparent. Some pressure sensitive labels will self-destruct upon removal. Printed labels that have raised letters make it difficult to alter information.

Correct application of the label, particularly the pressure sensitive type, is important. Many types of labels will tend to curl up at their edges unless they are applied correctly. The backing should be peeled off of the label, keeping the label flat, instead of the other way around. See Figure 9.

FIGURE 9 Pressure Sensitive Label



TO COMPLY WITH THE LAW

Will the label withstand exposure to:

- *Water*
- *Oil*
- *Salt spray*
- *Direct Sunlight*
- *Heat*
- *Cold*
- *Wear*

Will the label show signs of efforts to:

- *Remove data*
- *Alter data*

FEDERAL LAW:

183.516 Cellular plastic used to encase fuel tanks.

(a) Cellular plastic used to encase metallic fuel tanks must:

(1) Not change volume by more than five percent or dissolve after being immersed in any of the following liquids for 24 hours at 29 deg.C.:

(i) Reference fuel B ASTM D-471.

(ii) No. 2 reference oil of ASTM D-471.

(iii) Five percent solution of trisodium phosphate in water.

(2) Not absorb more than 0.12 pound of water per square foot of cut surface, measured under Military Specification MIL P-21929B.

(b) Non-polyurethane cellular plastic used to encase metallic fuel tanks must have a compressive strength of at least 60 pounds per square inch at ten percent deflection measured under ASTM D-1621, "Compressive Strength of Rigid Cellular Plastics."

(c) Polyurethane cellular plastic used to encase metallic fuel tanks must have a density of at least 2.0 pounds per cubic foot, measured under ASTM D-1622, "Apparent Density of Rigid Cellular Plastics."

If cellular plastic (foam) is to be used to encase a metallic fuel tank, it must as a minimum comply with the properties and tests specified in the regulation.

If the foam used for encasing a metallic fuel tank is to be counted as part of the flotation required for boats under 20 feet in length by Title 33 CFR 183 Subpart F, it may be required to comply with additional properties and tests as follows:

* If the foam is in the engine compartment and low in the bilge it must be resistant to gasoline and oil, and must not absorb water.

183.516 *Cellular plastic used to encase fuel tanks (continued)*

- a. If the encasing foam is:
- (1) in the engine compartment, and
 - (2) BELOW a height of 12 inches above the lowest point where liquid can collect in that compartment

then, the foam must not lose more than five percent of its buoyancy or dissolve after being immersed in any of the following liquids for 30 DAYS (instead of 24 hours) at 23°C (80°F):

- (1) Reference fuel B of ASTM D-471
- (2) No. 2 reference oil of ASTM D-471
- (3) Five percent solution of trisodium phosphate in water.

- * If the foam is high in the engine compartment it must be resistant to gasoline vapors.
- b. If the encasing foam is:
- (1) in the engine compartment, and
 - (2) ABOVE a height of 12 inches above the lowest point where liquid can collect in that compartment
- then, the foam must not lose more than five percent of its buoyancy or dissolve after being immersed in a fully saturated gasoline vapor atmosphere for 30 DAYS at 38°C (100°F).
- * If the foam is not in the engine compartment but is low in the bilge of the boat it must still have some resistance to gasoline and bilge cleaners.
- c. If the encasing foam is:
- (1) outside the engine compartment, and
 - (2) below a height of 4 inches above the lowest point where liquid can collect in that compartment

then, the foam must not lose more than five percent of its buoyancy or dissolve after being immersed in any of the following liquids for 24 hours at 23°C (80°F).

- (1) Reference fuel B of ASTM D-471
- (2) Number 2 reference oil of ASTM D-471
- (3) Five percent solution of trisodium phosphate in water.

Suppliers of foam should advise buyers if their products comply with these specifications.

NOTE:

The 4-inch and 12-inch heights are measured when the boat is in the static floating position. Refer to 183.505.

TABLE I Foam Requirements If Used For Both Fuel Tank Encasement And Flotation

LOCATION	24-HOUR IMMERSION 183.516 (a)(1)	30-DAY IMMERSION	WATER ABSORPTION 183.516 (a)(2)	COMPRESSIVE STRENGTH OR DENSITY 183.516(b) OR (c)	SATURATED GASOLINE VAPOR
<u>Engine Compartment</u>					
Below 12" height		•	•	•	
Above 12" height	•		•	•	•
<u>Outside Engine Compartment</u>					
Below 4" height		•	•	•	
Above 4" height	•		•	•	

A boat builder may choose to accept a foam supplier's certification to these requirements. Alternatively, these tests can be performed by the boat builder or a laboratory. There is special equipment involved and careful measurements required in accordance with laboratory techniques. It is recommended that all referenced standards and specifications be obtained and that the tests be performed in accordance with the detailed instructions contained therein.

Regardless of who performs the tests, the boat builder is responsible for compliance.

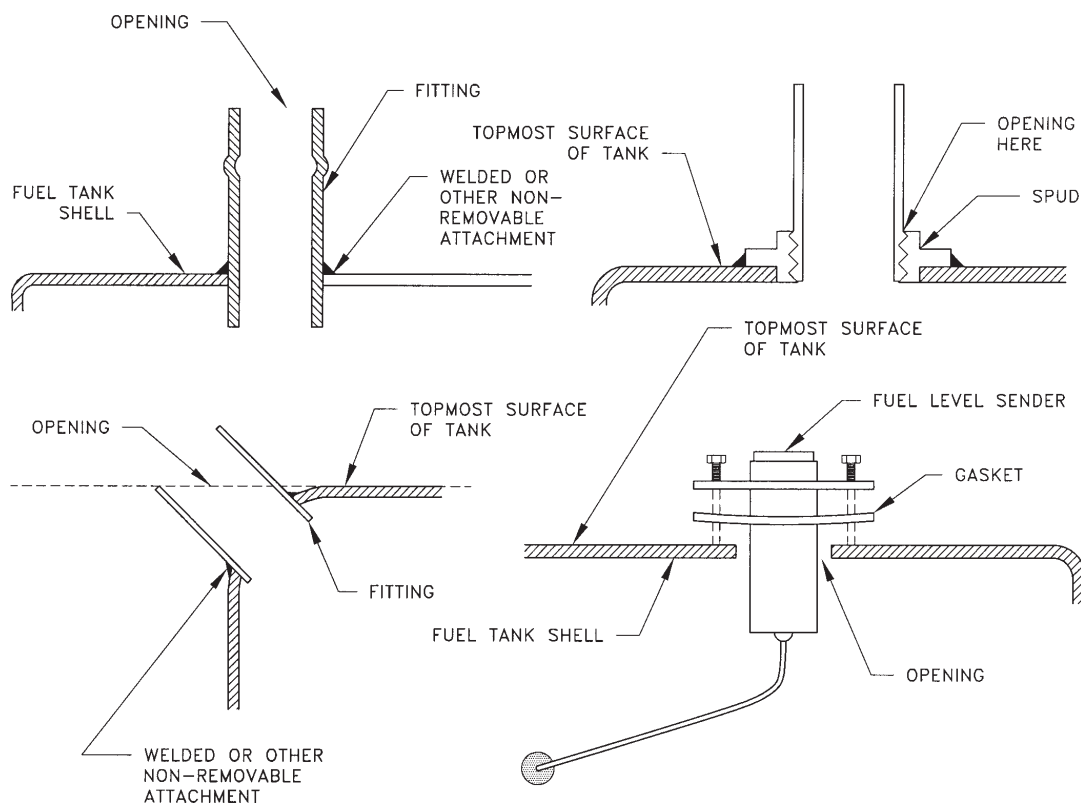
TO COMPLY WITH THE LAW

- *Foam meets the applicable chemical immersion requirements.*
- *Foam meets the water absorption requirements.*
- *Non-polyurethane foam meets the compressive strength requirement (60 pounds per square inch at 10 percent deflection).*
- *Polyurethane foam meets the density requirement (2.0 pounds per cubic foot minimum).*

FEDERAL LAW:**183.518 Fuel tank openings.**

Each opening into the fuel tank must be at or above the topmost surface of the tank.

Fuel tank openings refer to holes into which fittings may be installed or fuel lines attached. Fuel tank fill, fuel tank vent, fuel distribution, fuel tank sounding, and fuel level sender fitting accesses are examples of such openings. If the attachment fitting is welded or attached by other non-removable means to the fuel tank, the opening is considered at the top of the attachment. The sketches below clarify this interpretation.

FIGURE 10 Fuel Tank Openings**TO COMPLY WITH THE LAW**

- *Are all openings at or above the topmost surface of the tank?*

FEDERAL LAW:

183.520 Fuel tank vent systems.

- (a) Each fuel tank must have a vent system that prevents pressure in the tank from exceeding 80 percent of the pressure marked on the tank label under Sec.183.514(b)(5).

Pressure build-up can occur in a fuel tank due to temperature changes and during filling. The fuel tank vent system must be designed and installed to prevent the pressure build-up from exceeding 80 percent of the pressure marked on the tank label.

Unless there is trapped liquid or a clogged vent, temperature changes should not cause pressure problems. Filling a fuel tank at the normal rate of liquid flow (9 to 12 gallons per minute) found with most fuel dispensing pumps (some may put out more), might present a problem if too small a vent line is selected or if there are restrictions in the line. Blow-back through the fill opening will occur if the vent system is plugged. It has been generally found that a 9/16 inch inside diameter vent line with not less than 7/16 inch inside diameter fittings, provides sufficient flow capability to allow the fuel tank to breathe without excessive pressure build-up. It must be emphasized that vent lines be installed so that there are no potential liquid traps.

TO COMPLY WITH THE LAW

- *Does the vent prevent fuel tank build-up from exceeding 80 percent of the pressure marked on the label?*

FEDERAL LAW:

183.520 Fuel tank vent systems.

(b) Each vent must

- (1) Have a flame arrestor that can be cleaned unless the vent is itself is a flame arrestor; and**
- (2) Not allow a fuel overflow at the rate of up to two gallons per minute to enter the boat.**

Fuel tank vent flame arrestors must be able to be cleaned so they will not adversely restrict the breathing of a fuel tank. Flying particles, debris and salts from sea spray can attach to flame arrestor elements. There must be some means to free the arrestor from this contamination. Access to the arrestor may be from outside or inside the boat as long as it can be accomplished in a normal servicing manner. Removal of the vent fitting is also acceptable.

It is possible that a fuel tank vent system itself may perform the function of a flame arrestor. The diameter and length of the vent tubing and its routing are considerations in designing a fuel tank vent system that is itself a flame arrestor. There are no recommendations of proper diameters and lengths at this time. The burden of proof as to whether or not a fuel tank vent system performs is the boat manufacturer's.

The fuel tank vent outlet fitting must be located so that overflowing fuel coming out of the vent at a rate of up to 2 gallons per minute will not enter the boat. This requirement may involve deck design, cockpit coaming design, air vent location, hawsehole design for underdeck clearing of lines and any other opening where fuel would overflow into the boat.

Deck joints in riveted metal decks, or wooden decks, could provide a path for fuel to flow to the boat's interior unless they are caulked to resist such fuel leakage.

TO COMPLY WITH THE LAW

- *If the vent has a flame arrestor, can it be cleaned?*
- *Does the fuel tank vent system prevent overflow of up to 2 gallons per minute from getting into the boat?*

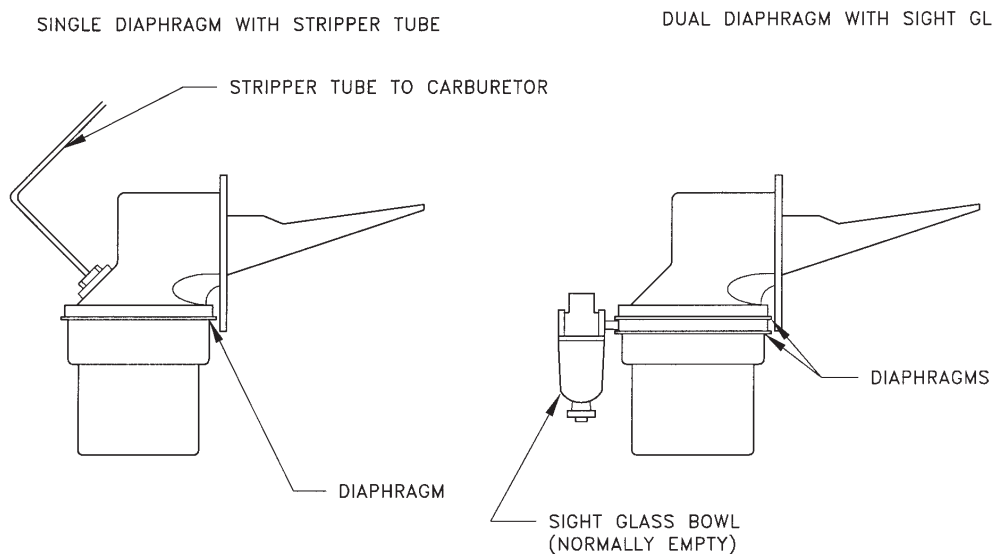
FEDERAL LAW:**183.524 Fuel pumps.**

- (a) Each diaphragm pump must not leak fuel from the pump if the primary diaphragm fails.

A diaphragm pump is the usual type of fuel pump found on marine engines. This requirement calls for means to prevent fuel from leaking into the interior of the boat or into the bilge if the main diaphragm fails. Some means presently used to accomplish this are:

- (1) A second diaphragm with a means of identifying failure of the primary diaphragm, such as a sight glass bowl, and
- (2) A sealed fuel pump housing connected to the crankcase or equipped with a stripper tube connected to the carburetor.

Automotive fuel pumps are vented. In a vehicle, fuel leaking from a ruptured diaphragm falls harmlessly on the ground; in a boat, this type of pump would allow leaking fuel to accumulate in the bilge.

FIGURE 11 Fuel Pumps, Diaphragm Type**TO COMPLY WITH THE LAW**

- *Is there a provision to prevent fuel leakage if the primary diaphragm of a fuel pump fails?*

FEDERAL LAW:

183.524 Fuel pumps.

(b) Each electrically operated fuel pump must not operate except when the engine is operating or when the engine is started.

Electric fuel pumps are not permitted to be operable except:

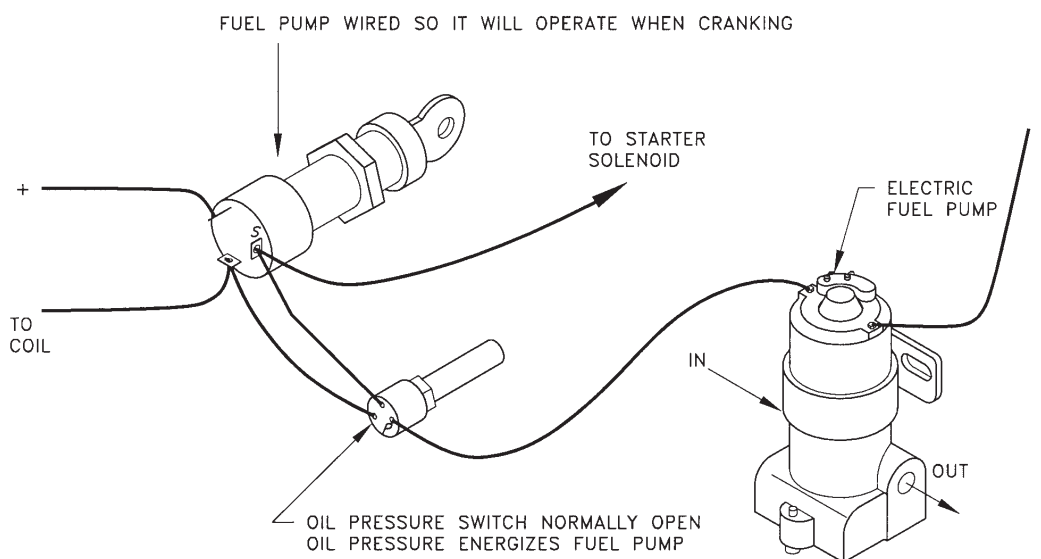
- (1) during the engine starting procedure, and
- (2) while the engine itself is operating.

This requirement does not apply to electric fuel pumps used to transfer fuel between tanks.

Compliance is typically achieved as follows:

1. wire the electric fuel pump to operate only when the starter is operating, and
2. by means of an oil pressure switch, only allow the pump to operate only as long as the engine is running.

FIGURE 12 Wiring Diagram For Electric Fuel Pump

**TO COMPLY WITH THE LAW**

- *Is the fuel pump unable to operate when ignition switch is turned on?*
- *Is the fuel pump unable to operate after engine stops with ignition switch turned on?*

FEDERAL LAW:**183.524 Fuel pumps.**

- (c) If tested under Sec. 183.590 each fuel pump, as installed in the boat, must not leak more than five ounces of fuel in 2-1/2 minutes, inclusive of leaks from fuel line, fuel filter and strainer.

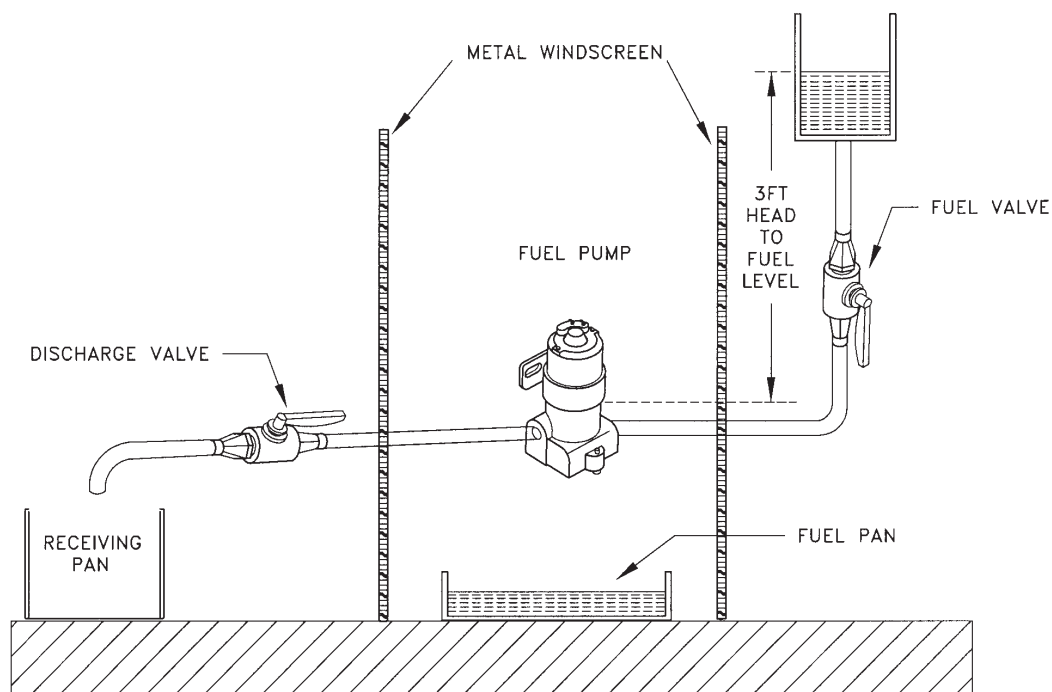
Fuel pumps must be able to withstand the 2-1/2 minute fire test as described in 183.590 of this regulation. The fuel pump may be tested separately in a fire chamber or as installed on the engine. If a fuel pump can be mounted either on the engine or remotely such as an electrically operated fuel pump, it may be tested according to where it is located in a specific installation. For example:

- (1) If the electric fuel pump is to be mounted on an engine, it may be fire tested on an engine.
- (2) If it is to be mounted remote from the engine, but in compliance with 183.566 (within 12 inches of the engine), it may be fire tested with the engine, providing the fire pan under the engine includes the fuel pump.
- (3) If it is to be mounted remote from the engine, such as a fuel transfer pump, it must be tested in a fire chamber as a separate component.
- (4) A fuel pump may be qualified for installation in any permitted location by conducting the fire test in a fire chamber.

Following the fire test, the fuel pump will be subjected to a 3-foot head of fuel in order to determine if it exceeds the permitted 5 ounces leakage of fuel in 2-1/2 minutes. While the fire test is usually performed by the pump manufacturer, the boat builder must remember that leakage from an associated fuel filter or strainer must be included. The content of an engine-mounted fuel line from the fuel pump to the carburetor must be added, if it will drain through the pump.

FIGURE 13 Fuel Pump Leakage Test

- (1) FILL THE SYSTEM WITH BOTH VALVES OPEN TO BLEED ALL THE AIR OUT OF THE TEST SET UP.
- (2) CLOSE THE LINE BLEEDING VALVE AND TOP OFF THE STANDPIPE WITH FUEL.
- (3) EXAMINE THE FUEL PUMP FOR LEAKAGE.

**TO COMPLY WITH THE LAW**

- Will the fuel pump withstand a fire test as specified in 183.590, without leaking more than five ounces of fuel in 2-1/2 minutes?

NOTE: You must also consider how much fuel will drain out of your fuel filter and hoses.

FEDERAL LAW:**183.526 Carburetors.**

- (b) Each carburetor must not leak more than five cubic centimeters of fuel in 30 seconds when:
- (1) The float valve is open;
 - (2) The carburetor is at half throttle; and
 - (3) The engine is cranked without starting; or
 - (4) The fuel pump is delivering the maximum pressure specified by its manufacturer.

There are two leakage tests for carburetors to satisfy the intent of 183.526(b). This test relates to 183.526(b)(1), (2), and (3).

This test is performed by the marine engine manufacturer and the carburetor manufacturer. Additional information and requirements for marine fuel metering devices may be found in SAE J1223 Marine Carburetors and Throttle Body Injection. Fuel injection is now prevalent in marine engines. The regulations specifically addresses carburetors, as fuel injection was not commonly available in the mid-1970s when the regulation was written. This test is to confirm the integrity of the fuel metering equipment and is conducted as follows:

- (1) the float valve is free to operate normally
- (2) the throttle is in the half open position.

Crank the engine without starting for 30 seconds. During this period there shall be no more than 5 cc observed gasoline flow coming from the carburetor fuel bowl, vent port or any other place on the exterior of the carburetor. This test includes only external flow, not fuel flowing down the throat of a downdraft carburetor.

NOTE:

A complete copy of the United States Coast Guard Compliance Test Procedures — Fuel System Standard Test Procedure, is provided in Appendix A of the Fuel Guide.

TO COMPLY WITH THE LAW

- *With the float free and the throttle half open, the carburetor will not leak more than 5 cc of fuel in 30 seconds while the fuel pump is delivering fuel, at the engine cranking pressure.*

This is the second leakage test for carburetors to satisfy the intent of 183.526(b). The test described on this page relates to 183.526(b)(4).

This test is to confirm the integrity of the float valve with a remote fuel pump and is conducted as follows:

- (1) the float valve is free to operate normally
- (2) the throttle is in the fully closed position.

Connect the fuel pump with the largest pressure intended for use with the carburetor and run it for 30 seconds. During this period there shall be no more than 5 cc observed gasoline flow coming from the carburetor fuel bowl, vent port or any other place on the exterior of the carburetor. This test includes only external flow, not fuel flowing down the throat of a downdraft carburetor.

NOTE:

A complete copy of the United States Coast Guard Compliance Test Procedures — Fuel System Standard Test Procedure, is provided in Appendix A of the Fuel Guide.

TO COMPLY WITH THE LAW

- *With the float valve open and the throttle half open, the carburetor will not leak more than 5 cc of fuel in 30 seconds while the engine is cranked without starting.*

FEDERAL LAW:**183.526 Carburetors.**

(c) Each updraft and horizontal draft carburetor must have a device that:

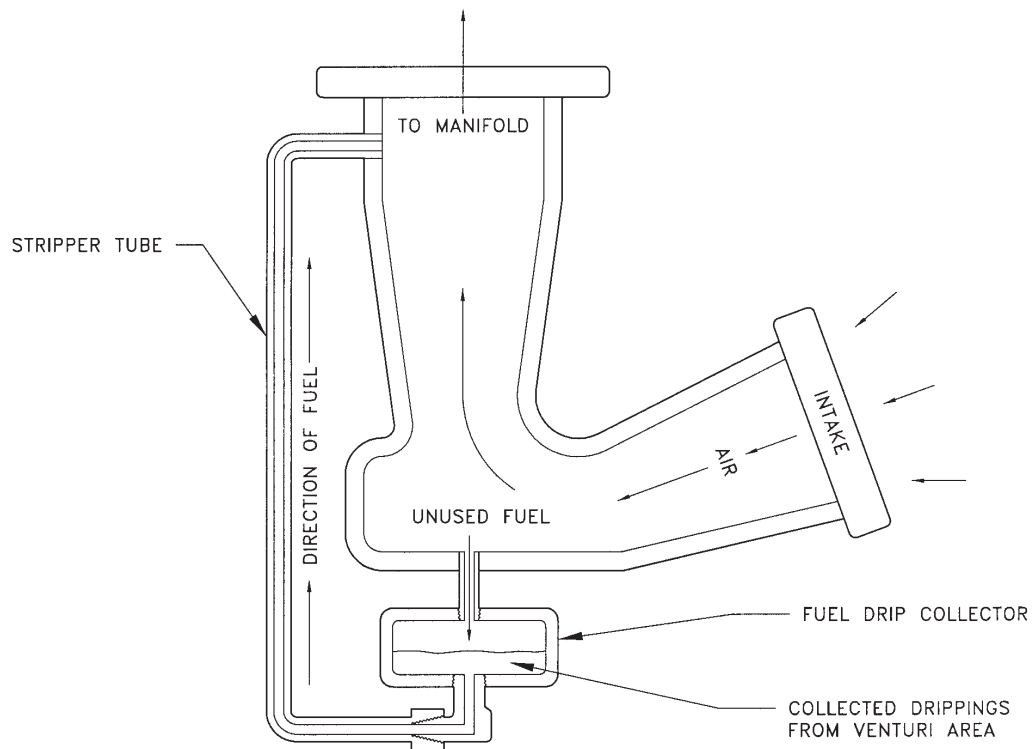
- (1) Collects and holds fuel that flows out of the carburetor venturi section toward the air intake;
- (2) Prevents collected fuel from being carried out of the carburetor assembly by the shock wave of a backfire or by reverse air flow; and,
- (3) Returns collected fuel to the engine induction system after the engine starts.

Marine engines today use downdraft carburetors; however, if an engine uses an updraft or a horizontal draft carburetor, then it must be fitted with a means to collect fuel from flooding and return it to the engine so it will be consumed. Some auxiliary generators and some small propulsion engines have updraft or horizontal draft carburetors.

The collector for the fuel must be capable of holding or delivering to the engine a quantity of fuel that collects during 12 ten-second periods of cranking without external leakage from the air inlet or dripping of liquid fuel from joints in the air inlet components. The collector and carburetor must be designed so that fuel will run into the collector rapidly to prevent fuel collection in the carburetor horn where it can be expelled during a backfire or "spit-back."

The collector must be fitted with a stripping means to return the collected fuel to the engine for combustion. Typically, this stripper is a tube connected to the throat of the carburetor so the manifold vacuum will pull the fuel out of the collector.

FIGURE 14 Updraft Carburetor



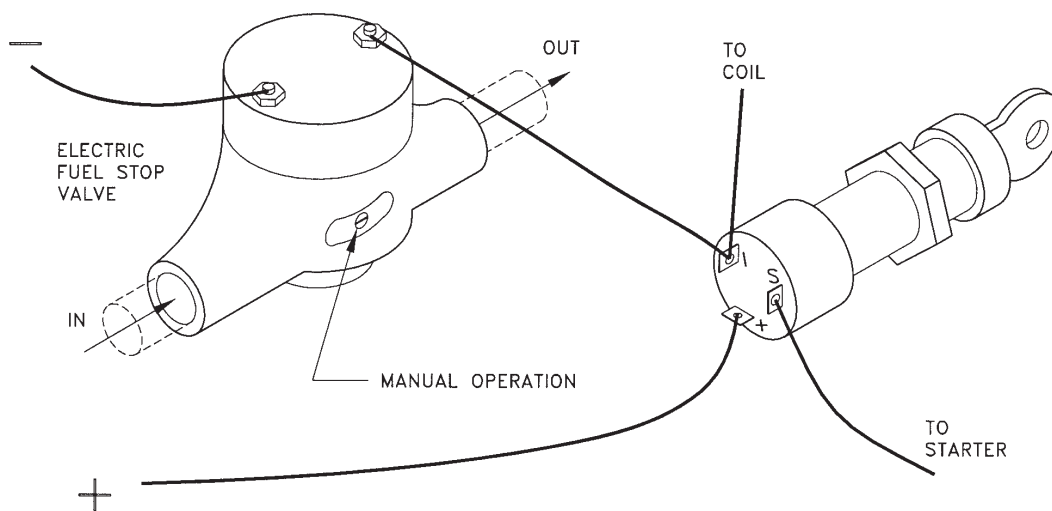
TO COMPLY WITH THE LAW

- *If you have an updraft or horizontal draft carburetor, is it equipped with a means to collect fuel?*
- *Also, is there a means to return the fuel to the engine for combustion?*

FEDERAL LAW:**183.528 Fuel stop valves.**

- (a) Each electrically operated fuel stop valve in a fuel line between the fuel tank and the engine must:
- (1) Open electrically only when the ignition switch is on; and
 - (2) Operate manually.

If an electrically operated fuel stop valve is in the fuel system, it must be wired to the ignition switch so it will open only when the ignition switch is on. It must also have a means to manually open the valve in the event of loss of electricity. This is often a slot for a screwdriver to turn the valve.

FIGURE 15 Electrically Operated Fuel Stop Valve**TO COMPLY WITH THE LAW**

If you use an electrically operated fuel stop valve:

- Does it open only when the ignition switch is on?
- Can it be operated manually?

FEDERAL LAW:

183.528 Fuel stop valves.

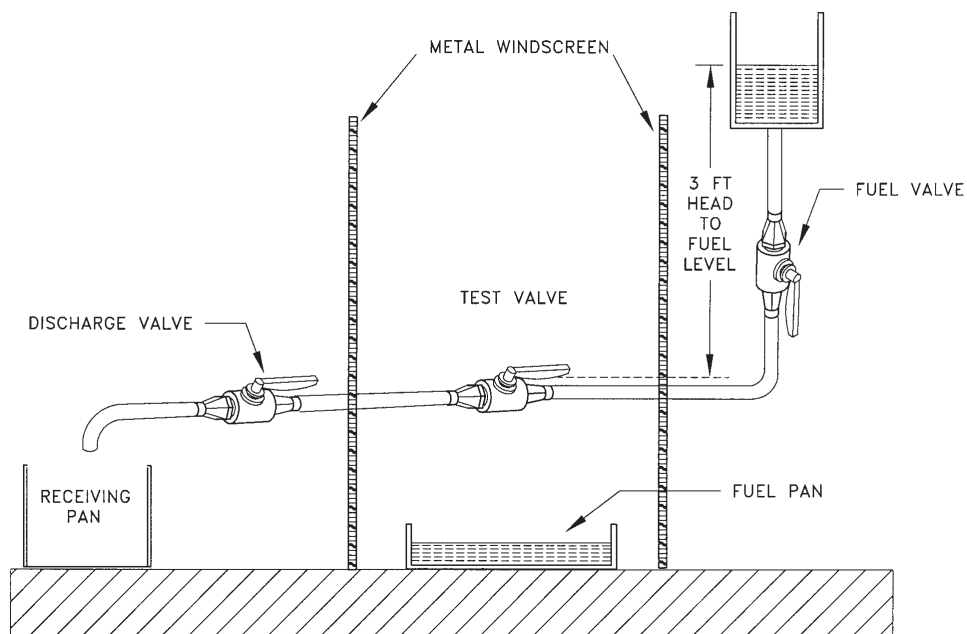
- (b) If tested in accordance with the fire test under Sec. 183.590, a fuel stop valve installed in a fuel line system requiring metallic fuel lines or "USCG Type A1" hose must not leak fuel.

All fuel stop valves installed in metallic fuel lines or Type A1 hose, whether they are of the manual type or electrically operated and equipped with the required means for manual operation, must withstand the 2-1/2 minute fire test. Fuel stop valves must be tested in a fire chamber described in 183.590(c) regardless of where they are installed.

After the fire test there shall be no leakage of fuel when subjected to the head as installed or a 36-inch head of fuel applied on the inlet side of the valve. Internal leakage such as could be expected with a soft seat type would not be considered leakage as long as it remained inside the fuel system.

Fuel stop valves installed in systems permitted to use USCG Type B hose need not be fire resistant.

FIGURE 16 Leakage Test For Valves



- (1) FILL THE SYSTEM WITH BOTH VALVES OPEN TO BLEED ALL THE AIR OUT OF THE TEST SET UP.
- (2) CLOSE THE LINE BLEEDING VALVE AND TOP OFF THE STANDPIPE WITH FUEL.
- (3) EXAMINE THE TEST VALVE FOR LEAKAGE.

TO COMPLY WITH THE LAW

- Will the fuel stop valves, electric or manual, withstand the fire test in 183.590 conducted in a fire chamber, without external leakage?

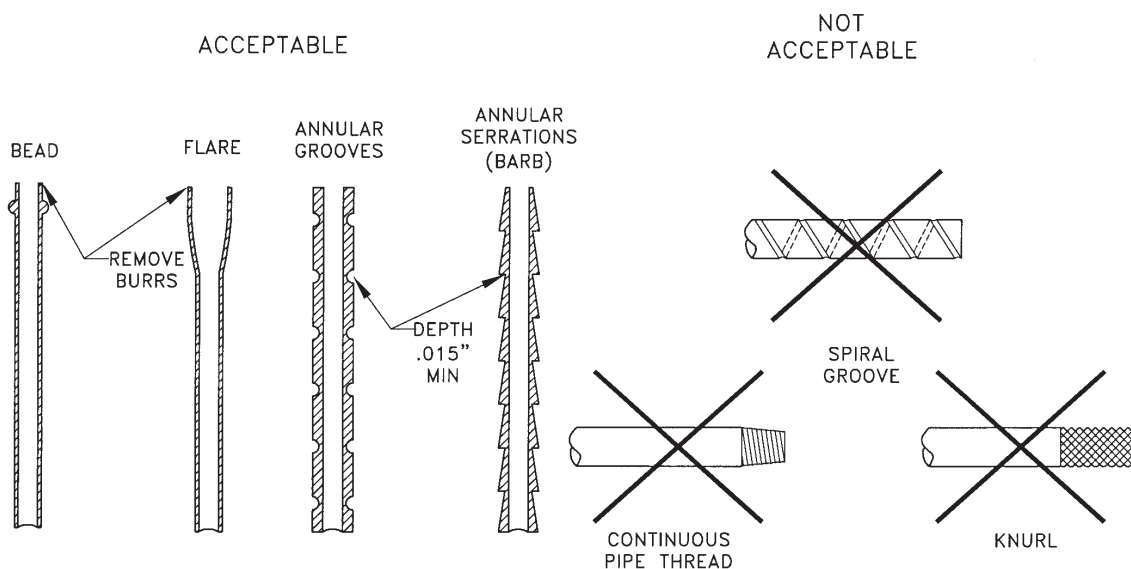
FEDERAL LAW:**183.530 Spud, pipe, and hose fitting configuration.**

Except when used for a tank fill line, each spud, pipe, or hose fitting used with hose clamps must have:

- (a) A bead;
- (b) A flare; or
- (c) A series of annular grooves or serrations no less than 0.015 inches deep, except a continuous helical thread, knurl, or groove.

Fittings (spud, pipe and hose barb are examples) require some treatment of their surface in order to be acceptable for use with hose and hose clamps.

The regulation prohibits continuous helical threads (pipe threads), knurls or grooves which can provide a path for fuel leakage. Depicted are a number of acceptable types and some of those that are not acceptable.

FIGURE 17 Spud, Pipe and Hose Fittings**TO COMPLY WITH THE LAW**

- *Do all fittings used with hose and hose clamps have the proper configuration for hose attachment?*

FEDERAL LAW:

- 183.532 Clips, straps, and hose clamps.
- (a) Each clip, strap, and hose clamp must:
- (1) Be made from a corrosion resistant material; and
 - (2) Not cut or abrade the fuel line.

A clip, strap, or hose clamp used anywhere in the fuel system must resist corrosion. The surfaces in contact with the fuel line must be smooth and their edges such that there will be no cutting or wearing of the fuel line.

It is recognized that all materials are corrosion resistant to a degree; however, the intent is to accept all stainless steel, plated steel, plastic coated steel, plastics and non-ferrous metals as suitable materials for clips, straps, and hose clamps.

TO COMPLY WITH THE LAW

Clips, straps, and hose clamps:

- *Are made of corrosion resistant material as defined above?*
- *Will not cut or abrade the fuel line?*

FEDERAL LAW:

183.532 Clips, straps, and hose clamps.

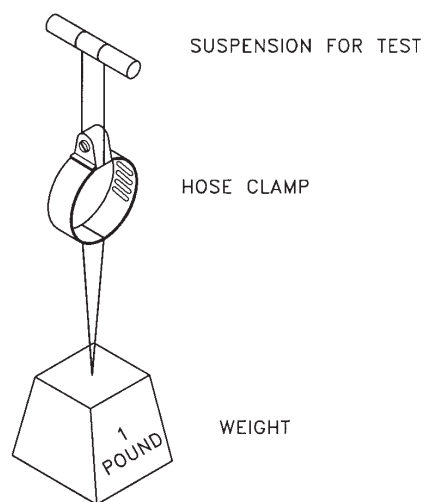
- (b) If tested in accordance with the fire test under Sec. 183.590, a hose clamp installed on a fuel line system requiring metallic fuel lines or "USCG Type A1" hose must not separate under a one-pound tensile force.

Hose clamps used to connect fuel lines in the fuel system, except stated below, must withstand a 2-1/2 minute fire test conducted in a fire chamber as described in 183.590(c). Tie straps, straps and clips used for support and bundling are not included in this requirement. Only nonmetallic clamps need to be tested, since all stainless steel clamps can easily pass this test.

At the end of the 2-1/2 minute fire test, the hose clamp must withstand a 1-pound force.

Clips, straps, and hose clamps used on systems permitted to use "USCG Type B" hose need not be fire resistant.

FIGURE 18 Hose Clamp Tensile Test

**TO COMPLY WITH THE LAW**

- Will hose clamps withstand a 1-pound tensile force after 2-1/2 minute fire test per 183.590?

FEDERAL LAW:**183.534 Fuel filters and strainers.**

If tested under Sec. 183.590, each fuel filter and strainer, as installed in the boat, must not leak more than five ounces of fuel in 2-1/2 minutes inclusive of leaks from the fuel pump and fuel line.

Fuel filters, strainers, and their connections must withstand a 2-1/2 minute fire test conducted as described in 183.590. The fire test may be performed on an engine for filters and strainers designed to be engine-mounted or may be performed in a fire chamber to qualify a filter or strainer to be mounted anywhere in the fuel system.

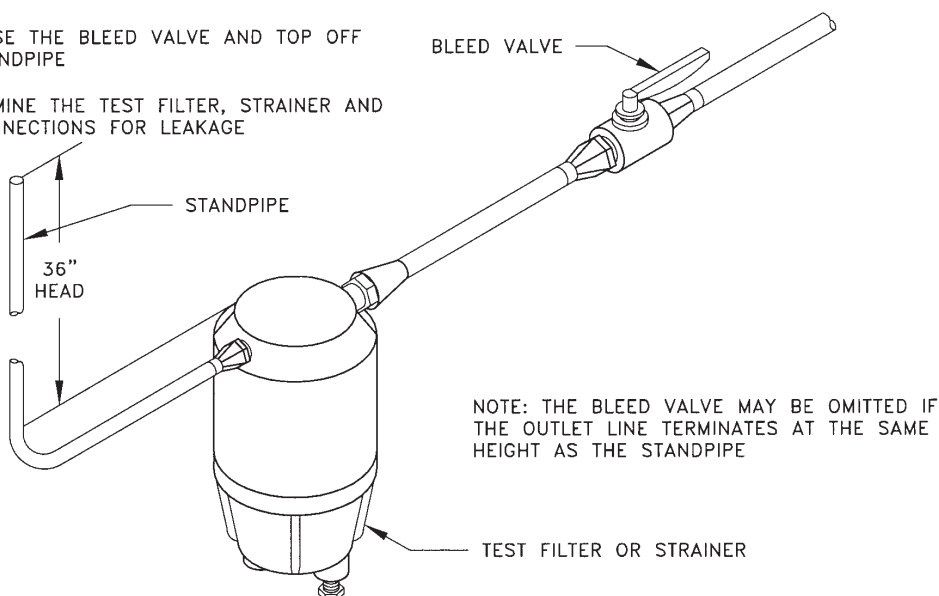
After the fire test, the filter or strainer is to be subjected to a 3-foot head of fuel to determine its rate of leakage. Acceptable leakage is up to 5 ounces of fuel in 2-1/2 minutes, but must include leakage from an associated fuel pump and fuel line. Internal leakage, destruction of straining or filtering elements, and impairment of function are acceptable.

FIGURE 19 Leakage Test For Fuel Filters And Strainers

[1] FILL THE SYSTEM WITH THE BLEED VALVE OPEN TO BLEED ALL THE AIR OUT OF THE TEST SET UP

[2] CLOSE THE BLEED VALVE AND TOP OFF THE STANDPIPE

[3] EXAMINE THE TEST FILTER, STRAINER AND THE CONNECTIONS FOR LEAKAGE

**TO COMPLY WITH THE LAW**

- Each fuel filter, strainer and its connections will not leak more than 5 ounces of fuel in 2-1/2 minutes after the fire test in 183.590.

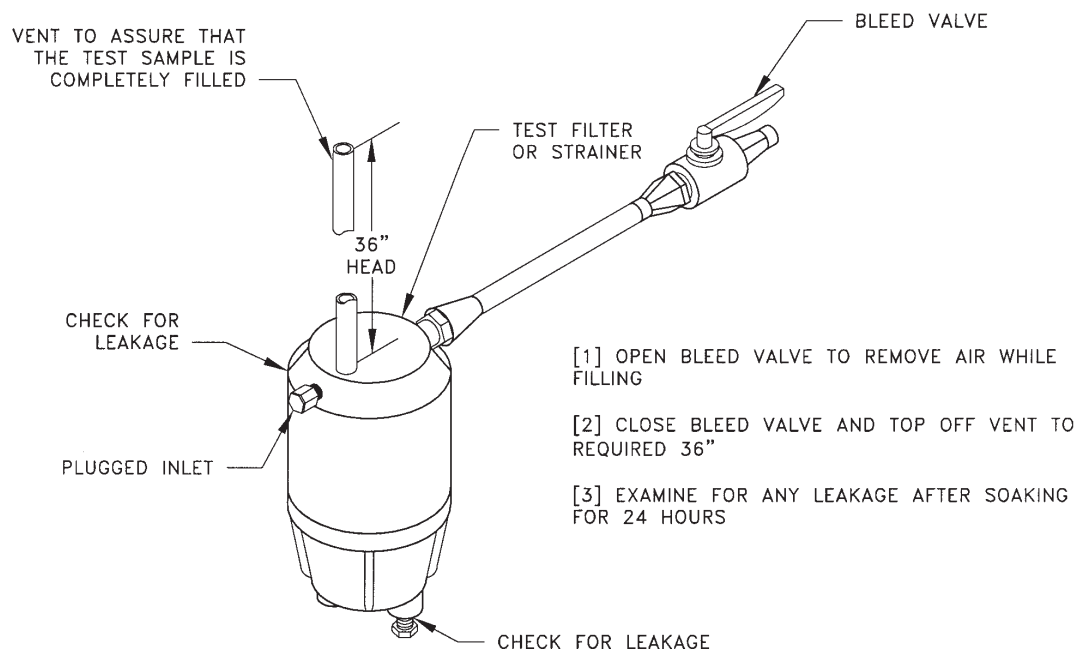
FEDERAL LAW:**183.536 Seals and gaskets in fuel filters and strainers.**

- (b) Each gasket and each sealed joint in a fuel filter and strainer must not leak when subjected for 24 hours to a gasoline that has at least 50 percent aromatic content at the test pressure marked on the fuel tank label.

Fuel is made up of basic petroleum products in various quantities or concentrations. Depending on the amount of these components, fuel may have varying effects on the materials used for gaskets and seals. Fuels with high aromatic content have been found to damage fuel system components such as gaskets, seals, hoses and other usually non-metallic items.

To test gaskets and seals, it is required to subject samples to gasoline with at least a 50 percent aromatic content for a period of 24 hours. The described fuel is to be placed in the filter or strainer at a minimum head of 3-feet. After the 24-hour period, there shall be no leakage external to the tested unit.

FIGURE 20 Seals and Gaskets Leakage Test



NOTE: THE BLEED VALVE MAY BE OMITTED IF THE OUTLET LINE TERMINATES AT THE SAME HEIGHT AS THE STANDPIPE

TO COMPLY WITH THE LAW

- *There is no leakage due to gasket or seal deterioration when tested to 183.536(b).*

FEDERAL LAW:**183.538 Metallic fuel line materials.**

Each metallic fuel line connecting the fuel tank with the fuel inlet connection on the engine must:

- (a) be made of seamless annealed copper, nickel copper, or copper nickel; and
- (b) except for corrugated flexible fuel line, have a minimum wall thickness of 0.029 inches.

If metal is used for any portion of the fuel line (except for fittings) from the tank connection to the engine connection (usually at the fuel pump), the metallic fuel line portions must be seamless, annealed:

- (1) Copper;
- (2) Nickel copper (Monel); or
- (3) Copper-nickel.

No other metals are permitted.

Also, the thickness of the tubing wall must be at least 0.029 inches unless the fuel line portion is a corrugated or accordion type of flexible fuel line. Tubing is available with thinner wall thicknesses, but they SHALL NOT be used.

Metal fuel lines used on the engine, i.e. the fuel line from the fuel pump to the carburetor, may be made of materials other than those listed. This line is usually supplied with the engine.

TO COMPLY WITH THE LAW

Are metallic fuel lines made of seamless annealed:

- *Copper;*
- *Nickel copper; or*
- *Copper-nickel?*

Is the thickness of the fuel line tube wall at least 0.029 inches?

FEDERAL LAW:

183.540 Hoses: Standards and markings.

- (a) "USCG Type A1" hose means hose that meets the performance requirements of:
 - (1) SAE Standard J1527 DEC85, Class 1 and the fire test in Sec.183.590;
or
 - (2) Underwriters' Laboratories, Inc. (UL) Standard 1114.
- (b) "USCG Type A2" hose means hose that meets the performance requirements of SAE Standard J1527 DEC85, Class 2 and the fire test in Sec 183.590;
- (c) "USCG Type B1" hose means hose that meets the performance requirements of SAE Standard J1527 DEC85, Class 1.
- (d) "USCG Type B2" hose means hose that meets the performance requirements of SAE Standard J1527 DEC85 Class 2.

NOTE: SAE Class 1 hose has a permeation rating of 100 grams or less fuel loss per square meter of interior surface in 24 hours.

SAE Class 2 hose has a permeation rating of 300 grams or less fuel loss per square meter of interior surface in 24 hours.

The permeation rating of the hose refers to the quantity of fuel which will pass through the walls of the hose out into the boat when the hose is filled with fuel. You could think of this as a slow leak. Fortunately, the fuel vapors formed by this low level of permeation are readily dissipated by the ventilation system.

You may use USCG Type A1 hose for any application. In some cases, you may find the difference in price between A1, A2, B1, and B2 does not justify stocking all four types.

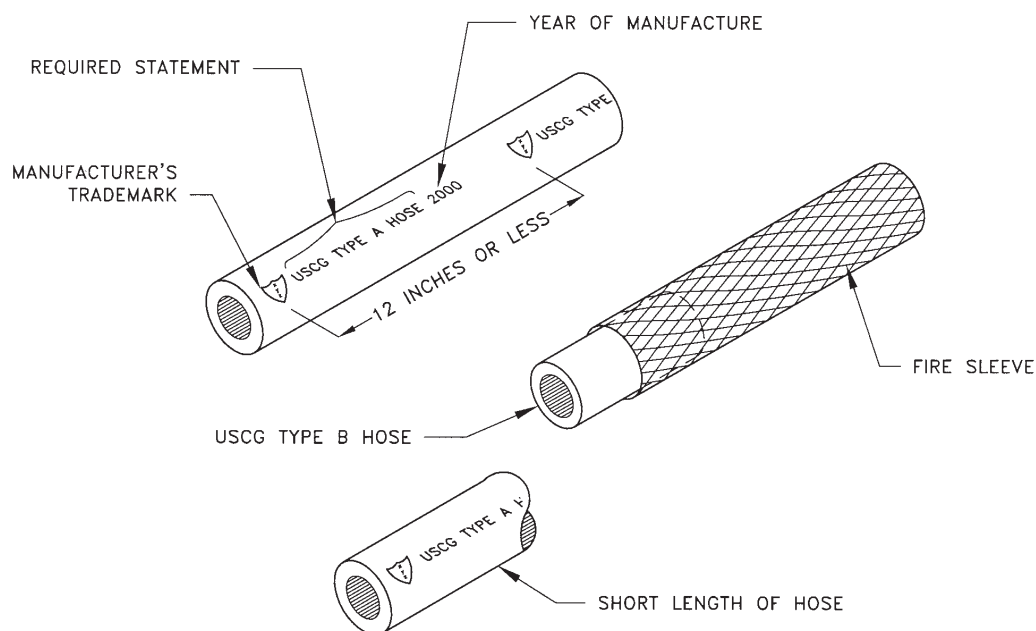
FEDERAL LAW:

- 183.540 Hoses: Standards and markings.**
- (e) Each "USCG Type A1," "USCG Type A2," "USCG Type B1," and "USCG Type B2" hose must be identified by the manufacturer by a marking on the hose.
 - (f) Each marking must contain the following information in English:
 - (1) The statement "USCG Type (insert A1 or A2 or B1 or B2)."
 - (2) The year in which the hose was manufactured.
 - (3) The manufacturer's name or registered trademark.
 - (g) Each character must be block capital letters and numerals that are at least one-eighth inch high.
 - (h) Each marking must be permanent, legible, and on the outside of the hose at intervals of 12 inches or less.

The use of a fire sleeve does not automatically qualify a hose as "USCG Type A." Hose and sleeve must be properly matched. Hose and sleeve suppliers should be consulted to obtain a certification that the hose-sleeve combination will qualify as "USCG Type A."

All lettering, numerals, and trademarks used on hose must be at least one-eighth inch high. Markings must be permanent, legible and on the outside of the hose. Hose markings must be repeated along the length of the hose so there is a complete marking within every 12-inch section of the hose. Short pieces of hose which do not show the complete label are permitted to be used, provided it is shown that the longer pieces of the same hose and the inventory of hose comply.

FIGURE 21 Hose Marking



TO COMPLY WITH THE LAW

- *Is the hose marked?*
- *Does the marking contain all the following?*
 - (1) *"USCG Type A1, A2, B1, or B2"*
 - (2) *Year of hose manufacture*
 - (3) *Manufacturer's name or trademark*
- *Are all the letters and numerals at least one-eighth inch high? and*
 - (1) *Are the markings permanent?*
 - (2) *Legible?*
 - (3) *In the English language?*
 - (4) *On the outside of the hose?*
- *Are the marking intervals on the hose 12-inches or less?*

FEDERAL LAW:**183.542 Fuel systems.**

- (a) Each fuel system in a boat must have been tested by the boat manufacturer and not leak when subjected to the greater of the following pressures:
- (1) Three pounds per square inch; or
 - (2) One and one-half times the pressure created in the lowest part of the fuel system when it is filled to the level of overflow with fuel.
- (b) The test pressure shall be obtained with air or inert gas.

The entire fuel system up to the engine fuel inlet, as installed in a boat, must be pressure tested by the boat manufacturer prior to the boat being sold to a customer. The entire fuel system includes:

- Fuel fill(s)
- Fuel vent(s)
- Fuel tank(s)
- Fuel distribution(s)
- All components and accessories in fuel distribution lines, to the attachment point on the engine. The attachment point may be a fuel filter, fuel pump or carburetor, depending on what components are supplied with, and mounted on the engine.

Each boat manufactured must be tested as part of the certification of compliance with this Federal regulation. Record the date and name of the person who performed that test.

TO COMPLY WITH THE LAW

- *The entire fuel system, up to the engine fuel inlet, has been pressure tested to 3 psig or 1-1/2 times the head whichever is the greater pressure.*
- *There is no leakage.*

5.0 Manufacturer Requirements

FEDERAL LAW:

183.550 Fuel tanks: Installation.

- (a) Each fuel tank must not be integral with any boat structure or mounted on an engine

Each fuel tank intended to be permanently installed, must be made as a separate component and then installed in the boat. Portions of a boat's structure, i.e. hull surfaces, bulkheads, stringers, floors, decks, frames, etc., may not form part of a fuel tank.

Fuel tanks glued, bonded or foamed-in-place are not considered integral and are therefore acceptable. However, that installation must comply with the applicable portions of this regulation.

Fuel tanks may not be mounted on an engine, except if the engine is part of a portable piece of equipment that is not permanently installed in the boat. If a fuel tank is removed from an engine to be installed in the boat, the installation must comply with the requirements of this standard. Particular attention is directed to the fuel tank vent requirements and the requirements for all openings to be in or at the topmost surface. Many tanks installed on engines have a bottom fuel supply; this fuel tank is not acceptable for installation in a boat.

TO COMPLY WITH THE LAW

- *Each fuel tank is not integral with any boat structure.*
- *There is no fuel tank mounted to a permanently installed engine.*

FEDERAL LAW:

183.550 Fuel tanks: Installation.

- (b) Each fuel tank must not move at the mounting surface more than one-fourth inch in any direction.

The basic intent of this requirement is to restrict the movement of an installed fuel tank with respect to its mounting surfaces to a minimum amount. No movement would be best. To establish a quantitative test, one-fourth inch in any direction has been selected.

TO COMPLY WITH THE LAW

- *The tank cannot move more than one-fourth inch in any direction, measured at its mounting surface when force is applied in the forward, aft, port, starboard, and vertical directions.*

FEDERAL LAW:

183.550 Fuel tanks: Installation.

- (c) Each fuel tank must not support a deck, bulkhead, or other structural component.

A fuel tank is not permitted to be a structural part of a boat to the extent that it provides support for a deck, bulkhead or other boat structure. To determine whether the intent of this regulation is met, the following question must be answered in the affirmative — Is the deck, bulkhead or other structural component properly supported to function as intended with the fuel tank removed? If the answer is no, the tank is providing support that is not acceptable.

It is not intended to prohibit incidental contact of a deck, or hatch with a fuel tank, or to prevent the use of protective covers or panels for fuel tanks. The Coast Guard has also accepted fuel tanks specifically designed to be walked or sat upon: Protective mats or panels resting on the tank top to provide a walking surface have also been accepted by the Coast Guard.

TO COMPLY WITH THE LAW

- *The fuel tank does not support a deck, bulkhead, or other structural component.*
- *The structure will not collapse if the tank is removed.*

FEDERAL LAW:

183.550 Fuel tanks: Installation.

- (d) Water must drain from the surface of each metallic fuel tank when the boat is in its static floating position.

Metallic fuel tanks must be designed, installed, or a provision made to drain water from the surface when the boat is in its static floating position. (See 183.505 for the definition of static floating position). It is recognized that irregularities in the top surface of a flat-topped fuel tank may be able to retain water by surface tension. The intent of this requirement is to prevent the entrapment of water which may occur with lipped edges or saucer type tops on fuel tanks.

Foamed-in-place metallic (must be non-ferrous) fuel tanks must be installed with a provision made to prevent water from collecting on top of the metal surface of the fuel tank, such as might occur if the foam formed a basin around fuel tank fittings. An alternate method is to coat the metal fuel tank surface with a barrier coating, other than paint, which will effectively prevent water from contacting the metal surface.

TO COMPLY WITH THE LAW

- *Water will drain from the metallic fuel tank surface when the boat is in its static floating position, or*
- *The tank is effectively coated to prevent water from contacting the metal surface.*

FEDERAL LAW:

183.550 Fuel tanks: Installation.

- (e) Each fuel tank support, chock, or strap that is not integral with a metallic fuel tank must be insulated from the tank surface by a non-moisture absorbing material.

Unless a metallic fuel tank has built-in means for supporting and holding the metallic fuel tank in place, a non-moisture absorbing material must be placed between the fuel tank surface and the support, chock or strap. The non-moisture absorbing quality of the material is necessary to prevent localized corrosion of the fuel tank that might occur if moisture was trapped at the support tank interface for prolonged periods of time.

Care should be taken to avoid abrasive combinations of materials even though it is not a mandated requirement of the regulation.

Basically, this requirement provides for the isolation of the metallic fuel tank from a potentially moisture laden support system and also from abrasion by the supports, chocks and straps. The following table lists some materials that appear to be suitable and some that should be avoided.

FUEL TANK ISOLATION MATERIALS**SUITABLE**

Neoprene
Teflon
High Density Plastics

UNSUITABLE

Cardboard
Carpeting
Unpainted Wood
Felt
Canvas
Foams

NOTE:

These lists are not limiting in the materials to be included. They are to establish the intent of the regulatory requirement prohibiting moisture absorbent materials. If possible, the isolation materials should be bonded (glued) to the tank so that moisture (from condensation) cannot be trapped next to the tank.

TO COMPLY WITH THE LAW

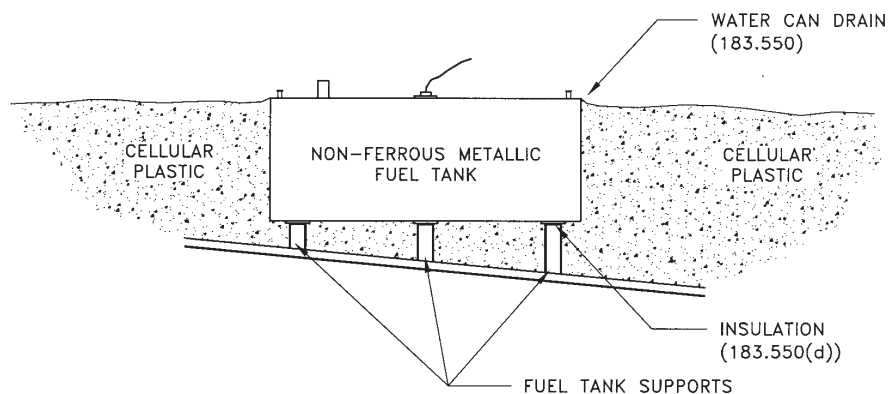
- *The fuel tank supports, chocks or straps are integral with the fuel tank, or*
- *The fuel tank supports, chocks or straps are insulated from the fuel tank by non-moisture absorbing material?*

FEDERAL LAW:**183.550 Fuel tanks: Installation.**

(f) Cellular plastic must not be the sole support for a metallic fuel tank.

Non-ferrous metallic fuel tanks may be foamed-in-place if the installation provides support for the fuel tank that is independent of the cellular plastic (foam) (see 183.512(c)). Supports for metallic fuel tanks must be in accordance with 183.550(e). The installation must comply with all applicable sections of 183.550, particularly sections (b), (c) and (d). It is recognized that the foam, upon curing, will assume some of the support for the tank. This is acceptable.

FIGURE 22 Foamed-in-Place Non-Ferrous Metallic Tank

**TO COMPLY WITH THE LAW**

If foam is used to install a metallic tank

- *Is the fuel tank made from non-ferrous metal?*
- *Is the fuel tank supported independently of the foam?*
- *Can water drain from the fuel tank's surface?*
- *Fuel tank supports, chocks and straps are integral with the fuel tank, or*
- *Fuel tank supports, chocks and straps are insulated from the fuel tank surface with a non-moisture absorbing material.*
- *The fuel tank does not support a deck, bulkhead or other component of boat structure.*
- *The fuel tank is restrained from moving more than one-fourth inch in any direction.*

FEDERAL LAW:

183.550 Fuel tanks: Installation.

(g) If cellular plastic is the sole support of a non-metallic fuel tank, the cellular plastic must meet the requirements of Sec.183.516 (b) or (c).

Cellular plastic (foam) may provide the only support for non-metallic fuel tanks. Fiberglass reinforced plastic fuel tanks and other suitable plastics used for fuel tanks may be installed in foam. In order to use foam as the only support for these non-metallic tanks, the foam must meet or exceed the requirements of 183.516(b) for non-polyurethane foam (i.e. compressive strength of at least 60 pounds per square inch at 10 percent deflection or 183.516(c) for polyurethane foam (i.e. density of at least 2.0 pounds per cubic foot). Refer to these sections for further information about the properties required of foam.

TO COMPLY WITH THE LAW

If foam is used as the only support for a non-metallic fuel tank:

- *The foam meets the requirements of 183.516 (b), or (c).*
- *The fuel tank is restrained from moving more than one-fourth inch in any direction.*
- *The fuel tank does not support a deck, bulkhead or other component of boat structure.*

FEDERAL LAW:**183.550 Fuel tanks: Installation.**

- (h) Each fuel tank labeled under Sec. 183.514(b)(8) for installation aft of the boat's half length must be installed with its center of gravity aft of the boat's half length.

Fuel tanks which are labeled "Must be installed aft of the boat's half length" in accordance with 183.514(b)(8) are to be installed with the fuel tank's center of gravity toward the stern of the mid-length of the boat. These fuel tanks have been qualified at a lower strength criteria than those fuel tanks capable of installation at any location in a boat. The shock loading or impacts felt by boats are more severe in the forward portion of a boat than in the aft section.

Fuel tanks that are meant for installation at any location in a boat shall be tested at 25g vertical accelerations in accordance with 183.584(e)(1), or they must be tested in accordance with either 183.586, or both 183.586 and 183.588, depending on their capacity. Fuel tanks meant only for installation aft of the boat's half length may be tested at 15g accelerations in accordance with 183.584(e)(2) if their capacity is less than 25 gallons. Table III shows the strength test for fuel tanks according to the tank's capacity and intended location in a boat.

TABLE III Strength Tests for Fuel Tanks

CAPACITY	STRENGTH TESTS		
	SHOCK	PRESSURE-IMPULSE	SLOSH
<u>Fuel Tank Located Anywhere in Boat</u>			
Less than 25 gallons	183.584 [use (e) (1)]	—	—
25 to less than 100 gallons	—	183.586	—
100 gallons or more	—	183.586	—
<u>Fuel Tank's Center of Gravity Aft of Half-Length</u>			
Less than 25 gallons	183.584 [use (e) (2)]	—	—
25 to less than 100 gallons	—	183.586	—
100 gallons or more	—	183.586	183.588

TO COMPLY WITH THE LAW

- *Is the fuel tank marked "Must be installed aft of the boat's half length"?*
- *If so marked, is the tank's center of gravity located aft of the boat's half length?*

FEDERAL LAW:**183.552 Plastic encased fuel tanks: Installation.**

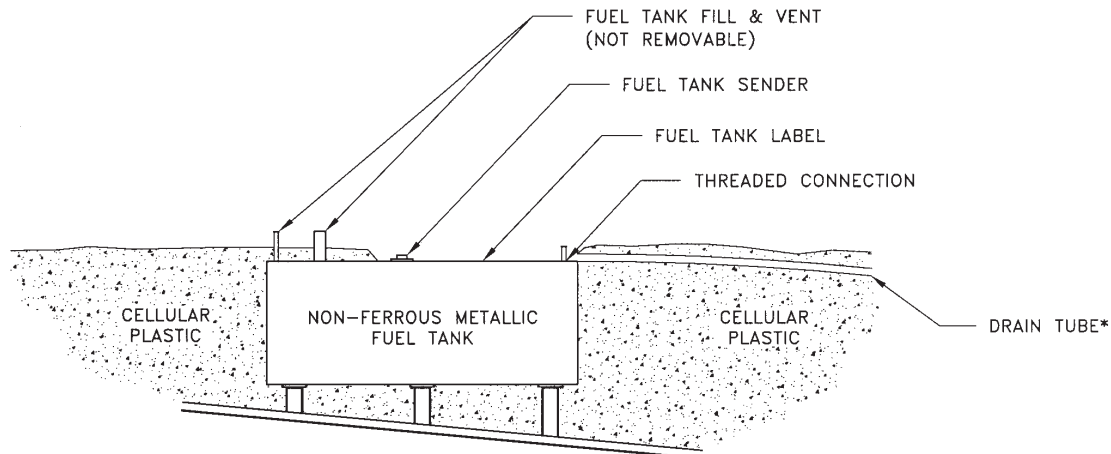
- (a) Each fuel tank encased in cellular plastic foam or in fiber reinforced plastic must have the connections, fittings, and labels accessible for inspection and maintenance.

The connections at the tank for the fuel tank fill, fuel tank vent, fuel distribution fittings, fuel level gauge and the fuel tank label must all be located to be available for inspection and servicing when using foam or fiberglass for the fuel tank installation.

If the fuel tank connections are welded to the fuel tank, then the top of the fuel tank may be covered with foam. If the fuel tank connections are screw-type spuds in the fuel tank surface, these connections and joints must be accessible.

Accessibility may be achieved by removable panels, hatches, access ports and boat components. Seats, fish boxes and consoles that are designed so they may be removed also provide accessibility.

FIGURE 23 Encased Fuel Tank Connections, Fittings and Label Accessibility



* NOTE : DRAIN TUBES ARE REQUIRED UNLESS THE FUEL TANK SURFACE IS NON-METALLIC OR PROTECTED WITH FIBERGLASS

TO COMPLY WITH THE LAW

- *Is the fuel tank encased in foam or fiberglass?*
- *If so, are the fuel tank connections, fittings and label accessible for inspection and maintenance?*

FEDERAL LAW:

183.552 Plastic encased fuel tanks: Installation.

- (b) If a metallic fuel tank is encased in cellular plastic or in fiber reinforced plastic, water must not collect between the plastic and the surface of the tank or be held against the tank by capillary action.

Encased metallic fuel tanks (only non-ferrous tanks are permitted) might corrode in the presence of stagnant moisture. This moisture could be held against a fuel tank surface by tight fitting, slip-in foam blocks or other plastic materials not bonded to the fuel tank surfaces (see 183.552(c)).

Unless the encasement materials are bonded to the fuel tank surfaces, there must be an air space between the fuel tank surface and the encasement materials to allow water to run off. This space must be sufficient to prevent water droplets from bridging the space and being held in place by capillary action. One-fourth inch has proven satisfactory in many installations; however, in installations where this may be a problem, the installation should be evaluated.

Supports, chocks or straps and the insulation material between these items and the fuel tank surface are not included in this requirement (see 183.550(e)). An intervening plastic film between the encasement materials and the fuel tank surface does NOT meet the intent of this requirement unless water is prevented from collecting against the surface of the fuel tank.

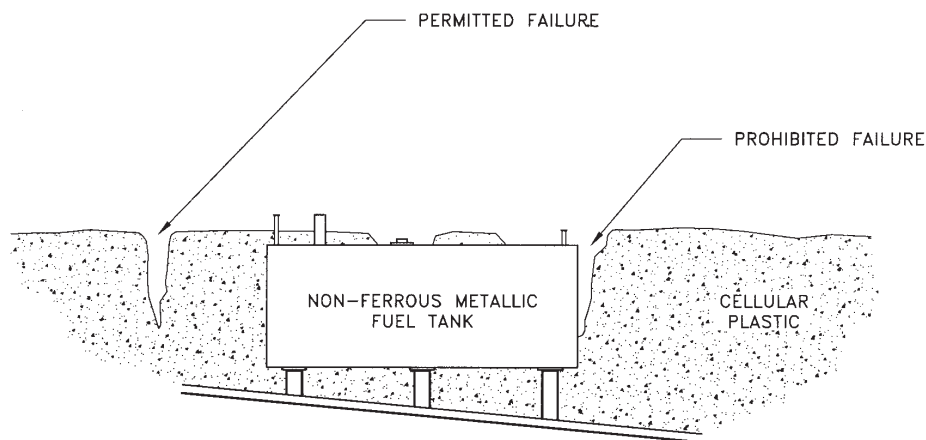
TO COMPLY WITH THE LAW

- *Is the fuel tank metallic?*
 - *Is the fuel tank encased in foam or fiberglass?*
 - *Does the installation prevent water from collecting between the plastic and the surface of the fuel tank?*
- or*
- *Does the installation prevent water from being held against the surface of the fuel tank by capillary action?*

FEDERAL LAW:**183.552 Plastic encased fuel tanks: Installation.**

- (c) If the plastic is bonded to the surface of a metallic fuel tank, the adhesive strength of the metal to the plastic bond must exceed the cohesive strength of the plastic.

Encasement of metallic (only non-ferrous tanks are permitted) fuel tanks must be done carefully to avoid accelerated corrosion. The adhesion of the encasement materials to the surface of the fuel tank must prevent water from contacting the fuel tank's metallic material. This is the reason for the requirement that the plastic's cohesive strength be less than the strength of the adhesive bond to the fuel tank. If a failure of the encasement material is to occur, it should fail within the encasement material rather than pulling away from the surface of the fuel tank.

FIGURE 24 Failure of Encasement Materials**TO COMPLY WITH THE LAW**

- *Should a failure occur to the encasement material used with a metallic tank, the failure will not occur at the joint to the surface of the fuel tank.*

FEDERAL LAW:**183.554 Fittings, joints and connections.**

Each fuel system fitting, joint, and connection must be arranged so that it can be reached for inspection, removal, or maintenance without removal of permanent boat structure.

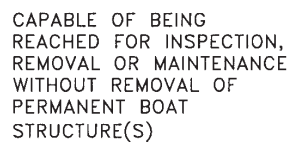
The fuel system must be installed and the boat must be designed and constructed to provide access to every fuel system fitting, joint and connection. This access must permit:

- (a) inspection of these items for leakage and deterioration (mirrors may be used to see the hidden portion),
- (b) removal of these fuel system components for repair or replacement, and
- (c) maintenance of these fuel system components to preserve the integrity and reliability of the fuel system.

All fuel system fittings, joints and connections must be accessible for inspection, removal and maintenance. This requirement does not apply to fuel tanks, only to the fuel tank fittings. Long runs of fuel hose, likewise must be accessible for inspection, but only the fittings must be readily accessible. In a long run of hose, it is acceptable to disconnect the fittings and to pull the hose out to inspect it. The entire run of hose does not have to be immediately accessible. Access may be gained by means of removable panels, hatches, ports, doors, removable seats, removable consoles or other means designed for such access. It is intended that these items be reached without cutting portions of the boat. Bolts, screws and other fastenings may be removed in order to move panels, flooring, furnishings and other items to gain access. Caulking and sealants do not make a part permanently attached so long as it can be removed and replaced without destruction of boat structure. Figure 25 depicts typical means of access.

TO COMPLY WITH THE LAW

- *Each fitting, joint and connection in the fuel system can be reached for inspection, removal or maintenance without removal or damage to permanent boat structure.*



FEDERAL LAW:

183.556 Plugs and fittings.

(a) A fuel system must not have a fitting for draining fuel.

There shall be no fitting or component in the fuel system with the purpose of draining fuel from the fuel system. Fuel tank drains, valves or plugged tee fittings in fuel lines, and drain or bleed valves at engine connections are prohibited.

TO COMPLY WITH THE LAW

- *Except as provided in 183.556(b) there is no fuel drain in the system.*

FEDERAL LAW:

183.556 Plugs and fittings.

- (b) A plug used to service the fuel filter or strainer must have a tapered pipethread or be a screw type fitted with a locking device other than a split lock washer.

Fuel filters and strainers may have a servicing plug or screw fitting; however, they must be either:

- (a) a tapered pipe-thread type of plug, or
- (b) a screw-type of plug incorporating or provided with a locking means other than a split lock washer. Gaskets and seals must be an unsplit ring and meet the leakage prohibition required by 183.536(b).

The locking device should provide for repetitive removal and replacement without leakage. Some types of a locking device, such as a star lock washer, can damage surfaces upon repetitive disassembly and assembly, potentially affecting the ability of the filter or strainer to remain leakproof.

TO COMPLY WITH THE LAW

The servicing plug for a filter or strainer is either:

- *a tapered pipe-thread, or*
- *a screw-type with a locking device other than a split lock washer.*

FEDERAL LAW:

183.558 Hoses and connections.

- (a) Each hose used between the fuel pump and the carburetor must be "USCG Type A1" hose.

If a hose is used in the fuel line running between the fuel pump and the carburetor, the hose must be "USCG Type A1" and so labeled as required by 183.540. This requirement is applicable whether the fuel pump is engine mounted or mounted remotely from the engine, as permitted by 183.566.

This requirement does not apply to a tube used to detect fuel pump diaphragm failure.

TO COMPLY WITH THE LAW

- A hose used between the fuel pump and the carburetor is "USCG Type A1."

FEDERAL LAW:**183.558 Hoses and connections.****(b) Each hose used:****(1) For a vent line or fill line must be:**

- (i) "USCG Type A1" or "USCG Type A2"; or
- (ii) "USCG Type B1" or "USCG Type B2" if no more than five ounces of fuel is discharged in 2-1/2 minutes when:
 - (A) The hose is severed at the point where maximum drainage of fuel would occur,
 - (B) The boat is in its static floating position, and
 - (C) The fuel system is filled to the capacity marked on the tank label under Sec. 183.514(b)(3).

(2) From the fuel tank to the fuel inlet connection on the engine must be:

- (i) "USCG Type A1"; or
- (ii) "USCG Type B1" if no more than five ounces of fuel is discharged in 2-1/2 minutes when:
 - (A) The hose is severed at the point where maximum drainage of fuel would occur,
 - (B) The boat is in its static floating position, and
 - (C) The fuel system is filled to the capacity marked on the tank label under Sec. 183.514(b)(3).

The selection of the type of hose to be used in a fuel system is evaluated in accordance with the following:

- (a) The boat must be in its static floating position as defined by 183.505. The fuel system is filled to the capacity marked on the fuel tank label as specified by 183.514(b)(3). Normally this quantity of fuel may fill the fuel tank to its topmost surface but will not fill the fuel tank fill or vent lines. Fuel is required to fill the fuel distribution line to the carburetor connection in order to determine the quantity of fuel that will leak in 2-1/2 minutes if a hose is severed.

Table IV shows the length of hose or tubing of various diameters, that if filled with fuel will contain five ounces. You will see that only a short portion of fuel fill or vent hose will require that hose to be "USCG Type A1 or A2"; Most fuel fill and fuel tank vent installations will permit the use of "USCG Type B1," but particular care must be taken if the fuel fill line and/or fuel tank vent line are run horizontally from the fuel tank connection. Any dips below the topmost surface of a fuel tank may cause a need for "USCG Type A1 or A2";

To determine what type of hose may be used for the fuel distribution line, it is necessary to:

- (a) determine where, in the hose portion of the fuel line, maximum drainage could occur.
- (b) cut the hose at the maximum drainage point. The intent is to cut the hose completely through and then support the hose at both sides of the cut at their original location.
- (c) measure the fuel leakage from this opening in the fuel hose for a period of 2-1/2 minutes. If more than five ounces leaks, use "USCG Type A1." If less than five ounces leaks, you may use "USCG Type B1."

"USCG Type A" hose may be used for all hose portions, regardless of whether the installation proves that "USCG Type B" hose is acceptable. If "USCG Type A" hose is used, there is no need to test for five ounces of fuel leakage in 2-1/2 minutes.

TABLE IV LENGTH OF HOSE VS. FIVE OUNCE FUEL CAPACITY

<u>Hose Inside Diameter</u>	<u>Length in Inches</u>
1/4	184
5/16	118
3/8	82
7/16	60
1/2	46
9/16	36
5/8	29
3/4	20
1	11
1-1/4	7
1-1/2	5
2	3

Note:

Table IV shows the length of hose or tubing of various diameters, that if filled with fuel will contain five ounces.

TO COMPLY WITH THE LAW

- Are all fuel distribution lines "USCG Type A1"? If not:
Place the boat in its static floating position (see 183.505) Fill the fuel system to the capacity marked on the fuel tank label. Cut the hose portion of the fuel line at its maximum drainage point. Measure the fuel leakage in 2-1/2 minutes.
- If less than five ounces leaks, "USCG Type B1" hose may be used.
- If more than five ounces leaks, "USCG Type A1" hose must be used or the fuel line must be rerouted to comply.

FEDERAL LAW:

183.558 Hoses and connections.

(c) Each hose must be secured by:

- (1) A swaged sleeve;
- (2) A sleeve and threaded insert; or
- (3) A hose clamp.

This requirement does not apply to the tube used to detect fuel pump diaphragm failure.

Hose connections may be made by one of the following means:

- (a) **SWAGED SLEEVE:** This type of connection is usually made by the supplier of a hose assembly since special machinery or apparatus is necessary to perform the swaging operation. The attachment to the fuel system is usually made by means of a threaded hose fitting.
- (b) **SLEEVE AND THREADED INSERT:** This type of connection usually can be made by an installer using normal shop tools. Usually the sleeve is placed on the outside of the hose and the threaded insert is screwed into the inside of the hose and sleeve. There are also connections in which the sleeve is installed on the hose after the insert is installed. The attachment to the fuel system is usually made by means of a threaded hose fitting.
- (c) **HOSE CLAMP:** This type of connection is usually made upon installation using normal shop tools. The device usually has a mechanically operated tightening mechanism such as a screw or bolt but may require a specific means of deformation to secure the connection. A hose clamp is usually slipped on each end of the hose in a loosened condition, the hose installed and the hose clamp tightened. The attachment to the fuel system is usually made by means of a beaded, flared or serrated spud, pipe or hose fitting.

NOTE:

Wire types of hose clamps are not acceptable.

TO COMPLY WITH THE LAW

- *Are all hose ends mechanically fastened?*
- *Is the securing device one of the following?*
A swaged sleeve,
A sleeve and threaded insert, or
A hose clamp

FEDERAL LAW:

183.558 Hoses and connections.

(d) The inside diameter of a hose must not exceed the actual minor outside diameter of the connecting spud, pipe, or fitting by more than the distance shown in Table 8.

Table 8

If minor outside diameter of the connecting spud, pipe or fitting is:	The inside diameter of the hose must not exceed the minor outside diameter of the connecting spud, pipe, or hose fitting by more than the following distance:
Less than 3/8 in.	0.020 in.
3/8 in. to 1 in.	0.035 in.
Greater than 1 in.	0.065 in.

This requirement does not apply to a tube used to detect fuel pump diaphragm failure.

To assure a leakproof hose connection, certain permitted hose to spud clearances have been established. Figure 26 depicts these clearances as applied to some spuds, pipes or fittings.

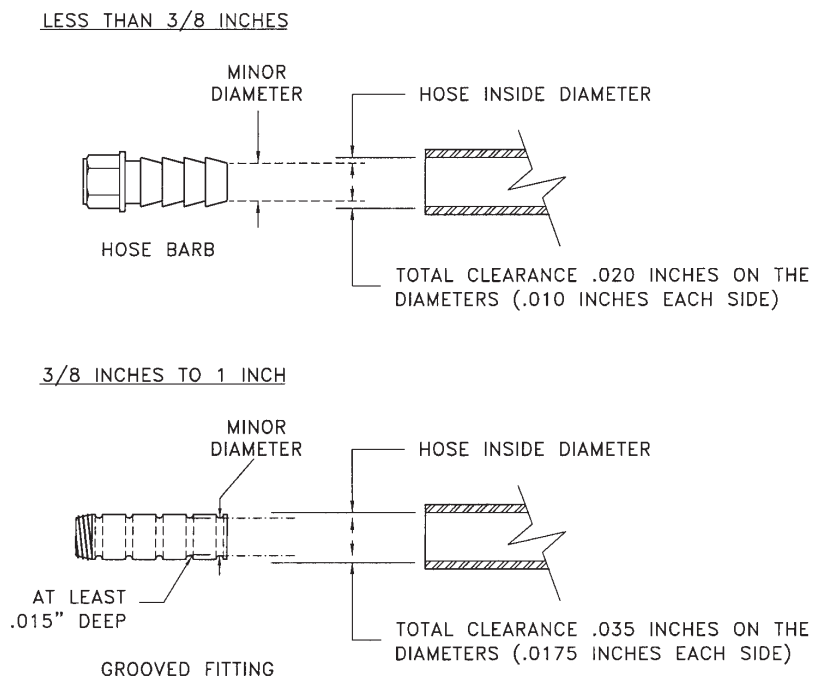
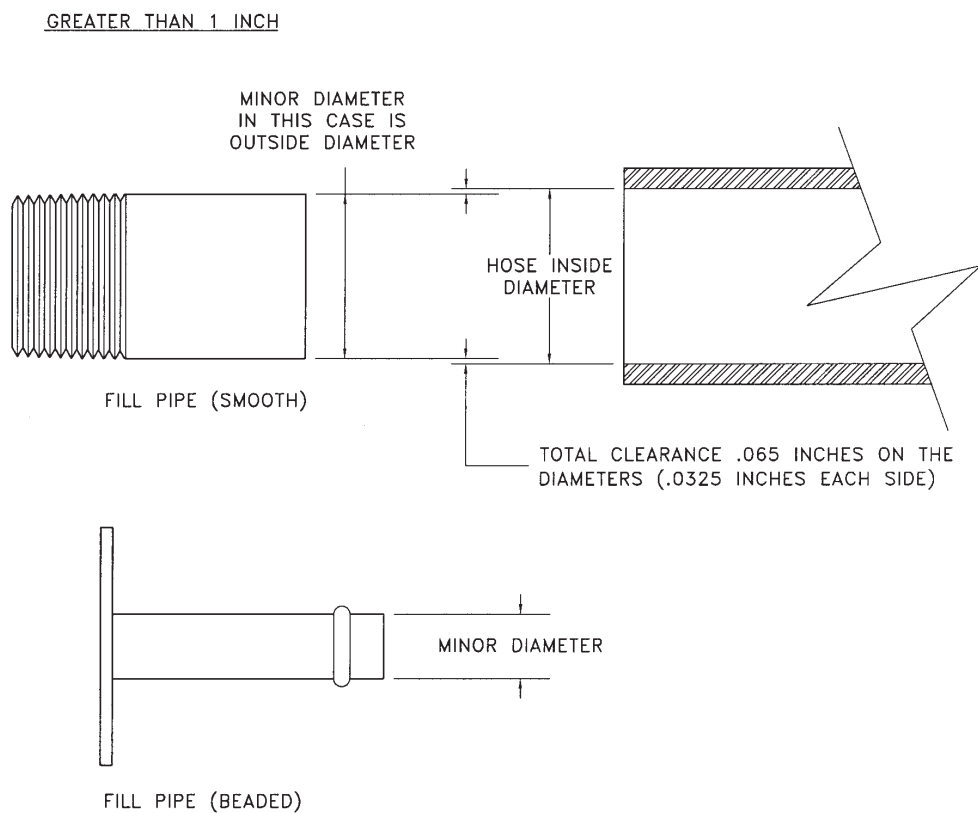
FIGURE 26 Hose Connections

FIGURE 26 Hose Connections (continued)

NOTE: Hose connections using hose clamps must comply with 183.530 which requires a bead, a flare or series of annular grooves or serrations at least .015 inches deep, on the connecting fitting. Fuel tank fill pipe connections may be made on smooth pipe.

TO COMPLY WITH THE LAW

- *The inside diameter of the hose is not larger than the minor diameter of the connecting fitting in accordance with the permitted clearance allowed in Table 8 of 183.558(d).*

FEDERAL LAW:**183.560 Hoses clamps: Installation.**

Each hose clamp on a hose from the fuel tank to the fuel inlet connection on the engine, a hose between the fuel pump and the carburetor, or a vent line must:

- (a) be used with hose designed for clamps.

This requirement does not apply to a tube used to detect fuel pump diaphragm failure.

Hoses may or may not be designed to be clamped, particularly wire or the mesh reinforced hoses. The proof of whether or not a hose is satisfactory is that the hose connection does not leak when subjected to the "Static Pressure Test for Fuel Systems" as required by 183.542.

TO COMPLY WITH THE LAW

- *Have you selected hose for your boat's fuel system that can work with hose clamps such that connections will not leak when subjected to the "Static Pressure Test for Fuel Systems" (183.542)?*

FEDERAL LAW:**183.560 Hoses clamps: Installation.**

Each hose clamp on a hose from the fuel tank to the fuel inlet connection on the engine, a hose between the fuel pump and the carburetor, or a vent line must:

- (c) Be beyond the bead, flare, or over the serrations of the mating spud, pipe, or hose fitting; and (see 183.560)

This requirement does not apply to a tube used to detect fuel pump diaphragm failure.

Any hose to be used with hose clamps and installed in:

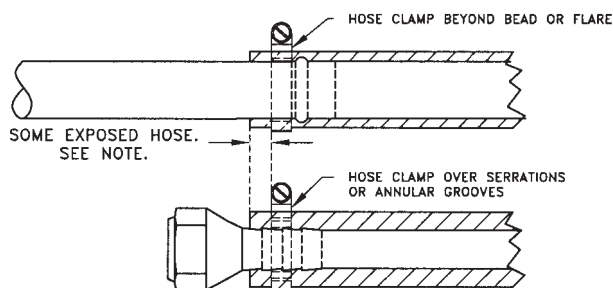
- the fuel tank vent line;
- the fuel line between the fuel pump and the carburetor; or
- the fuel distribution line between the fuel tank and the fuel inlet connection at the engine (this connection is often at the fuel pump)

is required to be assembled with the hose clamp:

- at least one-quarter inch from the end of the hose, and
- beyond a bead or flare, or
- over serrations or annular grooves (183.530).

NOTE:

Wire types of hose clamps are not acceptable.

FIGURE 27 Examples of Satisfactory Installations

NOTE: THE CFR DOES NOT REQUIRE A MINIMUM DISTANCE BETWEEN THE HOSE CLAMP AND THE END OF THE HOSE. GOOD PRACTICE IS TO LEAVE ONE CLAMP WIDTH OF HOSE EXPOSED.

TO COMPLY WITH THE LAW

- Is the hose clamp beyond a bead or flare, or installed over the serrations or annular grooves, depending upon the design of the hose barb fitting?*

FEDERAL LAW:**183.560 Hoses clamps: Installation.**

Each hose clamp on a hose from the fuel tank to the fuel inlet connection on the engine, a hose between the fuel pump and the carburetor, or a vent line must:

- (d) Not depend solely on the spring tension of the clamp for compressive force.

This requirement does not apply to a tube used to detect fuel pump diaphragm failure.

Hose clamps are available that use different means for securing the hose to the hose fitting, pipe or spud.

- (a) **MECHANICAL TIGHTENING:** This type employs a screw or bolt to apply pressure to the connection. A screwdriver, pliers or wrench is used to adjust the hose clamp depending on the adjustment configuration. These clamps are reusable.

NOTE:

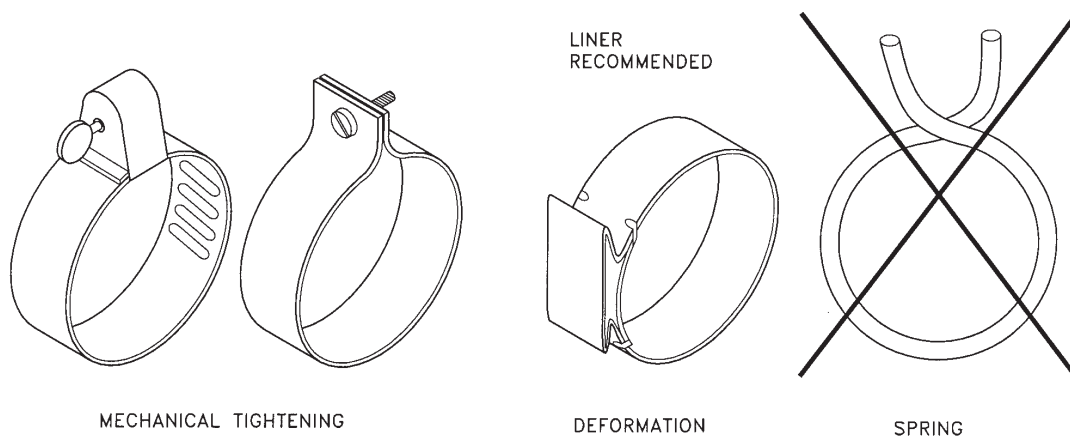
Wire type hose clamps are not acceptable.

- (b) **DEFORMATION OF THE CLAMP MATERIAL:** This type usually depends on the use of a special tool for installation. The clamp material is bent or formed in such a manner as to apply pressure to the hose thereby securing the hose connection. Generally this type of clamp is not reusable and may be difficult to tighten in the event of a leak. This style of clamp requires a specific tool for correct application. Since technicians in the field will not have access to these tools, these clamps should not be used on connections where routine disconnection for servicing may be required.
- (c) **SPRING TYPE:** This type is prohibited. The compressive force depends on the clamp material and there is no positive mechanical type of fastening.

TO COMPLY WITH THE LAW

- Do hose clamps rely on a means of tightening other than spring tension of the clamp?

FIGURE 28 Hose Clamp Types



FEDERAL LAW:**183.562 Metallic fuel lines.**

- (a) Each metallic fuel line that is mounted to the boat structure must be connected to the engine by a flexible fuel line.

Metallic fuel lines are relatively rigid and need protection from vibration. This is particularly true for the fuel lines attached to the boat structure that run from the fuel tank to the engine.

A boat responds to forces created by waves and resultant pounding by the hull twisting and moving. An engine vibrates and moves in its resilient mounts. If a rigid fuel line is connected directly to the engine, unusual stress is likely to be transmitted to its connections, probably resulting in leakage. For these considerations, a flexible portion of fuel line is required to connect the metallic fuel line that is attached to the boat to the engine connection.

The flexible fuel line may be hose, "USCG Type A1" or "USCG Type B1," depending on compliance with the criteria of 183.558.

TO COMPLY WITH THE LAW

- *If a metallic fuel line is used, is there a flexible fuel line connecting this line to the engine?*

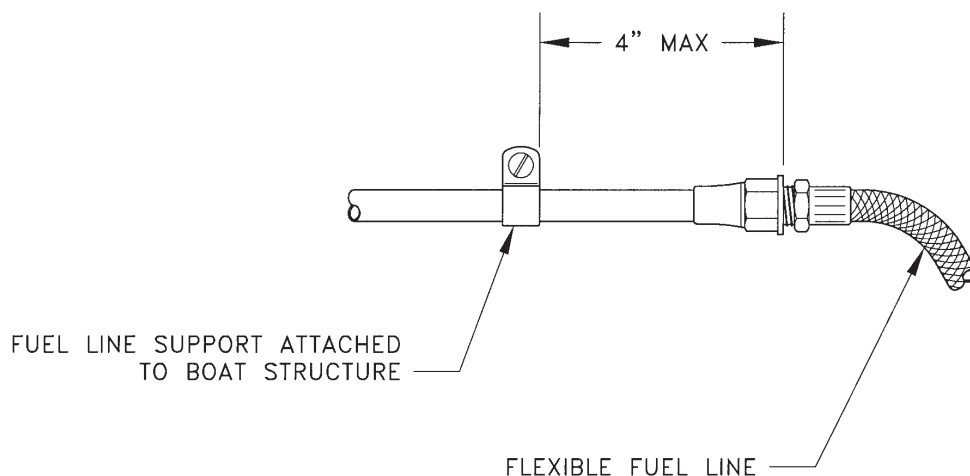
FEDERAL LAW:

183.562 Metallic fuel lines.

- (b) Each metallic fuel line must be attached to the boat's structure within four inches of its connection to a flexible fuel line.

To prevent damaging stresses on the metallic fuel line at the connection of the flexible fuel line, there must be a means of support for the metallic fuel line within four inches of the connection. This support must be installed wherever a flexible fuel line is used and attached to a rigid metallic fuel line. The closer the support is to the end of the metallic fuel line, the better the protection of the metallic fuel line.

FIGURE 29 Metallic Fuel Line Support

**TO COMPLY WITH THE LAW**

- *Is there support for metallic fuel lines within four inches of a connection to a flexible fuel line?*

FEDERAL LAW:**183.564 Fuel tank fill system.**

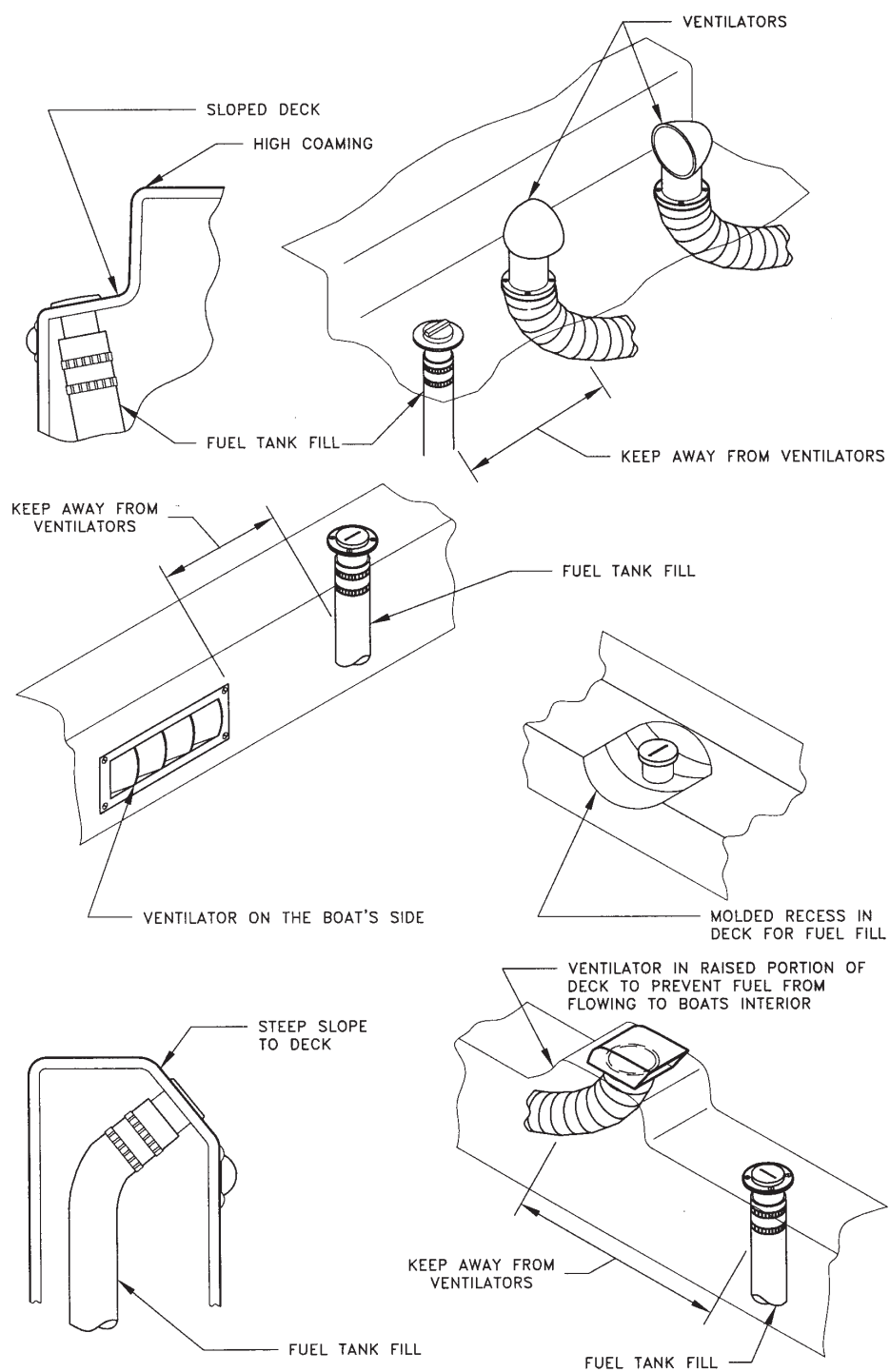
- (a) Each fuel fill opening must be located so that a gasoline overflow of up to five gallons per minute for at least five seconds will not enter the boat when the boat is in its static floating position.

One of the key principles of this regulation is to prevent gasoline from getting inside a boat where it can vaporize and create an explosive atmosphere. Overflow at the fuel fill opening is one potential source of fuel that could get inside a boat unless precautions are taken.

The location of the fuel tank fill opening must be chosen with the following considerations in mind:

- (a) Nearby ventilators, on deck or on the side of a boat, could provide access for fuel to flow inside a boat. The distance between the fuel fill opening and ventilators may have to be increased over that normally considered adequate for keeping vapors from entering ventilators.
- (b) The deck configuration and its slope could channel overflow fuel into a boat.
- (c) High coamings or cabin sides can offer protection against overflow from flowing into a boat,
- (d) Deck joints in riveted construction or wooden construction could provide a path for fuel to flow into the boat's interior unless they are caulked to resist such fuel leakage.

FIGURE 30 Fuel Fill Locations



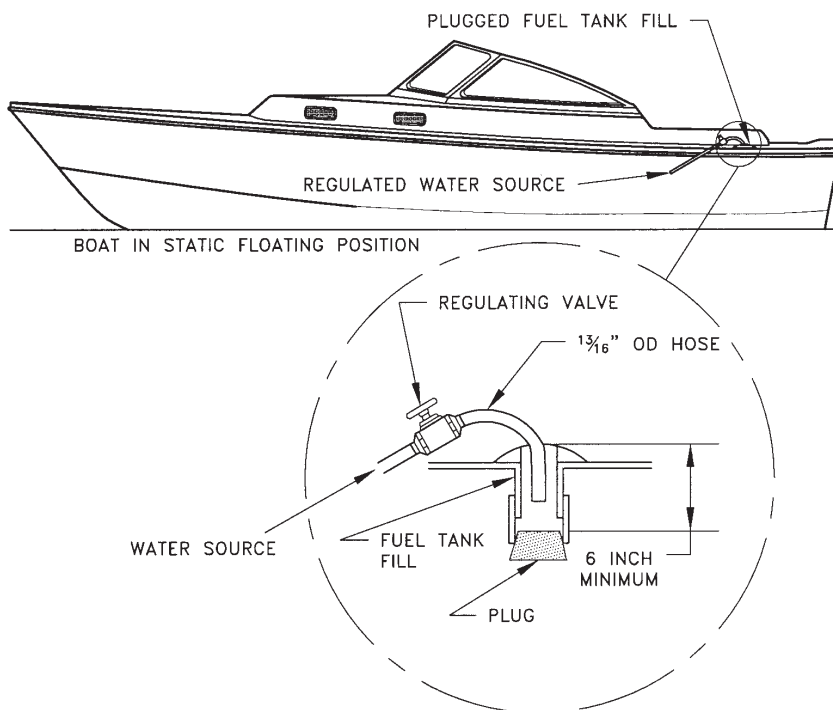
The test to determine compliance is as follows:

- Place the boat in its static floating position — see 183.505
- Plug the fuel tank fill line at least a distance of six inches below the fuel tank fill opening.
- Insert a 13/16 outside diameter hose into the fuel tank fill opening.
- Discharge water at a rate of five gallons per minute (53.3 ounces in five seconds).
- Time the overflowing water for five seconds and shut off the flow.
- Investigate to determine if any of the overflowing water got into the boat. None is permitted in order to comply. Overflow entering a self-bailing cockpit is considered entering the boat and is not permitted.

NOTE:

Interpretation of this requirement by the Coast Guard prohibits fuel fill fittings located in the cockpit sole or in seats inside the gunwales.

FIGURE 31 Fuel Overflow Test



TO COMPLY WITH THE LAW

- Gasoline will not overflow into the boat when its fuel fill is tested at an overflow rate of five gallons per minute for a period of five seconds with the boat in its static floating position.

FEDERAL LAW:

183.564 Fuel tank fill system.

(b) Each hose in the tank fill system must be secured to a pipe, spud, or hose fitting by:

- (1) A swaged sleeve;
- (2) A sleeve and threaded insert; or
- (3) Two adjacent metallic hose clamps that do not depend solely on the spring tension of the clamps for compressive force.

Fuel tank fill system hose connections shall be made to a pipe (smooth pipe is acceptable), a spud or a hose fitting. The hose connections may be made by one of the following means:

- (a) **SWAGED SLEEVE:** This type of connection is usually made by the supplier of a hose assembly, since special machinery or apparatus is necessary to perform the swaging operation. The attachment to the fuel system is usually made by means of a threaded hose fitting.
- (b) **SLEEVE AND THREADED INSERT:** This type of connection usually can be made by an installer using normal shop tools. Usually the sleeve is placed on the outside of the hose and the threaded insert screwed into the inside of the hose and sleeve. There are connections in which the sleeve is installed on the hose after the insert is installed. The attachment to the fuel system is usually made by means of a threaded hose fitting.
- (c) **TWO ADJACENT METALLIC HOSE CLAMPS THAT DO NOT DEPEND SOLELY ON THE SPRING TENSION OF THE CLAMPS FOR COMPRESSIVE FORCE:** For a fuel tank fill line, 2 hose clamps are usually slipped on each end of the hose in a loosened condition, the hose installed and the hose clamps tightened. The attachment to the fuel system is usually made by means of a beaded, flared or serrated spud, pipe or hose fitting. Hose clamps are to be installed side by side, not on top of each other. Two clamps are required for mechanical strength and to resist any tendency for the hose to twist.

NOTES:

1. Spring wire and other type clamps that depend on the spring tension properties of the clamp material are prohibited from use on fuel line installations on boats.
2. Wire type hose clamps are not acceptable.

TO COMPLY WITH THE LAW

- Are all fuel tank fill hoses secured?
- Is the securing device one of the following?
A swaged sleeve
A sleeve and threaded insert
Two hose clamps on each end of the hose

FEDERAL LAW:

183.564 Fuel tank fill system.

- (c) Each hose clamp in the tank fill system must be used with a hose designed for clamps.

Hoses may or may not be designed to be clamped, particularly wire or wire mesh reinforced hose. The proof of whether or not a hose is satisfactory is that the hose connection does not leak when subjected to the "Static Pressure Test for Fuel Systems" as required by 183.542.

TO COMPLY WITH THE LAW

- *A hose has been selected for use with hose clamps and is installed such that connections will not leak when subjected to the "Static Pressure Test for Fuel Systems" in 183.542.*

FEDERAL LAW:

183.564 Fuel tank fill system.

(d) Hose clamps used in the tank fill system must:

- (1) Have a minimum nominal band width of at least one-half inch; and
- (2) Be over the hose and the spud, pipe, or hose fitting.

If hose clamps are used to secure a hose in the fuel tank fill system, they must have a nominal band width of at least one-half inch. "Nominal" means that the normal SAE tolerances specified for hose clamps are acceptable. SAE states in their J536b standard, "Hose Clamps," that a one-half inch band width may actually measure 0.495 inches.

NOTE:

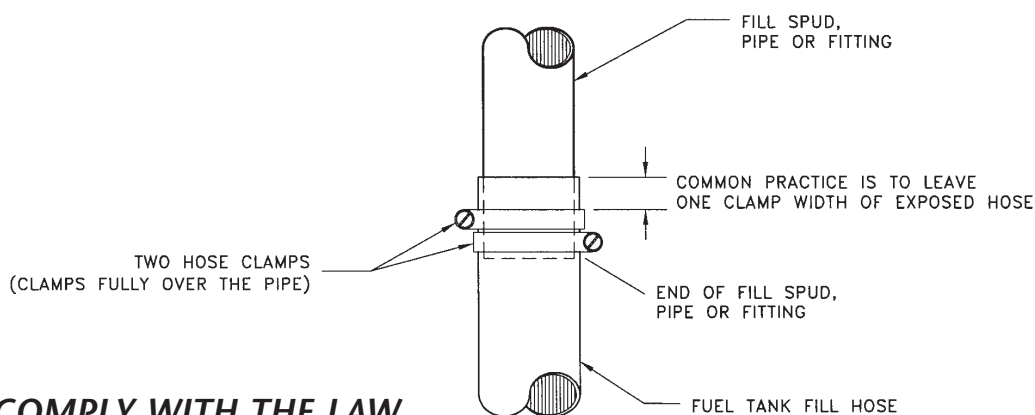
Wire type hose clamps are not acceptable.

Hose and hose clamp installations must be made so the hose is pushed onto the spud, pipe (smooth pipe is permitted for fuel tank fill systems) or hose fitting far enough to permit 2 hose clamps to be fully over the spud pipe or hose fitting.

NOTE:

The inside diameter of a fuel tank fill hose may NOT be more than 0.065 inches larger than the minor outside diameter of the spud, pipe or hose fitting.

FIGURE 32 Fuel Tank Hose Clamping

**TO COMPLY WITH THE LAW**

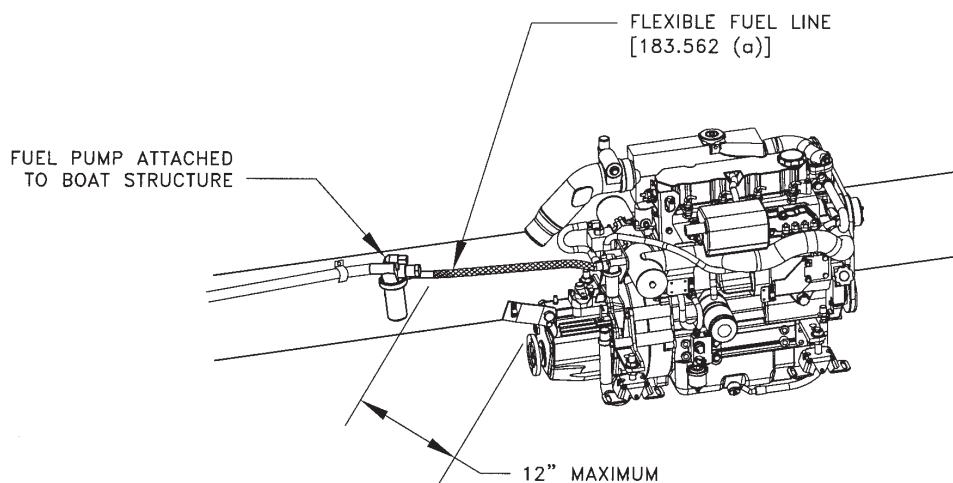
- *Do the hose clamps used in the fuel tank fill system have at least a nominal band width of one-half inch?*
- *Are the 2 hose clamps fully over the spud, pipe or hose fitting?*

FEDERAL LAW:**183.566 Fuel pumps: Placement.**

Each fuel pump must be on the engine it serves or within 12 inches of the engine, unless it is a fuel pump used to transfer fuel between tanks.

Most engines are equipped by the engine manufacturer with a fuel pump as an installed engine component. For engines that are not so equipped, a remote fuel pump, usually electric, may be used. In order to keep the length of the pressurized portion of the fuel distribution line at a minimum, it is required that a remote fuel pump be installed within 12-inches of the engine. The 12-inches are measured directly to the engine, not along the fuel line.

Pumps used to transfer fuel from one tank to another may be installed in other locations, and are not required to be within 12 inches of the engine.

FIGURE 33 Remote Fuel Pump**TO COMPLY WITH THE LAW**

- *If the fuel pump is not on the engine, is it within 12 inches of the engine?*
- *If the fuel pump is not on the engine or within 12 inches of the engine, is it used only to transfer fuel from tank to tank?*

FEDERAL LAW:**183.568 Anti-siphon protection.**

Each fuel line from the fuel tank to the fuel inlet connection on the carburetor must:

- (a) Be above the level of the tank top; or
- (b) Have an anti-siphon device or an electrically operated fuel stop valve:
 - (1) At the tank withdrawal fitting; or
 - (2) Installed so the line from the fuel tank is above the top of the tank; or
- (c) Provided that the fuel tank top is below the level of the carburetor inlet, be metallic fuel lines meeting the construction requirements of Sec. 183.538 or "USCG Type A1" hose, with one or two manual shutoff valves installed as follows:
 - (1) Directly at the fuel tank connection arranged to be readily accessible for operation from outside the compartment, and
 - (2) If the length of fuel line from the tank outlet to the engine inlet is greater than 12 feet, a manual shutoff valve shall be installed at the fuel inlet connection to the engine.

"Anti-siphon protection" is a term applied to the means of preventing the siphon action of permitting fuel to continue to flow out of the fuel tank in the event there is a break or rupture in a fuel distribution line, or if a fitting in the fuel line loosens, creating a leak.

"Anti-siphon protection" may be accomplished by one or more of the following methods:

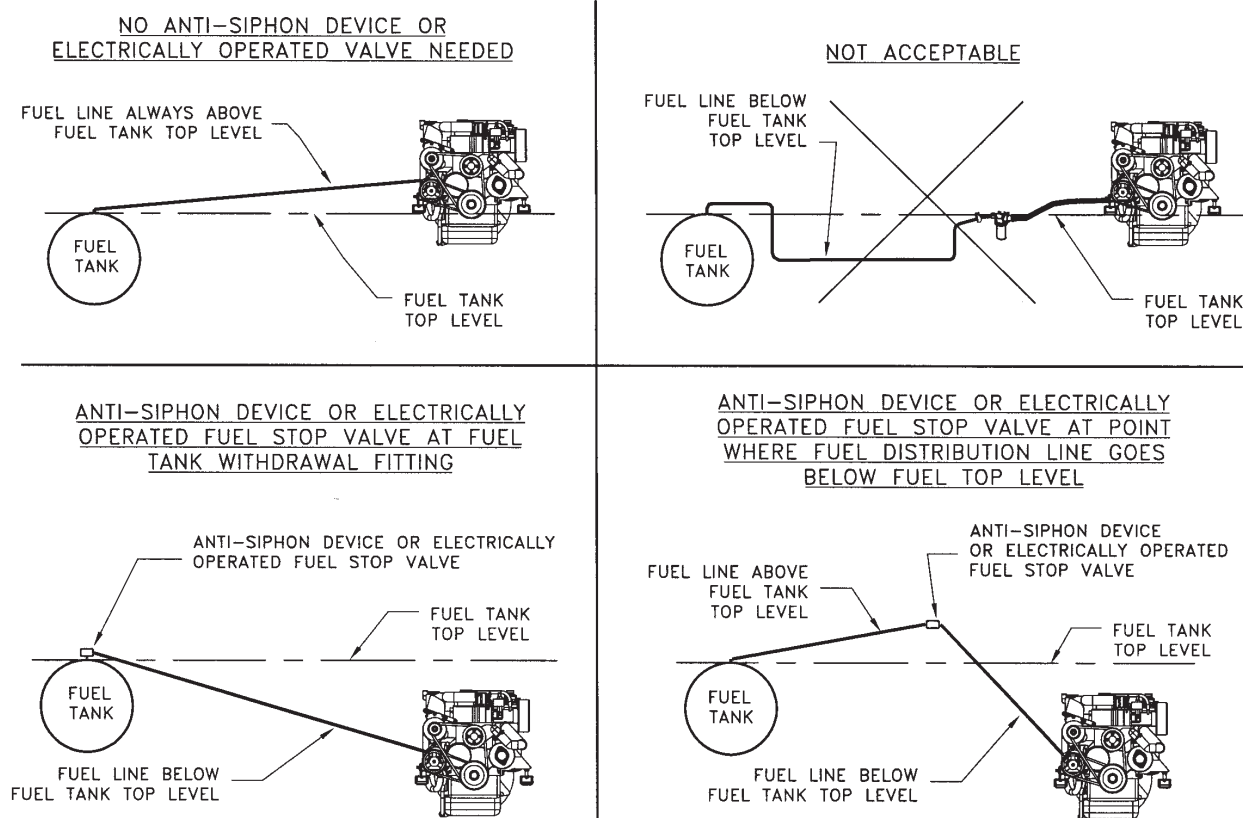
- (a) Keep all parts of the fuel line from the fuel tank to the fuel line connection at the carburetor above the level of the top of the fuel tank. The tank top level is determined with the boat in its "static floating position." Practically, the fuel pump and fuel filter(s) must also be above the tank top.
- (b) Install an anti-siphon device at the tank withdrawal fitting. The fuel distribution line may then run below the level of the tank top. A filter may be installed between the fuel tank withdrawal fitting and the anti-siphon device.

NOTES:

1. *Some anti-siphon devices are spring loaded check valves. These valves have a specific cracking pressure and provide protection up to a specific head. Therefore, the anti-siphon valve must be selected or ordered to protect against the siphon head for a particular installation.*
 2. *Too high a cracking pressure may cause vapor lock. This has become an increasing problem with reformulated gasoline (RFG). Be sure to select the correct cracking pressure.*
 3. *Some anti-siphon devices involve a bleed hole in the fuel pick-up tube, near the top of the fuel tank. The size of the hose is critical for a particular application. Each installation using this type of protection must be evaluated to assure its effectiveness. Too large a hole will bleed excessive air into the fuel flow effecting engine operation. Too small a hole may not stop fuel flow in the event of a fuel leak. This installation is used very infrequently because of inherent problems that may result.*
- (c) Install an anti-siphon device at a location where a line from the fuel tank will no longer remain above the fuel tank top level. The anti-siphon device will then protect the portion of the line that must run below the tank top level. The portion of the line that is above the fuel tank top level will be automatically taken care of.
- (d) Install an electrically operated fuel stop valve at the fuel tank withdrawal fitting. This valve requires electrical power to open and must be connected to operate only when the ignition switch is on. A filter may be installed between this valve and the fuel tank withdrawal fitting. Electrically operated fuel stop valves must comply with 183.528.
- (e) Install an electrically operated fuel stop valve at the point in a fuel line where it must run lower than the fuel tank top level. This valve requires electrical power to open and must be connected to operate only when the ignition switch of the engine it serves is on. A filter may be installed between this valve and the fuel tank withdrawal fitting. Electrically operated fuel stop valves must comply with 183.528.

NOTES:

1. *Fuel stop valves used in the fuel system, whether electrically operated or manually operated, must withstand the 2-1/2 minute fire test in accordance with 183.590.*
2. *Anti-siphon devices are not required to meet a fire test.*
3. *The fuel stop valve is required to be directly at the fuel tank connection by 183.568(c)(1) and must be installed so that it can be operated from outside the compartment. This can be accomplished with a reach rod or a long valve stem. The installation of an access panel over the valve is also permitted. However, once open, the valve must be immediately accessible inside the panel so that the operator does not have to reach through fire to shut off the fuel.*

FIGURE 34 Anti-Siphon Protection**TO COMPLY WITH THE LAW**

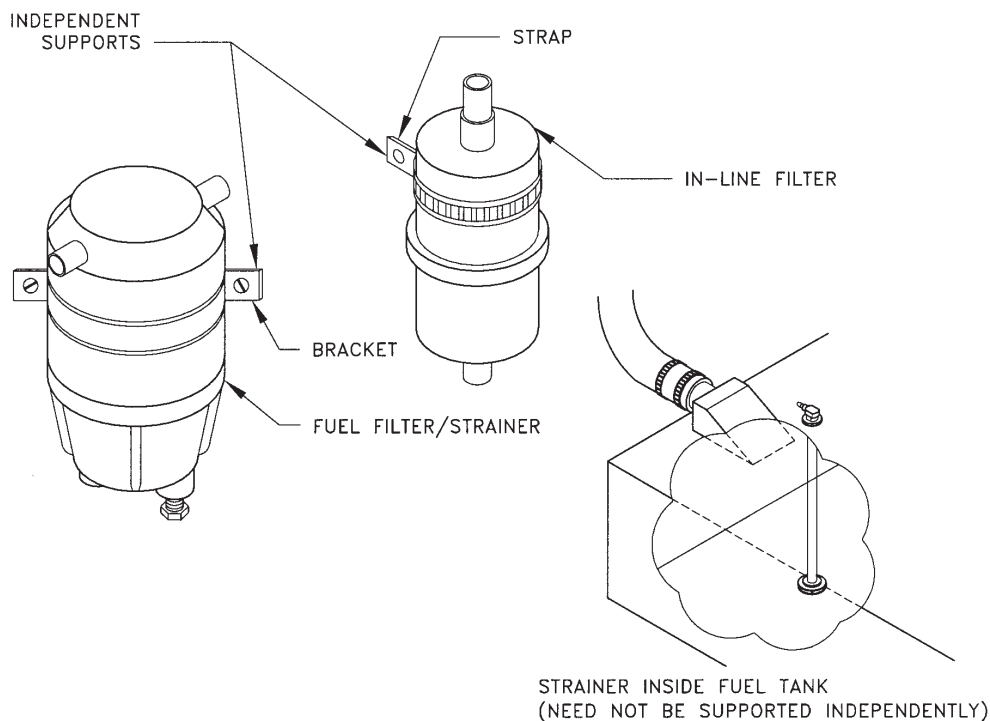
- *Is the fuel distribution line above the fuel tank top level?*
- *If not, is an anti-siphon device or an electrically operated fuel stop valve installed at the fuel tank withdrawal fitting?*
- *If not, is an anti-siphon device or an electrically operated fuel stop valve installed at the point where the fuel distribution line goes below the fuel tank top level?*

FEDERAL LAW:**183.570 Fuel filters and strainers: Installation.**

Each fuel filter and strainer must be supported on the engine or boat structure independent from its fuel line connections, unless the fuel filter or strainer is inside a fuel tank.

Fuel filters and strainers may not use the attached fuel lines for their primary means of support. Many fuel filters and strainers have brackets designed to provide support. If brackets are not provided as part of the fuel filter or strainer, clips, straps or other means must be employed to support the fuel filter or strainer independent of its connected fuel lines.

Fuel filters or strainers used inside a fuel tank, such as might be attached to the fuel tank withdrawal fitting, are not required to be independently supported.

FIGURE 35 Fuel Filter or Strainer Support**TO COMPLY WITH THE LAW**

- Are fuel filters and strainers not installed in a fuel tank provided with support independent of the connected fuel lines?

FEDERAL LAW:**183.572 Grounding.**

Each metallic component of the fuel fill system and fuel tank which is in contact with fuel must be statically grounded so that the resistance between the ground and each metallic component of the fuel fill system and fuel tank is less than 100 ohms.

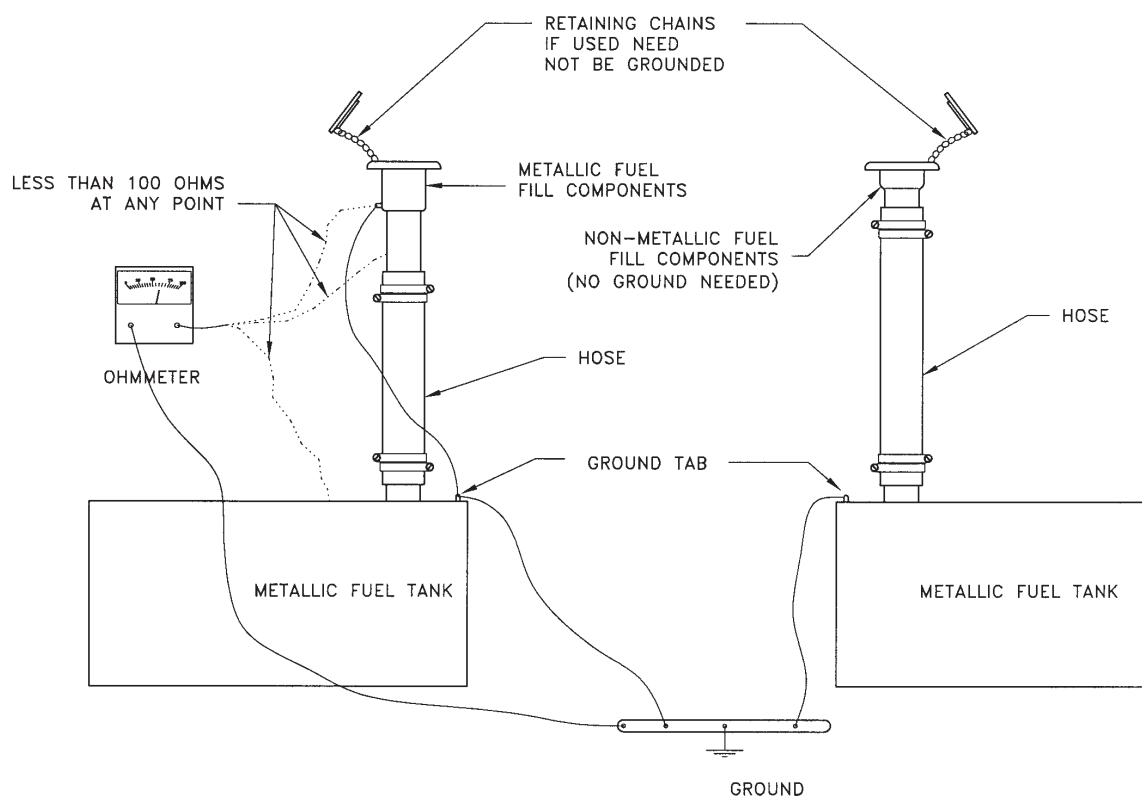
Fuel flowing from the dispensing nozzle into a fuel tank is a potential source of a static electric charge which could cause a spark between the dispensing nozzle and metal component of the fuel tank fill system. To prevent such a spark from occurring, metallic components of the fuel tank fill system and metallic fuel tanks must be grounded.

Grounding or bonding may be accomplished by connecting the metallic components electrically by running a wire from one component to the next, and so forth to the boat's ground. Grounding can usually be accomplished by a connection to the common bonding conductor or the engine negative terminal.

If the fuel tank deck fill fitting is nonmetallic, and nonconductive hose is used as a fill pipe, there is no need for grounding the fill fitting. Chrome-plated plastic fill fittings are treated the same as metallic fittings.

NOTES:

1. *If a metal hose attachment fitting is used, it must be grounded.*
2. *Fill cap retaining chains need not be grounded.*

FIGURE 36 Fuel Fill System Grounding**CAUTION:**

BONDING WIRES PUT UNDER THE END OF A HOSE COULD CAUSE A FUEL LEAK. The bonding wire should be a "bolted connection" on the tank's ground tab. At the deck plate the bonding wire may be securely connected to a ground fitting provided on the deck plate, or securely connected to a deck fill plate bolt.

TO COMPLY WITH THE LAW

- *Are metallic components of the fuel tank fill system and the metallic fuel tank grounded?*
- *Is the resistance between each of these metallic components, including the metallic fuel tank and ground less than 100 ohms?*

CAUTION

THE FOLLOWING TEST PROCEDURES ARE NOT INTENDED TO PROVIDE SUFFICIENT DETAILS TO PROPERLY CONDUCT THE REQUIRED TESTS.

THE INFORMATION IS PROVIDED TO FAMILIARIZE THE USER OF THIS GUIDELINE WITH THE OBJECTIVES OF THE TESTS AND TO DIAGRAM IN SCHEMATIC FORM SOME OF THE TEST CONSIDERATIONS.

FOR FULL DETAILS, REFER TO THE APPROPRIATE PROCEDURE PROVIDED IN APPENDIX A.

NOTE: A COMPLETE COPY OF THE UNITED STATES COAST GUARD COMPLIANCE TEST PROCEDURES — FUEL SYSTEM STANDARD TEST PROCEDURE, IS PROVIDED IN APPENDIX A OF THE FUEL GUIDE.

Tests

FEDERAL LAW:

183.580 Static pressure test for fuel tanks.

A fuel tank is tested by performing the following procedures in the following order:

- (a) Fill the tank with air or inert gas to the pressure marked on the tank label under Sec. 183.514(b)(5).

In most installations, it is almost impossible to completely inspect all surfaces of a tank. Therefore, this test should be performed before the tank is installed. Testing the tank before installation should result in the discovery of defects in the tank that could result in drastic disassembly of the boat, if such test was performed after installation.

The tank should be empty for this test. Testing pressure can be supplied by pressurized air or compressed inert gas. The tank's rated testing pressure is marked on the tank, but in no case will it be below 3psig.

During the test, the sides, top and bottom of the tank should be accessible. All openings except the one used to admit the pressure should be sealed.

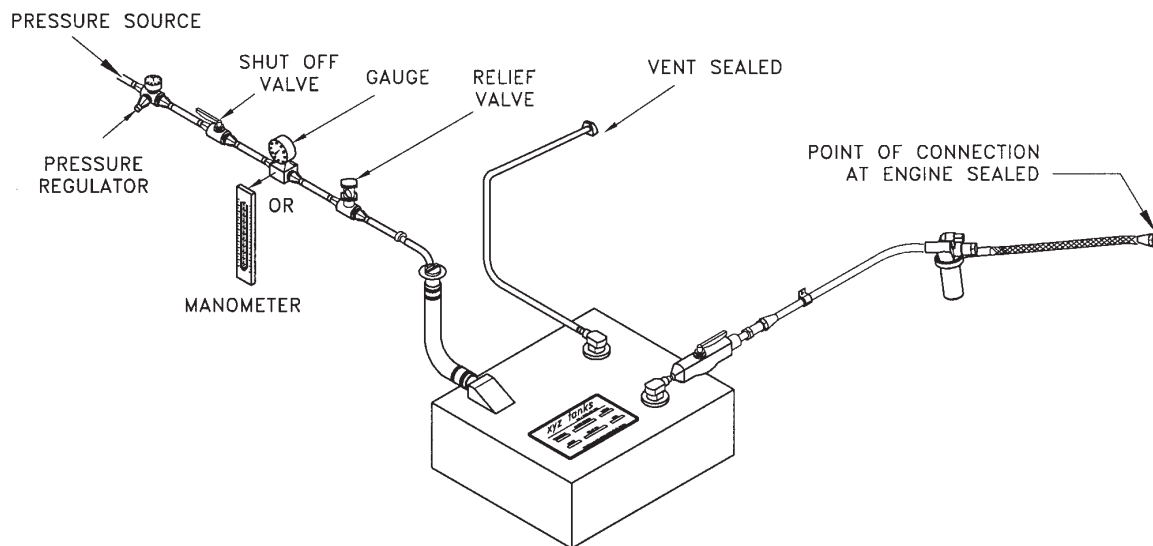
A regulated source of pressure, a gauge or manometer, a pop-off or relief valve and a shut-off valve will be needed. The gauge should have a range of less than three times the test pressure. The relief valve should be set for less than the maximum gauge pressure to prevent harm to the gauge and as a safety measure for testing personnel.

When the tank has been pressurized to its rating, it should be isolated from the pressure source by closing the shut-off valve.

NOTE:

A complete copy of the United States Coast Guard Compliance Test Procedures — Fuel System Standard Test Procedure, is provided in Appendix A of the Fuel Guide.

FIGURE 37 Typical Fuel Tank Pressure Test



FEDERAL LAW:

183.580 Static pressure test for fuel tanks.

(b) Examine each tank fitting and seam for leaks using a leak detection method other than the pressure drop method.

The static pressure test must be supplemented with another method to check for leaks. Soapy water or a detergent solution, both of which should be non-corrosive and non-toxic, can be used as well as total immersion of the tank in water. Most small leaks do not produce an immediately detectable drop on the face of the pressure gauge, but soap solutions or immersion will reveal very small leaks by bubbling.

CAUTION:

It is suggested that soapy test solutions be non-corrosive and non-toxic. Ammonia, which is present in some soaps and detergents, creates a condition which attacks brass fittings like those used in fuel systems. Undetectable at first, in a matter of months these fittings may develop cracks creating a very hazardous situation.

If immersion of the tank is used, remember that immersion increases the pressure on the outside of the tank above normal atmospheric pressure. The testing pressure in this case must be the differential in actual pressures. For example, if the head of water over a tank will produce 1 pound of pressure and the tank is to be tested to a label pressure of 3 pounds of pressure, then, when underwater, the pressure inside the tank must be 4psl. For every foot of head, the pressure correction is 0.433 psig.

There are also several devices available that are designed to detect small leaks of the nature of those that might appear in fuel systems. Most work by a principle of amplification of sound or detection of sounds of certain frequencies.

Inspect all seams and attachments — fill, vent, fuel lines, fuel level indicator, etc. for leakage.

To determine the height of the head pressure, measure from the top of the fuel fill plate, or the vent system; if it is lower than the deck fill, measure to the lowest point in the system.

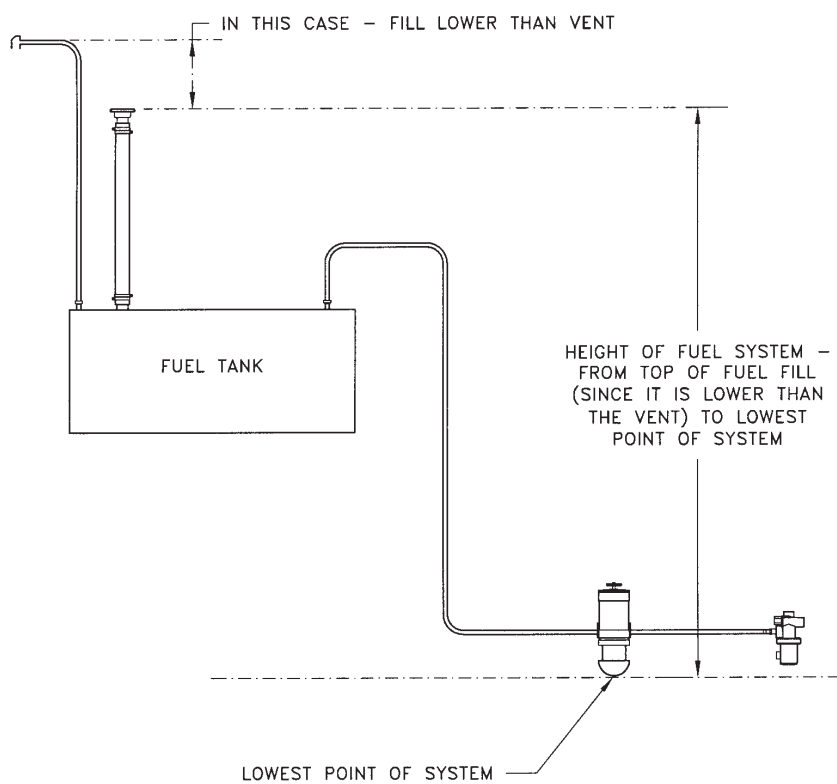
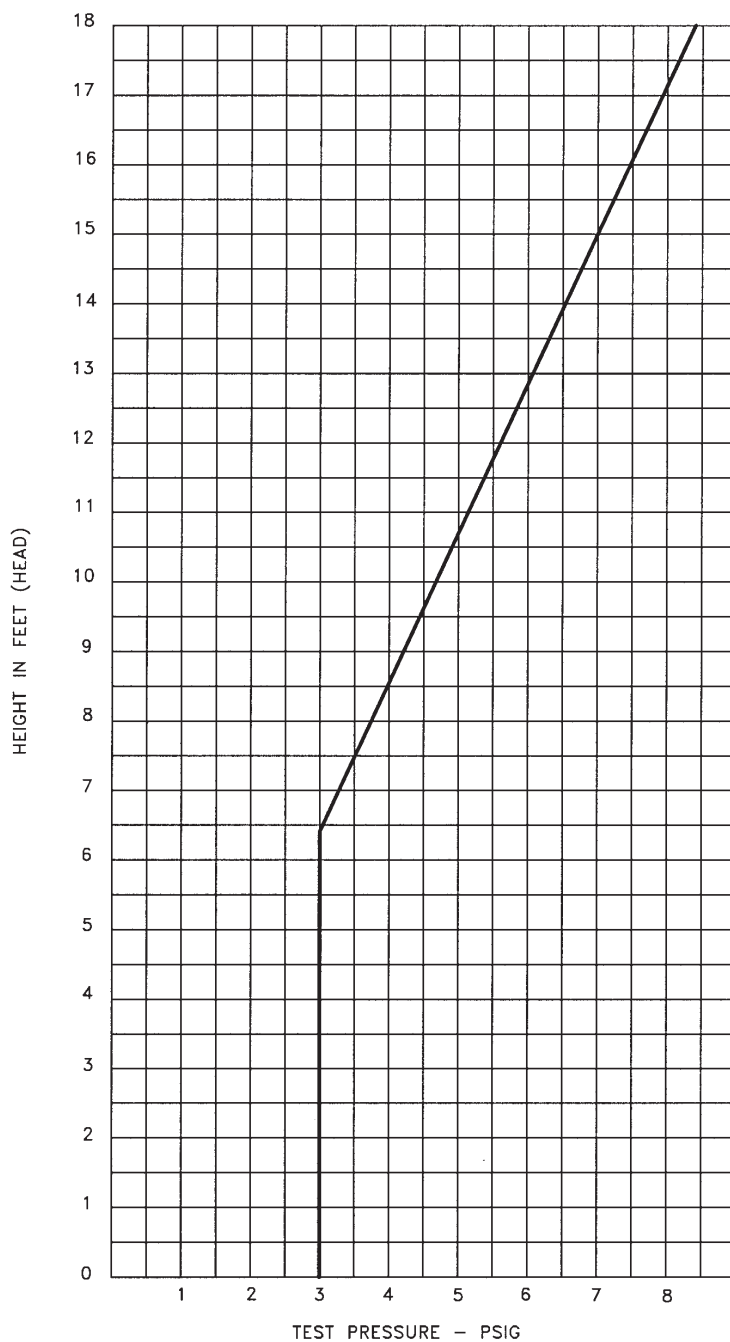
FIGURE 38 Test Pressure Determination

FIGURE 39 Fuel System Test Pressure

For a given measured height, this chart gives you the required test pressure.

FEDERAL LAW:**183.584 Shock test.**

A fuel tank is tested by performing the following procedures in the following order:

- (a) Perform the static pressure test under Sec. 183.580.

To prepare fuel tank for the shock test, a pressure test must be conducted first (see 183.580.)

The fuel tank must be pressurized with air or inert gas to the pressure stated on the label and, while pressurized, inspected for leaks using soapy water or total immersion test. If bubbles reveal leaks, the fuel tank fails this test — do not proceed any further.

The test is construed to be a destructive test and a fuel tank subjected to this test should not be installed in a boat.

NOTE:

A complete copy of the United States Coast Guard Compliance Test Procedures — Fuel System Standard Test Procedure, is provided in Appendix A of the Fuel Guide.

FEDERAL LAW:

183.584 Shock test.

(b) If the tank is non-metallic, fill it to capacity with a gasoline that has at least a 50 percent aromatic content. Keep the fuel in the tank at 21 deg.C. or higher for 30 days prior to testing.

This test is performed on all tanks of less than 25 gallons.

If the fuel tank passes the pressure test, and it is nonmetallic, it must then be filled with a gasoline that has at least 50 percent aromatic content.

What this refers to is the same type of test fuel specified as "ASTM Reference Fuel C." The average premium grade gasoline bought at a roadside filling station does not quite reach 50 percent aromatics — it usually averages about 45 percent. The Phillips Petroleum Company does sell a 50 percent aromatic gasoline in some locations.

ASTM Reference Fuel C is compounded to produce the severe swelling (or shrinking) and degrading actions of premium gasoline. It consists of 50 percent Tolulene and 50 percent ISO-octane.

The nonmetallic fuel tank must be kept filled with this fuel for 30 days at an ambient temperature [but no less than 70°F (21°C)]and ambient pressure without being adversely affected.

This is a pre-conditioning for further testing.

FEDERAL LAW:**183.584 Shock test.****(c) Mount the tank to the platform of an impact test machine.**

Generally, the mounting of the fuel tank to be tested should simulate the actual installation conditions to be found aboard a boat.

The fuel tank will be subjected to 1,000 shock cycles using a suitable shock machine. Few boat manufacturers have the test equipment to conduct these tests, so they are usually done by the fuel tank manufacturer, a testing lab or other facility.

A flat bottomed fuel tank shall be mounted on separating strips or battens under each baffle and end plate directly on the test platform; a fuel tank with something other than a flat bottom must be mounted in fitting chocks, and it is best to use the type of chocks used in actual construction of the boat — chocks that exactly fit the contour of the fuel tank's bottom.

The fuel tank should include all attachments and fittings as would normally be found on a fuel tank, such as a fuel gauge, fuel feed adapter, etc.

FEDERAL LAW:

183.584 Shock test.

(d) Fill the tank to capacity with water.

Before conducting further testing, if the tank is a non-metallic type, it has undergone the 30-day test with a 50 percent aromatic fuel, or if it is a tank that has previously contained fuel, it should have been flushed or purged of all traces of the fuel. This can be done with water or inert gas.

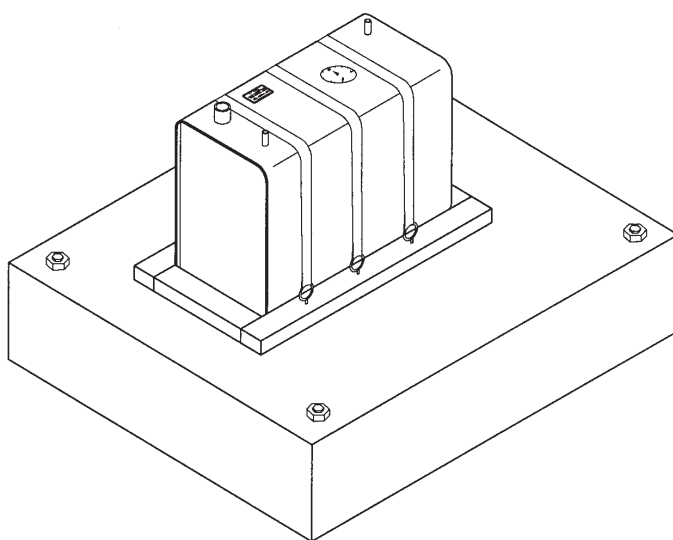
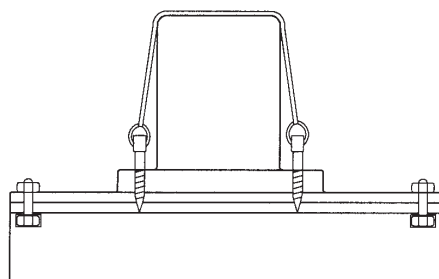
Fill the tank with water to at least the rated capacity.

FEDERAL LAW:

183.584 Shock test.

- (e) Apply one of the following accelerations within three inches of the center of the horizontal mounting surface of the tank. The duration of each vertical acceleration pulse is measured at the base of the shock envelope.

FIGURE 40 Shock Test — Fuel Tank Mounting

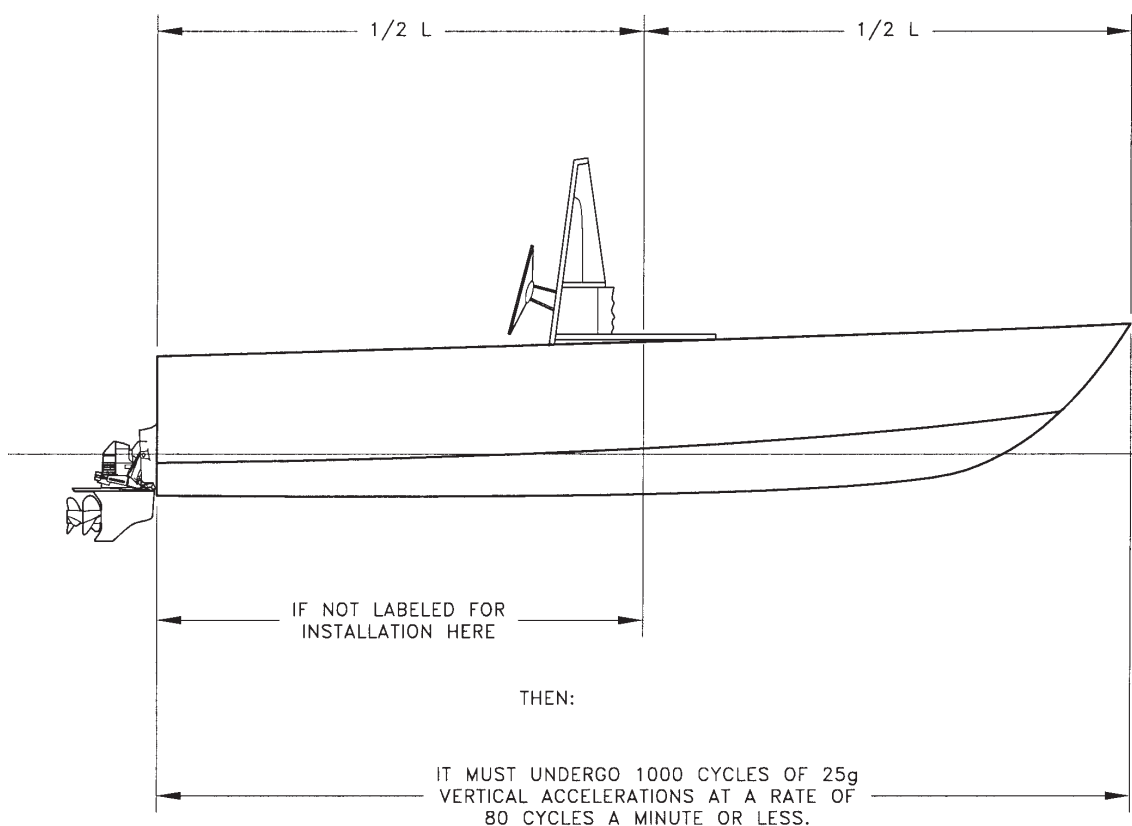


FEDERAL LAW:

183.584 Shock test.

- (e) (1) If the tank is not labeled under Sec. 183.514(b)(8) for installation aft of the half-length of the boat, apply 1000 cycles of 25g vertical accelerations at a rate of 80 cycles or less per minute. The duration of the acceleration pulse must be between 6 and 14 milliseconds.

FIGURE 41 Fuel Tank Installed Anywhere in the Boat

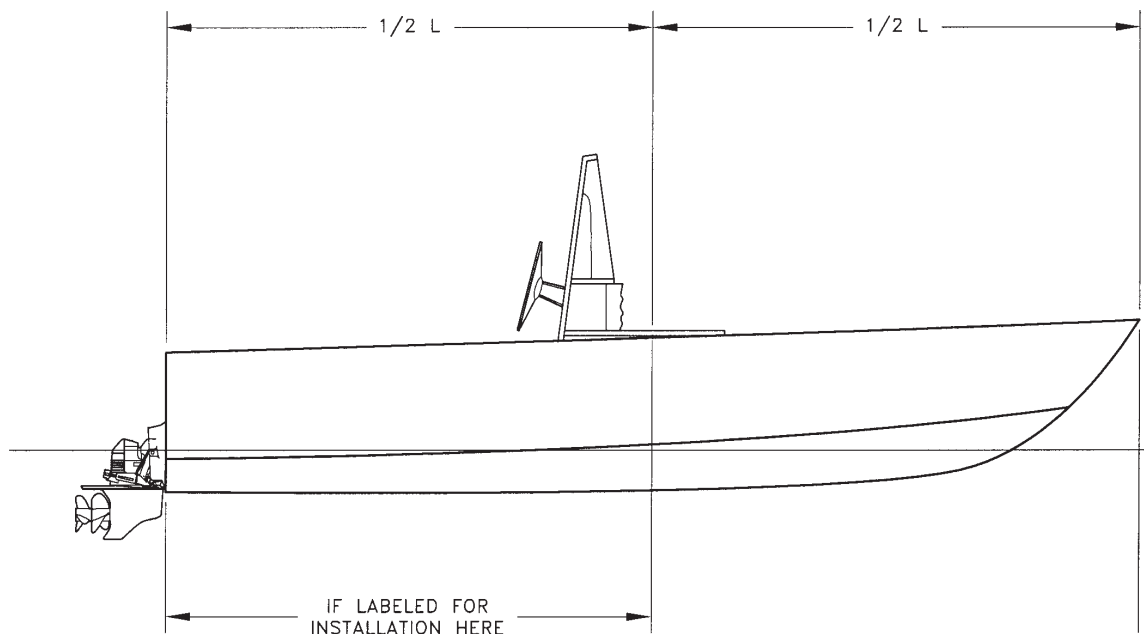


The test should be monitored with suitable instrumentation mounted as near to the center of gravity of the tank as is possible.

The tank should be inspected during the shock test to detect an obvious failure. This is a visual inspection, and should a failure of any type occur, the tank should be rejected.

FEDERAL LAW:**183.584 Shock test.**

- (e) (2) If the tank is manufactured for installation with its center of gravity aft of the half-length of the boat, apply 1000 cycles of 15g vertical accelerations at a rate of 80 cycles or less per minute. The duration of the shock pulse must be between 6 and 14 milliseconds.

FIGURE 42 Fuel Tank Installed Aft of the Half-Length

THEN:

IT MUST UNDERGO 1000 CYCLES OF 15g
VERTICAL ACCELERATIONS AT A RATE OF
80 CYCLES A MINUTE OR LESS.

The test should be monitored with suitable instrumentation mounted as near to the center of gravity of the tank as is possible.

During the shock test, the tank should be visually inspected, and the tank should be rejected at the slightest sign of failure.

FEDERAL LAW:

183.584 Shock test.

(f) Perform the static pressure test under Sec. 183.580.

After performing the shock test, a pressure test must be performed as a verification that the tank doesn't leak. If any leakage is found during the pressure test, the tank has failed the test.

FEDERAL LAW:

183.586 Pressure impulse test.

A fuel tank is tested by performing the following procedures in the following order:

(a) Perform the static pressure test under Sec. 183.580.

The pressure impulse test is applicable only to fuel tanks which have a rated capacity of 25 gallons or more. Tanks which have a rated capacity of between 25 gallons (94.61 liters) and 199 gallons (756.0 liters) must be subjected to the pressure impulse test. Tanks which have a rated capacity of 200 gallons or more must be subjected to both the pressure impulse test and the slosh test.

Before subjecting the tank to the pressure impulse test, it should be subjected to the static pressure test (see 183.580) and pass with no leakage.

The empty tank must be pressurized with air or compressed inert gas to the pressure indicated on the tank label.

This test is construed to be a destructive test and a fuel tank subjected to this test should not be installed in a boat.

NOTE:

A complete copy of the United States Coast Guard Compliance Test Procedures — Fuel System Standard Test Procedure, is provided in Appendix A of the Fuel Guide.

FEDERAL LAW:

183.586 Pressure impulse test.

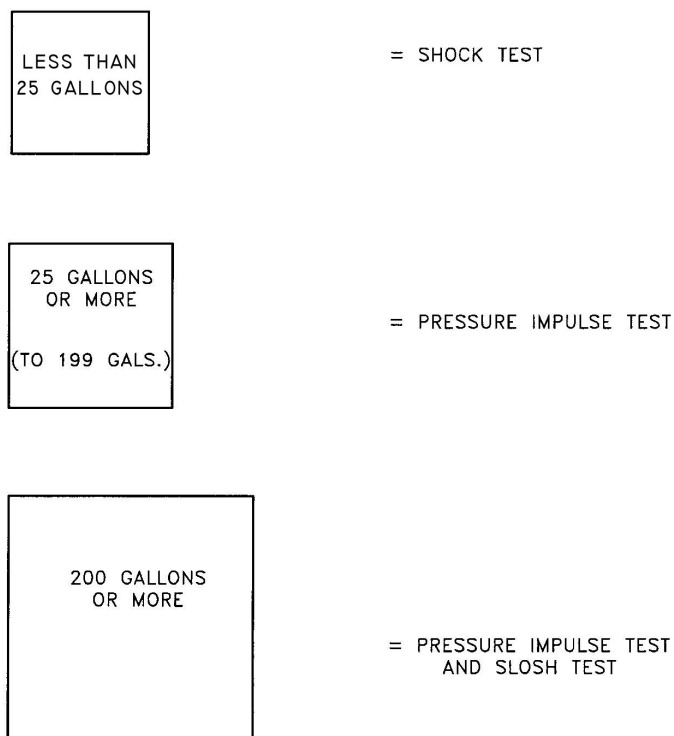
(b) If the tank is non-metallic, fill it to capacity with a gasoline that has at least a 50 percent aromatic content. Keep the fuel in the tank at 21 deg.C. or higher for 30 days prior to testing.

This test is performed on all tanks of 25 gallons or greater capacity.

Non-metallic tanks should be filled to rated capacity with a gasoline such as ASTM Reference Fuel C for a period of 30 days at a temperature of not less than 70°F (21°C).

This is a pre-conditioning for further testing.

FIGURE 43 Pressure Impulse Test Applicability



FEDERAL LAW:

183.586 Pressure impulse test.

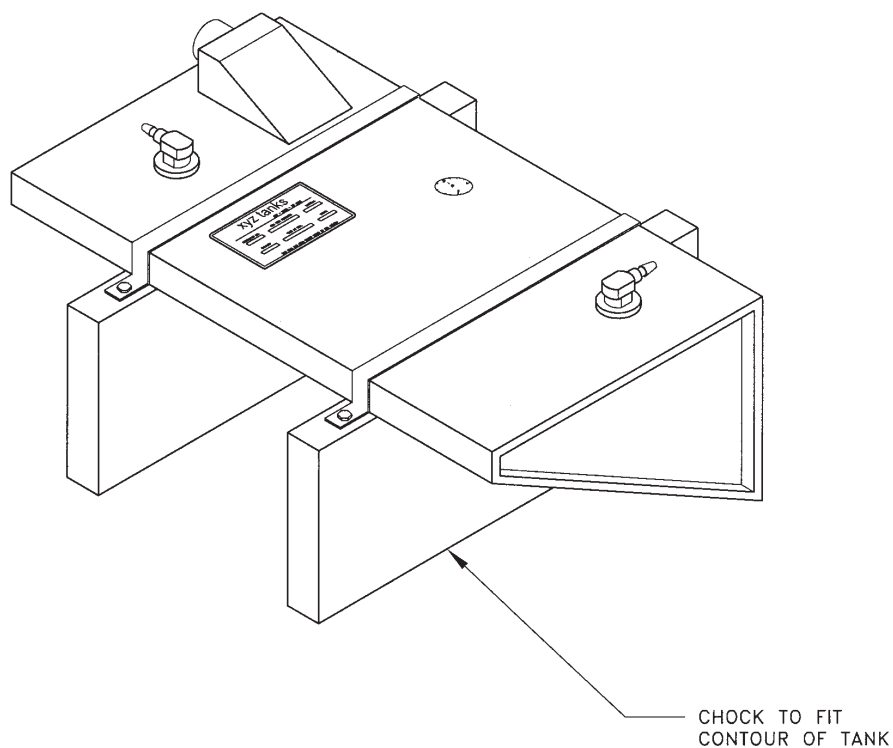
(c) Mount the tank on a test platform.

The tank should be mounted in a similar manner to an actual installation and secured in that position.

The fuel tank should include all attachments and fittings as would normally be found on a fuel tank, such as a fuel gauge, fuel feed adapter, etc.

A flat-bottomed tank may be mounted directly on the test platform. A tank that doesn't have a flat bottom shall be mounted on chocks cut to fit the contour of the tank under the ends of the tank and under baffles, if any.

FIGURE 44 Fuel Tank Mounting for Testing



FEDERAL LAW:

183.586 Pressure impulse test.

(d) Fill the tank to capacity with water.

If the fuel tank has previously contained fuel, it should be purged using water or inert gas. It should be reasonably clean and not contaminated with fuel.

Fill the tank to at least its rated capacity with water. The more water in the tank, the faster the test cycle will be.

FEDERAL LAW:

183.586 Pressure impulse test.

(e) Cap and seal each opening in the tank.

After the tank has been filled to its rated capacity with water, cap or plug the fuel feed adapter. If a fuel gauge is not installed, cap this opening. Also, seal the fuel fill and vent openings. Some of the openings may be used for piping necessary to conduct the test.

FEDERAL LAW:

183.586 Pressure impulse test.

- (f) Apply 25,000 cycles of pressure impulse at the rate of no more than 15 impulses per minute varying from zero to three PSIG to zero inside the tank top from a regulated source of air, inert gas or water.

A regulated source of pressurized air or compressed inert gas should be connected to the tank fill pipe. A calibrated pressure gauge should be connected to the vent or fill pipe to monitor the tank pressure.

A pressure relief valve should be installed in the pressure gauge line. Adjust the pressure relief valve to 3.5+/-0.5 psig.

A pressure switch with a maximum range of 0–20 psig should be installed into the pressure gauge line.

The pressure in the tank should be controlled by a solenoid valve. A counter capable of recording 25,000 cycles should be tied to the solenoid valve.

In this test, the pressure in the fuel tank should vary from zero psig to 3+/-0.4 psig at a rate not to exceed 15 cycles per minute. The cycle rate will vary depending on the following conditions:

- (a) supply pressure
- (b) air volume in the tank after water is added
- (c) line sizes
- (d) valve sizes, particularly in the vent port
- (e) actual pressure settings

NOTE:

Any of the above may be varied within reasonable limits to give the desired cycle rate up to the maximum of 15 cycles per minute.

Apply 25,000 cycles of pressure to the fuel tank. It should not leak during or after this test.

FEDERAL LAW:

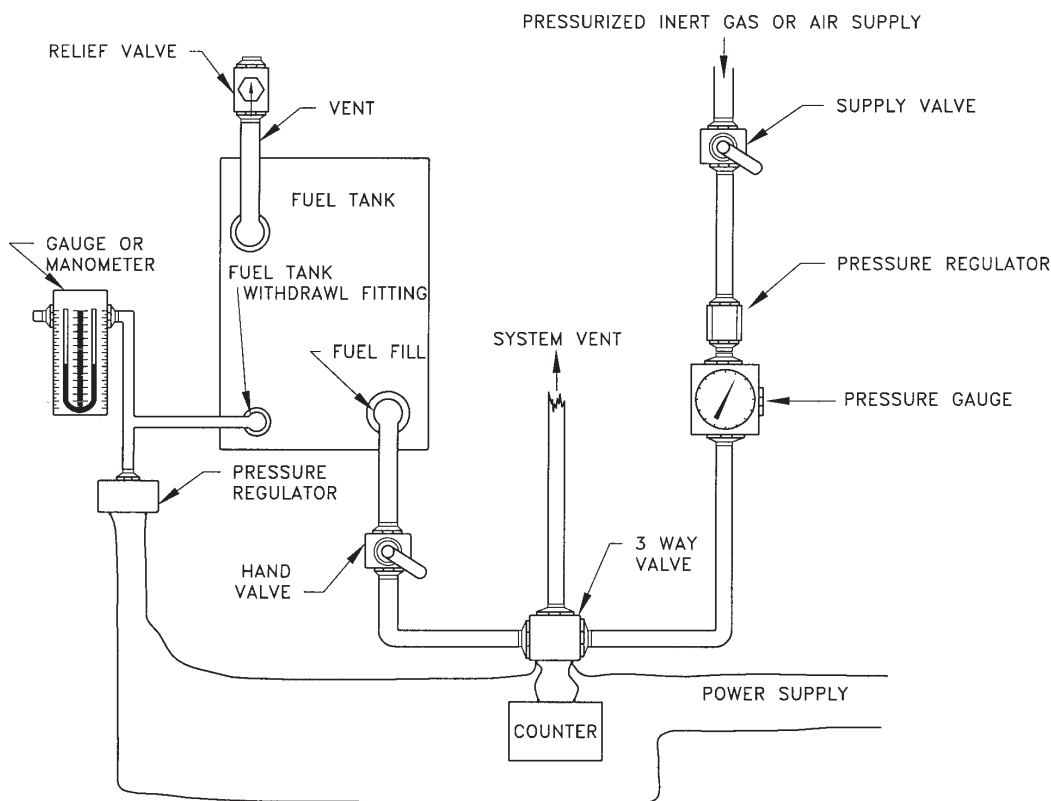
183.586 Pressure impulse test.

(g) Perform the static pressure test under Sec. 183.580.

When the fuel tank cycling of the pressure impulse test is completed, subject it to the static pressure test as a verification that the tank does not leak. If any leakage is found, the tank has failed the test.

This test is construed to be a destructive test and a fuel tank subjected to this test should not be installed in a boat.

FIGURE 45 Pressure Impulse Test



FEDERAL LAW:

183.588 Slosh test.

A fuel tank is tested by performing the following procedures in the following order:

(a) Perform the static pressure test under Sec. 183.580.

If the tank has a rated capacity of 200 gallons or more, and it has passed the pressure impulse test in 183.586, then it must be subjected to the slosh test.

First, it must pass the static pressure test (see 183.580). This could be the same static pressure test used at the end of the pressure impulse test.

This test is construed to be a destructive test and a fuel tank subjected to this test should not be installed in a boat.

NOTE:

A complete copy of the United States Coast Guard Compliance Test Procedures — Fuel System Standard Test Procedure, is provided in Appendix A of the Fuel Guide.

FEDERAL LAW:

183.588 Slosh test.

(b) Perform the pressure impulse test under Sec. 183.586.

In order for a fuel tank to be subjected to the slosh test, it is first necessary for the fuel tank to have successfully passed the pressure impulse test in 183.586.

FEDERAL LAW:

183.588 Slosh test.

(c) Secure the tank to the platform of a tank rocker assembly.

A set up similar to the pressure impulse test is used, but in addition, wood blocks should be mounted to the test platform forward and aft of the tank to prevent longitudinal movement. Similarly, wood blocks should be mounted to the platform to prevent lateral movement. Straps or clips may be used to prevent vertical movement.

FEDERAL LAW:

183.588 Slosh test.

(d) Fill the tank to one-half capacity with water.

If the fuel tank has previously contained fuel, it should be purged using water or inert gas. It should be reasonably clean and not contaminated with fuel.

Fill the tank to one-half its rated capacity with water.

FEDERAL LAW:

183.588 Slosh test.

(e) Cap and seal each opening in the tank.

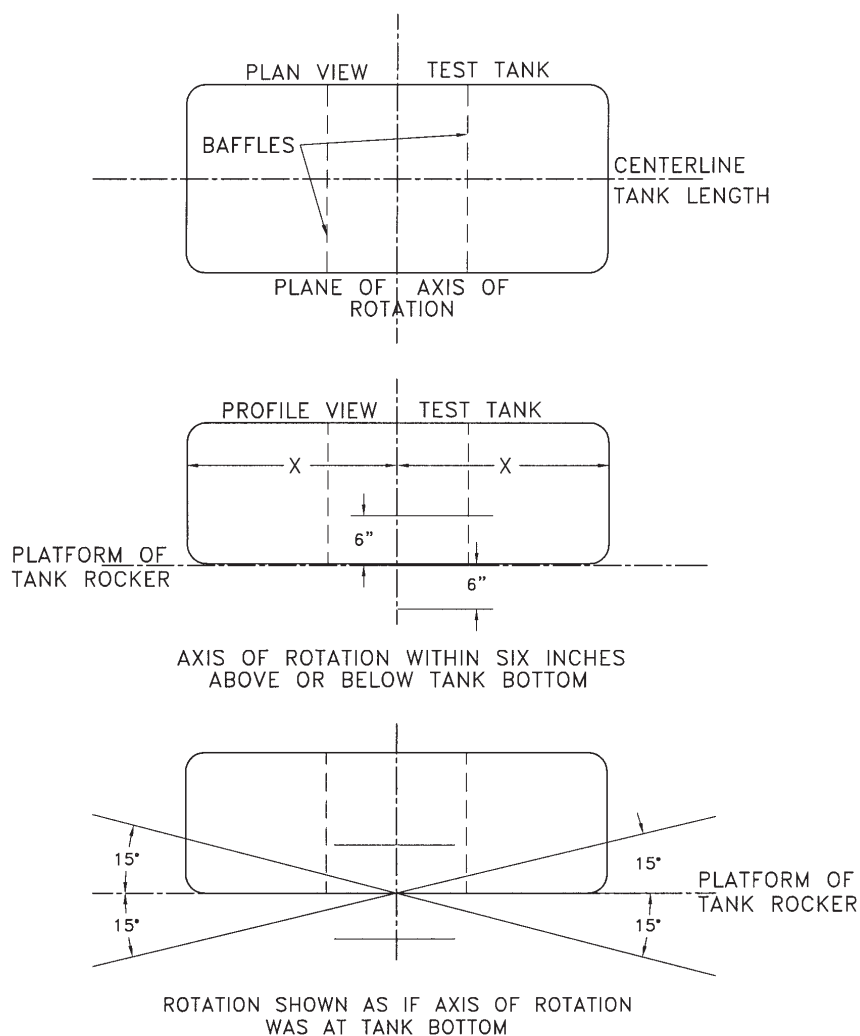
After the tank has been filled to one-half its rated capacity with water, cap or plug the fuel feed adapter. If a fuel gauge is not installed, cap this opening. Also, seal the fuel fill and vent openings.

FEDERAL LAW:

183.588 Slosh test.

- (f) Apply 500,000 cycles of rocking motion 15 degrees to each side of the tank centerline at the rate of 15 to 20 cycles a minute. The axis of rotation of the rocker and fuel tank must be perpendicular to the centerline of the tank length at a level six inches or less above or below the tank's bottom.

Figure 46 shows how to locate the fuel tank for mounting. The axis of rotation of the test machine is also located in the diagram. The fuel tank should withstand 500,000 complete cycles. The fuel tank must not leak during or at the completion of the test.

FIGURE 46 Slosh Test — Fuel Tank Mounting

FEDERAL LAW:

183.588 Slosh test.

(g) Perform the static pressure test under Sec. 183.580.

When the fuel tank cycling of the slosh test is completed, conduct the static pressure test as a verification that the tank doesn't leak. If leakage is found, the tank has failed the test.

FEDERAL LAW:

183.590 Fire test.

- (a) A piece of equipment is tested under the following conditions and procedures:
 - (1) Fuel stop valves, "USCG Type A1" or "USCG Type A2" hoses and hose clamps are tested in a fire chamber.
 - (2) Fuel filters, strainers, and pumps are tested in a fire chamber or as installed on the engine in a boat.
 - (3) Fuel tanks must be tested filled with fuel to one-fourth the capacity marked on the tank in a fire chamber or in an actual or simulated hull section.
- (b) Each fire test is conducted with free burning heptane and the component must be subjected to a flame for 2-1/2 minutes.

CAUTION:

Fire tests can be dangerous, particularly using heptane. Heptane is a gasoline type of product that produces a repeatable fire test. Gasolines vary, due to additives, in their heat content and therefore will not uniformly reach a repeatable temperature from test to test — heptane will. Precautions must be taken when conducting fire tests to have fire-fighting equipment capable of extinguishing Class B (gasoline and oil) fires and have personnel experienced in firefighting. Typical extinguishing agents are CO₂, dry chemical, foam and Halon or other clean agent extinguishing systems. CO₂ is frequently used for testing as there is no residue that could inhibit inspection of the test sample.

It is important that the fire be extinguished quickly at the end of the 2-1/2 minutes so the test sample may be judged at the required time and not subjected to a prolonged fire.

NOTE:

A complete copy of the United States Coast Guard Compliance Test Procedures — Fuel System Standard Test Procedure, is provided in Appendix A of the Fuel Guide.

TABLE V Fire Test Selection

ITEM	FIRE CHAMBER	ON ENGINE	HULL SECTION
Fuel Tank	•		•
Fuel Stop Valves	•		
USCG Type A Hose	•		
Fuel Filters	•	•	
Strainers	•	•	
Fuel Pumps	•	•	

FEDERAL LAW:

183.590 Fire test.

(c) If the component is tested in a fire chamber:

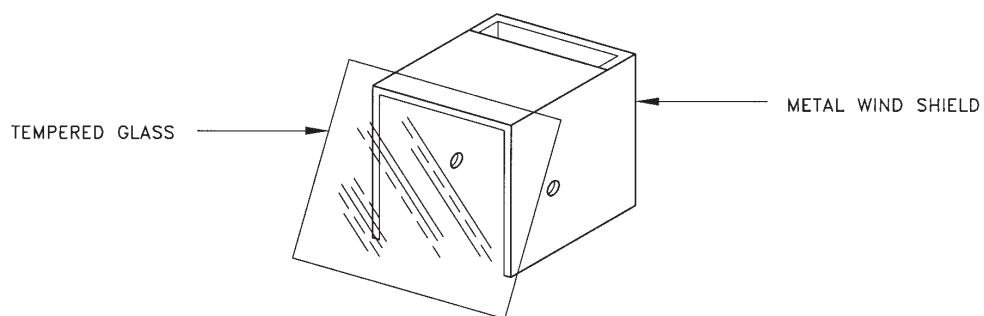
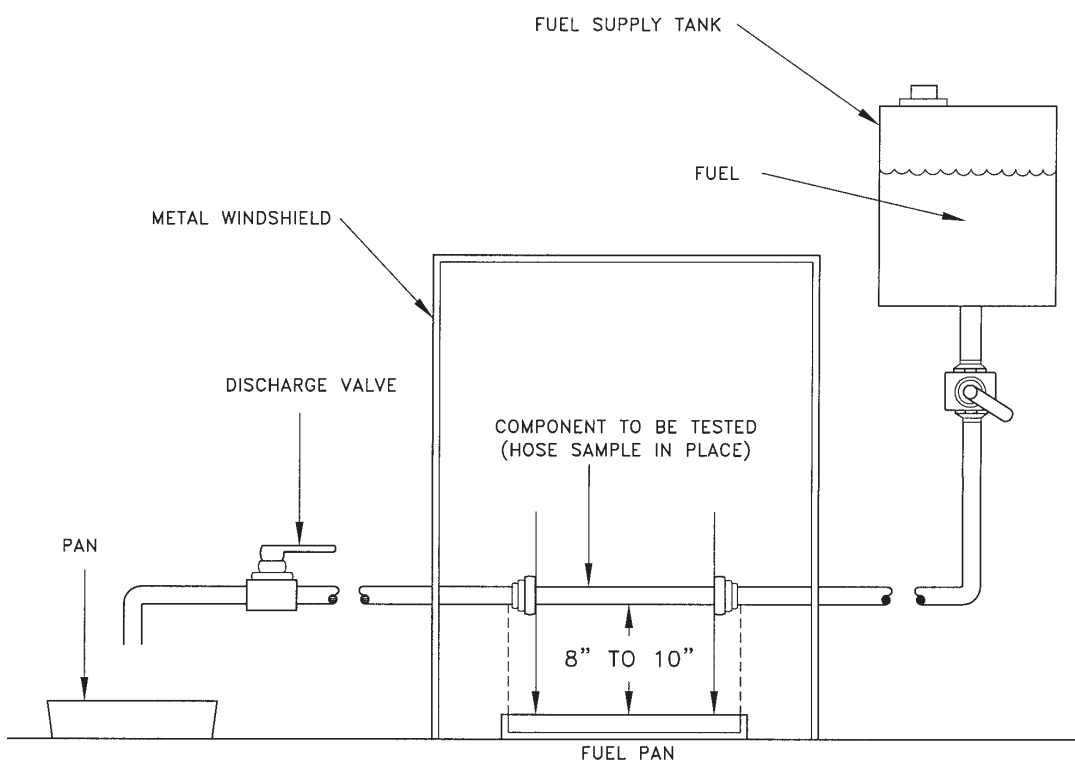
- (1) The temperature within one inch of the component must be at least 648 deg.C. sometime during the 2 and 1/2 minute test;
- (2) The surface of the heptane must be 8 to 10 inches below the component being tested; and
- (3) The heptane must be in a container that is large enough to permit the perimeter of the top surface of the heptane to extend beyond the vertical projection of the perimeter of the component being tested.

If the component being tested is a hose clamp, it must be subjected to a tensile test after the fire test. It must withstand a 1-pound (0.5 kg.) pull in any direction in which it might be subjected in any use. It must not separate, break, crack or noticeably deform as a result of the application of the weight used for the test.

"USCG Type A1" and "USCG Type A2" fuel hoses and stop valves must not leak fuel after the fire test when subjected to a 3-foot head of fuel. (See 183.528 and 183.532).

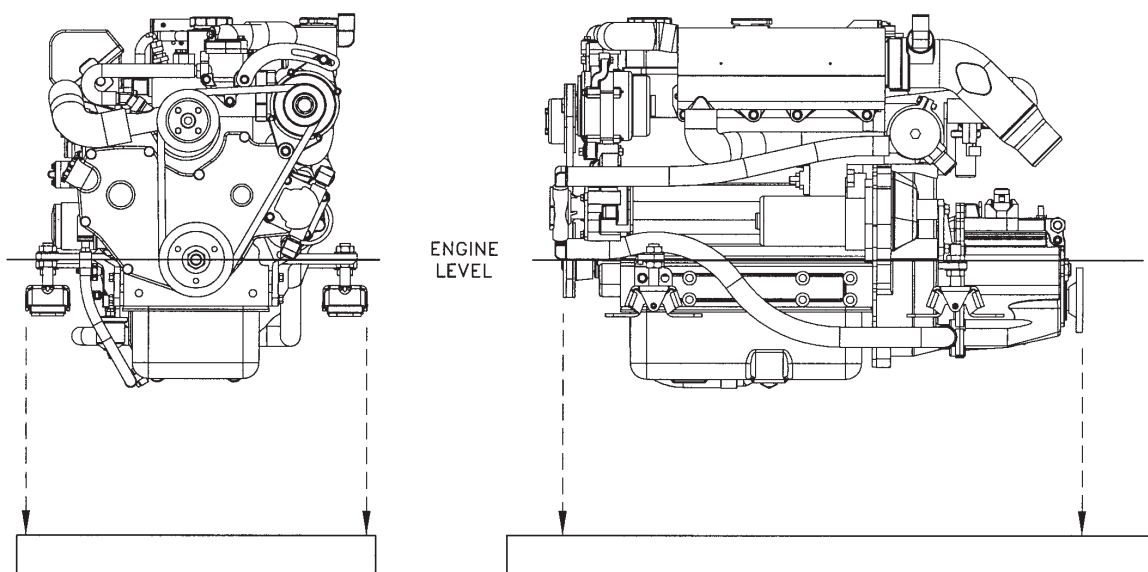
Fuel filters, fuel strainers and fuel pumps must not leak more than 5 ounces of fuel in 2-1/2 minutes after the fire test, in accordance with 183.524 and 183.534.

All fuel components including fuel tanks tested in a fire chamber must be subjected to a fire test that causes the temperature within one inch of the component to reach at least 648°C (1200°F).

FIGURE 47 Fire Test in a Typical Fire Chamber

FEDERAL LAW:**183.590 Fire test.**

- (d) If the component is being tested as installed on an engine, heptane sufficient to burn 2 and 1/2 minutes must be poured over the component and allowed to run into a flat-bottomed pan under the engine. The pan must be large enough to permit the perimeter of the top surface of the heptane to extend beyond the vertical projection of the perimeter of the engine.

FIGURE 48 Fuel Component Fire Test on an Engine

FLAT BOTTOMED FUEL PANS – LARGE ENOUGH TO PERMIT THE FUEL TO EXTEND BEYOND THE VERTICAL PROJECTION OF THE PERIMETER OF THE ENGINE AND TO HOLD ENOUGH FUEL TO BURN FOR 2½ MINUTES.

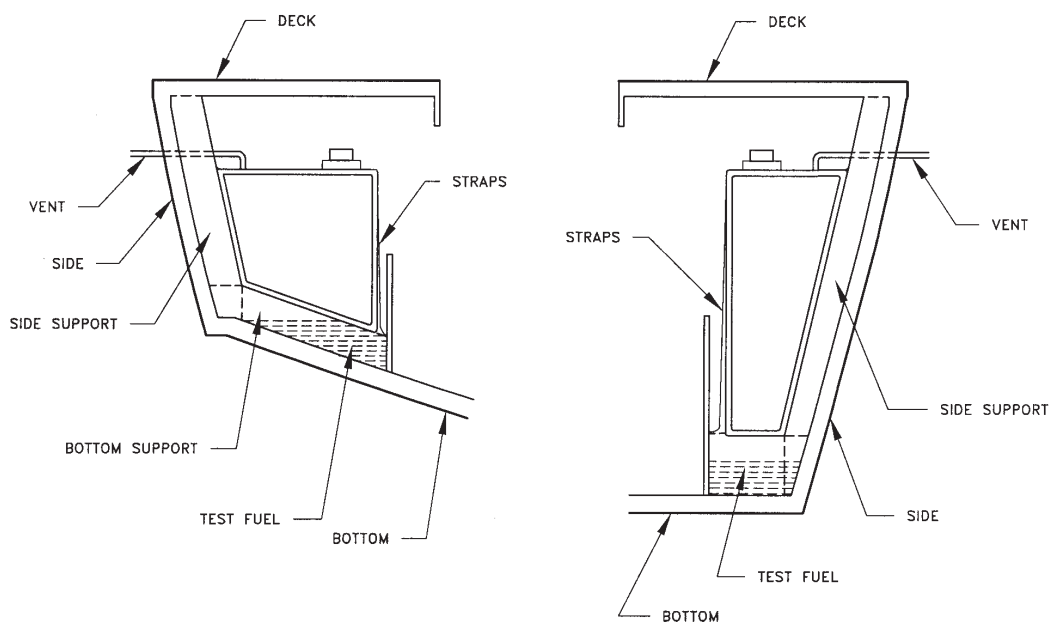
FEDERAL LAW:**183.590 Fire test.**

- (e) If a fuel tank is being tested in an actual or simulated hull section, the actual or simulated hull section must be of sufficient size to contain enough heptane to burn for 2 and 1/2 minutes in a place adjacent to the tank.

An actual or simulated hull section must duplicate the configuration from which the tank was removed or is intended to be installed. Figure 49 shows typical test setups using simulated hull sections.

Just as with other components of the fuel system, the test tank, filled to no more than quarter of its listed capacity with fuel, must withstand the 2-1/2 minute fire test. There are no temperature requirements for this test as the temperature achieved depends on the configuration of the hull section and the distribution of the fuel in this hull section. The hull section must be arranged so there will be enough fuel to burn for 2-1/2 minutes, even if a special dam is necessary to hold the fuel.

FIGURE 49 Fuel Tank Fire Test in a Simulated Hull Section



The fuel tank is subjected to a fire test. The tank being tested here is supported by structure to replicate the actual installation in a boat. A dam has been built to contain the heptane fuel during the test.



APPENDIX A — Fuel System Standard

Report No. CG-B-005-78

FUEL SYSTEM STANDARD TEST PROCEDURE

U.S. Coast Guard Office of Boating Safety
2100 2nd Street SW
Washington, DC 20590



January 1978
Final Report

Document is available to the U.S. public through the
American Boat & Yacht Council Inc.
3069 Solomons Island Road
Edgewater, MD 21037-1416
(410) 956-1050
www.abycinc.org
Email: info@abycinc.org

Prepared for
United States Coast Guard
Washington, DC 20590

14.0 LAB EXAMINATION NO. 10

FUEL TANK STATIC PRESSURE TEST

183.580 Static pressure test for fuel tanks

A fuel tank is tested by performing the following procedures in the following order:

- (a) Fill the tank with air or inert gas to the pressure marked on the tank label under section 183.514(b)(5). The pressure is measured by a calibrated pressure gauge with a pressure range not exceeding three times the test pressure required by this paragraph or by a manometer.
- (b) Examine each tank fitting and seam for leaks using a leak detection method other than the pressure drop method.

The requirements of this Lab Examination are prescribed in sections 183.510(a), 183.584(a) and (f), 183.586(a) and (g), and 183.588(a) and (g) of the Fuel Systems Standard.

14.1 Apparatus — Regulated pressure source of either air or nitrogen, manometer and leak detection solution.

14.2 Test Specimens — The fuel tank(s) as received in the boat with all attachments and fittings installed by the tank manufacturer on the tank(s).

14.3 Test Conditions — All openings and fittings in the tank(s) shall be plugged and sealed prior to pressurization.

14.4 Test Procedure

14.4.1 Obtain the test pressure used for the pressure check of the tank from the tank nameplate or the tank manufacturer.

14.4.2 The tank shall be attached to a regulated-pressure source of either air or nitrogen and subjected to the test pressure. The pressure is to be measured by a manometer; a pressure gauge with a maximum range of no more than three times the test pressure may be used, but a pop-off relief valve should be used in conjunction with the pressure gauge to protect against over pressurization, which could be hazardous.

14.4.3 All seams, fittings, and joints shall be tested for leakage and the fuel tank checked for signs of permanent deformation.

14.4.4 Determination of leakage shall be made utilizing acceptable leak detection methods, which include the use of soapy water or liquid detergent solution applied to all seams, fittings, and joints.

14.4.5 There shall be no leakage. Another method of leak detection is to completely submerge the pressurized tank in water and visually inspect it for gas bubbles over 100% of the outer surfaces. The test pressure must be at least 3-psig greater than the hydrostatic pressure of the water at the lowest part of the fuel tank being tested.

15.0 LAB EXAMINATION NO. 11

FUEL SYSTEM STATIC PRESSURE TEST

183.582 Static pressure test for fuel systems

A fuel system is tested by performing the following procedures in the following order:

- (a) Fill the portion of the system that is between the fuel inlet and the fill and vent fitting on the boat with air or inert gas to the greater of the following pressures:
 - (1) Three PSIG.
 - (2) One and one-half times the pressure created at the lowest point in the fuel system when the fill or vent line, whichever is lower in height, is filled to its top with fuel.
- (b) Read the pressure. The pressure is measured by a calibrated pressure gauge with a pressure range not exceeding three times the test pressure required by this paragraph or by a manometer.
- (c) Wait at least five minutes and thereafter wait one additional minute for each 10-gallon increment, or fraction thereof, in the tank's capacity greater than 50 gallons.
- (d) Read the pressure in accordance with paragraph (b) of this section. A pressure drop measured at the end of the time required by paragraph (c) of this section is due to leakage.
- (e) If no pressure drop is measured by the manometer or pressure gauge, then while the system remains pressurized, examine each fuel fitting, joint, and connection except each connection at fill and vent fittings for leaks, using a leak detection method other than the pressure drop method.

Note:

The requirements of this Lab Examination are prescribed in section 183.542.

- 15.1 Constraints** — Prior to the start of this test the system is required to be at a constant ambient temperature of $\pm 5^{\circ}\text{F}$ for two hours in order to accomplish the pressure decay test with an acceptable degree of accuracy. Due to outside temperature changes, which occur throughout the day, although not required, it is highly desirable to perform the test inside a building where some temperature control is available. The system shall be empty of any gasoline.
- 15.2 General Description** — The system shall be subjected to a pressure decay test. Upon successful completion of this test, each component's fittings, joints, and connections shall be leak checked using a leak detection solution or other suitable means capable of detecting extremely small leaks.
- 15.3 Test Media** — Shop grade compressed air or gaseous nitrogen. No special analysis is required. GN_2 is preferred, especially if gasoline has been used in the system prior to this test.

15.4 Test Equipment and Material

Component Find No.	Title	Description
1	Pressurant Supply Bottle	Fuel system pressurant, may be shop grade compressed air or nitrogen.
2	Pressure Regulator	Manually controlled pressure regulator to reduce supply bottle pressure to fuel system test pressure.
3	Supply Valve	Flow control shutoff valve for pressurant supply.
4	Relief Valve	Manually adjustable relief valve to prevent fuel system overpressurization.
5	Pressure Supply Indicator	Pressure gauge readable to 0.25-psi increments or Hg manometer. <i>Note: The pressure gauge shall have a range not exceeding three times the test pressure.</i>
6	Pressure Supply Adapter Assembly	Adapter to seal the fill hose and provide connectors for the pressurant supply, pressure indicator and relief valve.
7	Pressure Indicator	If an auxiliary fuel tank is installed a pressure gauge readable to 0.25-psi or Hg manometer is required to be located in the fill pipe to that tank. <i>Note: The pressure gauge shall have a range not exceeding three times the test pressure.</i>

15.5 Test

15.5.1 This procedure shall be used to perform a pressure test of the fuel system after the entire system has been installed in a boat. It is in addition to any pre-installation component leak tests that may have already been accomplished.

15.5.2 Visually inspect the entire fuel system up to and including the inlet fitting in the carburetor.

Known discrepancies, which may be corrected without invalidating the test, should be completed at this time. Verify that the system has been at a reasonably constant ambient temperature for two hours prior to the start of the test and will remain so during the performance of the test. To accomplish this, it is highly desirable, although not mandatory, for the system to be in a controlled atmosphere, such as in a building, rather than outside where the temperature may vary quite rapidly depending on the time of day, sunshine, etc.

Note:

When accomplishing the following test, it is highly desirable to break into the fuel system in as few places as possible. It is recognized, however, that due to the location or a particular type of fill and vent fitting used, it may be impossible or unreasonably difficult to test the system without breaking the system at the upper end of the fill and/or vent hoses. Therefore, the test has been written with the assumption that these hoses have been disconnected at the boat connect end (not at the fuel tank end). If for a particular boat or installation the test can reasonably be accomplished without breaking the system at one or both of these points, the test should be run in the same manner.

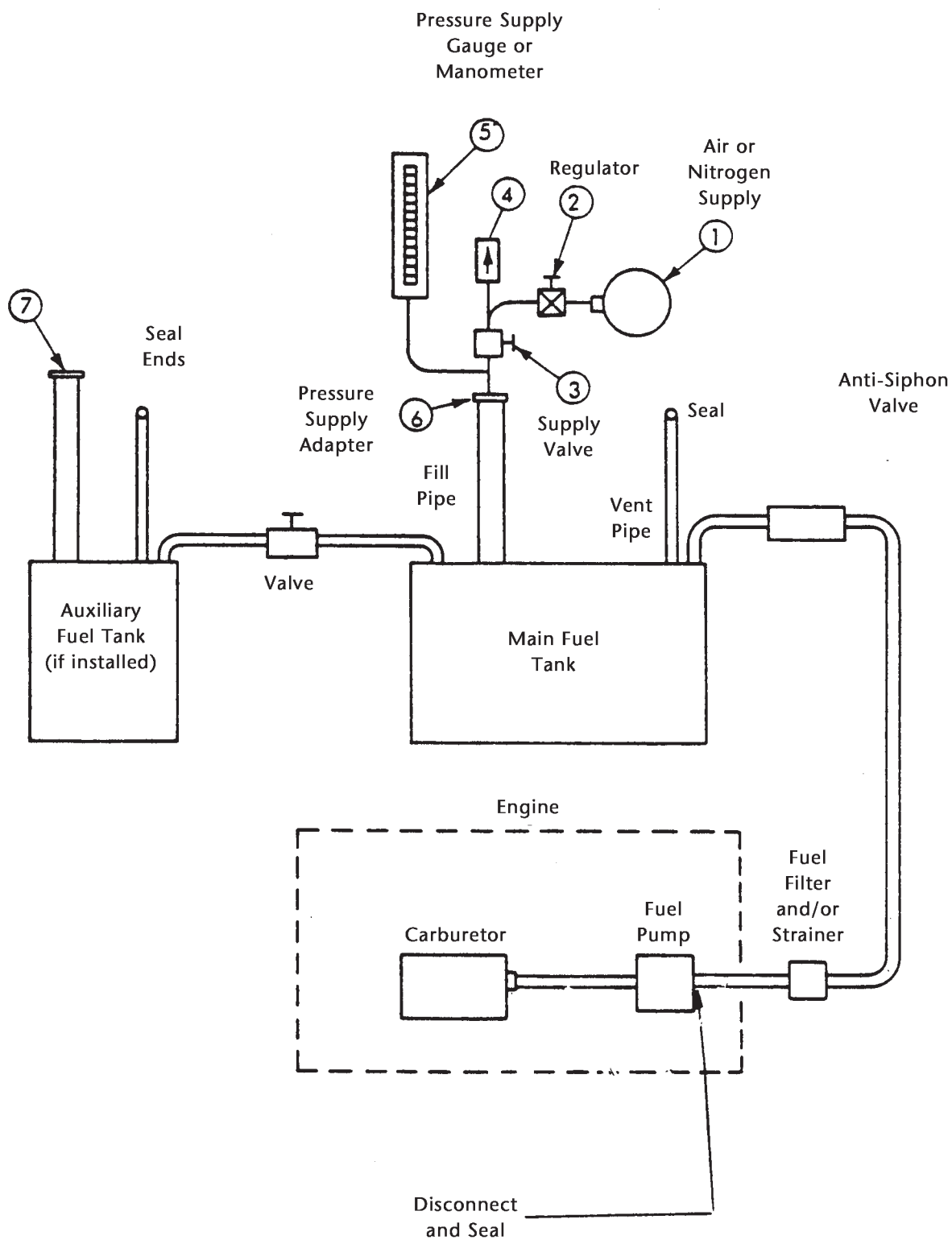
- 15.5.3 Disconnect the fuel feed line at the engine fuel inlet, engine installed fuel pump or filter and install a pressure gauge or a suitable manometer.
- 15.5.4 Disconnect the fuel tank vent line at the deck fitting the plug the vent hose (the preferred method is to plug the external vent fitting).
- 15.5.5 Disconnect the fuel tank fill line at the deck fitting and connect the pressure supply adapter assembly to the fill hose (the preferred method is to use a modified fill cap for the adapter).

Note:

If it is more convenient to connect the pressure supply adapter assembly to the vent line and plug the fill line, it is permissible to do so.

- 15.5.6 If an auxiliary fuel tank is installed in addition to the main tank, the fill and vent lines on it should be capped or plugged, similar to the main tank, and a pressure gauge installed.
- 15.5.7 The pressure required for this test shall be the greater of the two pressures as called out below:
 - a. Three (3) psig
 - b. One and one-half (1-1/2) times the static head pressure as determined in this manner: measure the vertical height (H) in inches from the lowest point in the fuel system to the top of the fill or the vent line, whichever is lower. If the calculated pressure ($0.04 \times H$ in.) is greater than the tank labeled pressure, stop the test. If H is 75 in. (1.9 m) or less, use 3-psig for the test pressure as called out in part (a) above and record this pressure on Data Form No. 2, Part A-3. If H is greater than 75 in. (1.9 m), the test pressure shall equal $0.04 (H)$ psig.
- 15.5.8 Connect either an air or GN₂ pressure source capable of supplying a regulated pressure of 0–10-psig to the pressure supply adapter in the fill hose. A pressure gauge or a manometer shall be connected to a tee in the pressure supply line as close as possible to the pressure supply adapter. A pressure gauge shall have a range not exceeding three times the test pressure as required by paragraph 15.5.7. The relief valve shall be set at 1.5 ± 0.5 -psi above the test pressure as required by Paragraph 15.5.7.

Procedure — Test Schematic



- 15.5.9** Verify that the system is configured similar to the Test Schematic and is ready for testing:
- Pressure supply valve closed.
 - Pressure supply regulator fully decreased (ccw).
 - Fuel shutoff valve between main tank and any auxiliary tank full open (if any).
 - Any valve between the main tank and the carburetor full open (if any).
- 15.5.10** Open the pressure supply valve. Slowly increase the pressure supplied to the system by turning the regulator cw for monitoring the pressure gauge or manometer. Increase the pressure at a rate not to exceed 1/2-psi per minute until the required test pressure is reached as determined by Paragraph 15.5.7 and indicated on the pressure supply gauge or the manometer.
- 15.5.11** Maintain this test pressure $\pm 1/4$ -psi for at least 5 minutes and allow the system to stabilize. During this period verify that there is no audible leakage in the system.

Note:

At any time during the test when leakage is detected, the points of leakage should be noted and documented, and the system should be vented to 0-psig. If the leakage is due entirely to the test hardware, the leak shall be corrected and the test rerun starting with Paragraph 15.5.9. If the leakage is in the fuel system and determined to be caused solely by the improper installation of a component as determined by the test engineer (such as a hose clamp left off or a loose B-nut), the installation may be corrected to the proper specification and the test rerun starting with Paragraph 15.5.9. Any discrepancies shall be so documented in the procedure.

- 15.5.12** Verify that the entire fuel system has been pressurized as evidenced by the pressure gauge readings at the auxiliary fuel tank, if installed, and at the engine fuel inlet. These gauges will not necessarily indicate much less than the pressure as the pressure supply gauge and there is no requirement for them to do so. The engine fuel inlet pressure gauge may indicate much less than the pressure supply gauge, depending on the anti-siphon valve installed and the other components in the fuel feed line. Any positive indication of pressure is acceptable. If 0-psig is indicated, the test shall be halted until the situation has been examined, and the proper corrective action is determined by the test engineer.
- 15.5.13** With the pressure supply gauge indicating the required test pressure $\pm 1/4$ -psi and stable, close the pressure supply valve and record the pressure indicated. This is the initial pressure decay reading.
- 15.5.14** Observe the pressure supply gauge or manometer for a period of five minutes for tanks whose fuel capacity is 50-gal. (189.3 l) or less. For tanks over 50-gal. (189.3 l), an additional minute shall be added to the five minutes for each 10-gal. (37.9 l) increment or fraction thereof.

Example:

A 61-gal. (230.9 l) tank, or a 70-gal. (265 l), tank shall be observed for seven (7) minutes.

At the end of the required time, record the pressure indicated on the pressure supply gauge. This is the final reading. The pressure reading shall have decreased from the initial pressure reading less than 1/4-psi if a pressure gauge was used or less than 0.5 in. (1.3 cm) if an Hg manometer was used.

- 15.5.15** If the system pressure has decayed more than allowed from the initial pressure reading, verify no leakage exists in the test hardware using a leak detection solution and reject the fuel system if required by Paragraph 15.5.11. Otherwise, correct the problem and rerun the test starting with Paragraph 15.5.13. Document any discrepancy.
- 15.5.16** Perform a complete leak test of the entire fuel system using a leak detection solution. The test shall include:
- a. fuel tank(s) and vent connections except at the hull or deck fitting(s)
 - b. fuel tank(s) fuel indicator fitting
 - c. fuel tank(s) feed line connection
 - d. any other connection or fitting on the fuel tank(s)
 - e. feed line between main tank and auxiliary tank, if installed, and any valves or components including connections and fittings
 - f. feed line between main tank and the carburetor and any valves or components such as anti-siphon valve, shutoff valve, fuel fittings and/or strainer, fuel pump including connections and fittings
 - g. any other line or component which is part of the fuel systems

No leakage in the system is allowed. If leakage is detected, the fuel system shall be rejected. If no leakage is detected, the fuel system shall be deemed acceptable according to the requirements of this procedure. Record whether or not any leakage was found and the location(s).

183.520(a) Fuel tank vent system

- (a) Each fuel tank must have a vent system that prevents pressure in the tank from exceeding 80% of the pressure marked on the tank label under section 183.514(b)(5).

15.6 Fuel Tank Vent Test

- 15.6.1** Remove the plug from the vent line and reconnect the vent line to the deck fitting.
- 15.6.2** Attempt to pressurize the system to 80% of the pressure marked on the tank label.
- 15.6.3** If the pressure reached 80% of the pressure marked on the tank label, the vent system shall be rejected.
- 15.6.4** Secure the system as required. Vent the test pressure to zero (0) psig. Remove all gauges and reconnect all lines and hoses disconnected for the test to the proper specification.

16.0 LAB EXAMINATION NO. 12

FUEL TANK SHOCK TEST

183.584 Shock Test

A fuel tank is tested by performing the following order:

- (a) Perform the static pressure test under section 183.580.
- (b) If the tank is non-metallic, fill it to capacity with a gasoline that has at least a 50% aromatic content. Keep the fuel in the tank at 21°C or higher for 30 days prior to testing.
- (c) Mount the tank to the platform of an impact test machine.
- (d) Fill the tank to capacity with water.
- (e) Apply one of the following accelerations within three inches of the center of the horizontal mounting surface of the tank. The duration of each vertical acceleration pulse is measured at the base of the shock envelope.
 - (1) If the tank is not labeled under section 183.514(b)(8) for installation aft of the half-length of the boat, apply 1000 cycles of 25g vertical accelerations at a rate of 80 cycles or less per minute. The duration of the acceleration pulse must be between six and 14 milliseconds.
 - (2) If the tank is manufactured for installation with its center of gravity aft of the half-length of the boat, apply 1000 cycles of 15g vertical accelerations at a rate of 80 cycles or less per minute. The duration of the shock pulse must be between six and 14 milliseconds.
- (f) Perform the static pressure test under section 183.580

16.1 General Description — The fuel tank shall be mounted on a test fixture similar to a typical or actual boat installation and subjected to 100 shock cycles using a suitable shock machine. There shall be no leakage of the fuel tank as a result of these applied shocks.

16.1.1 Test Article — The test article shall consist of a fuel tank as delivered by the manufacturer or as removed from an actual installation. The tank shall include all attachments and fittings that would normally be found in such an installation, i.e. fuel gauge, fuel feed adapter, vent and fill pipes, etc.

16.1.2 Constraints —

- a. This test applies to tanks with a capacity of less than 25 gallons.
- b. Fuel tanks which are labeled under section 183.514(b)(8) of the Fuel System Standard “for installation only in the aft half-length of the boat” shall be tested for 1000 cycles of 15 g vertical acceleration at a rate of 80 cycles per minute.
- c. Other tanks shall be tested at 25 g vertical acceleration.

16.1.3 Pre-Test Conditions and Assumptions —

- a. The Static Pressure Test per section 183.580 shall have been completed successfully.
- b. Personnel performing the test shall be reasonably familiar with boat systems and testing practices to accomplish the procedure without undue training required.

16.2 Test Equipment and Schematic

Component Find No.	Title	Description
1	Test Platform	A flat level fixture on which the fuel tank is mounted and secured. The whole assembly is then mounted to a suitable shock machine.
2	Eye Lag Bolts	A bolt used to secure the fuel tank to the test platform.
3	Tie Down Straps	Steel or equivalent straps to hold the fuel tank in position during the test.
4	Positioning Blocks	2 x 4 board or equivalent to maintain the tank in the proper position during the test.
5	Chocks	2 x 6 board or equivalent cut to the contour of the tank to maintain and support the tank in the proper position during the test. For non-flat bottomed tanks only.

16.3 Test

16.3.1 This procedure shall be used to shock test metallic and non-metallic fuel tanks of any size and capacity. Fuel tanks which have a capacity of 25-gal. (94.6 l) or larger shall not be tested.

Verify the applicability of this procedure to the tank being tested before proceeding by filling the tank to its maximum capacity.

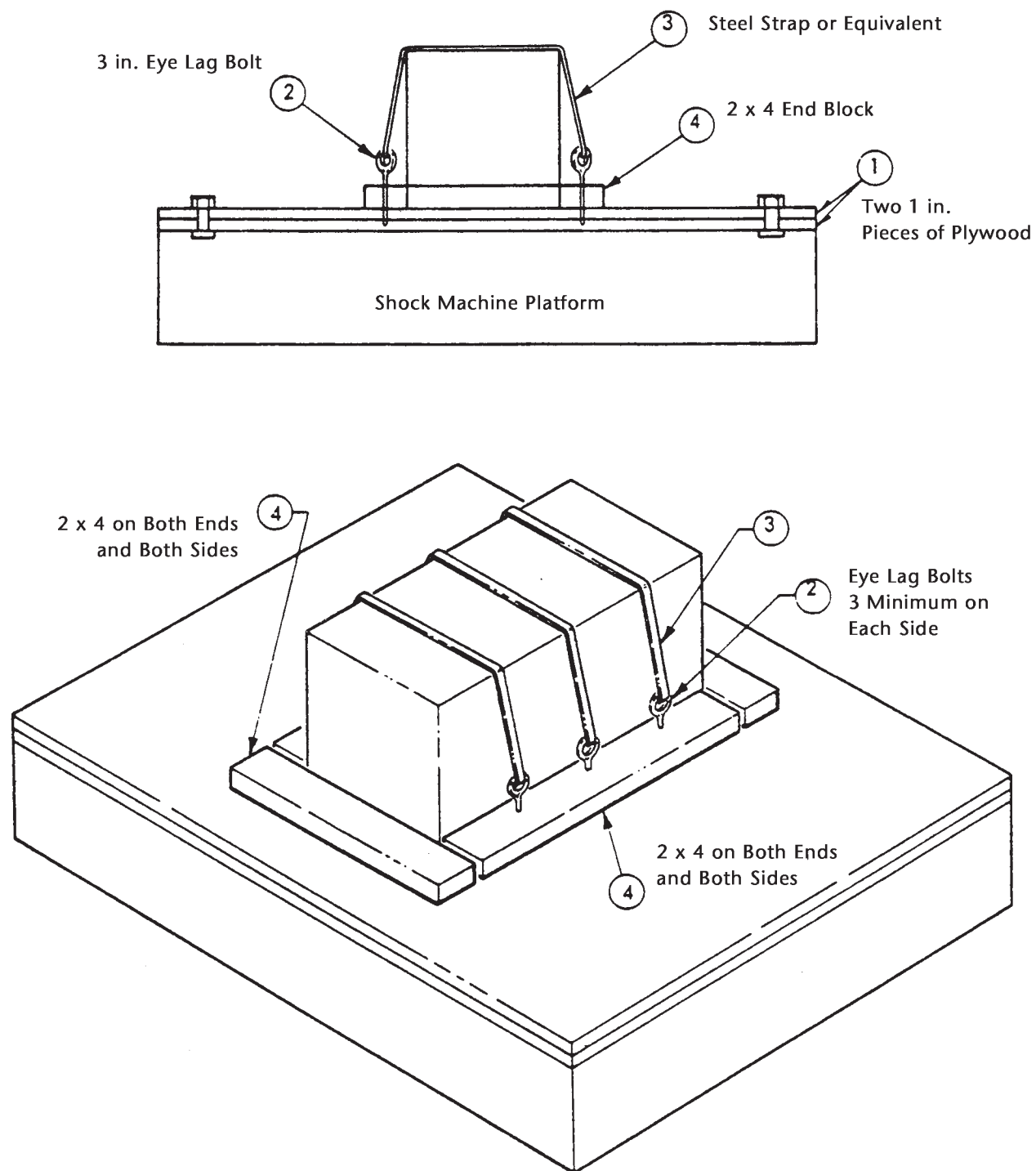
16.3.2 Visually inspect the fuel tank. Review the results of the Receiving Inspection (Data Form No. 1) and verify that the component is acceptable and ready for testing. Tanks that obviously would leak and have failed the pressure test, or those that do not have a proper label shall be rejected.

16.3.3 Verify that the fuel tank to be tested has successfully completed the static pressure test. If it has not been accomplished, the pressure test shall be completed at this time. Record whether the pressure was accomplished previously or is being completed at this time.

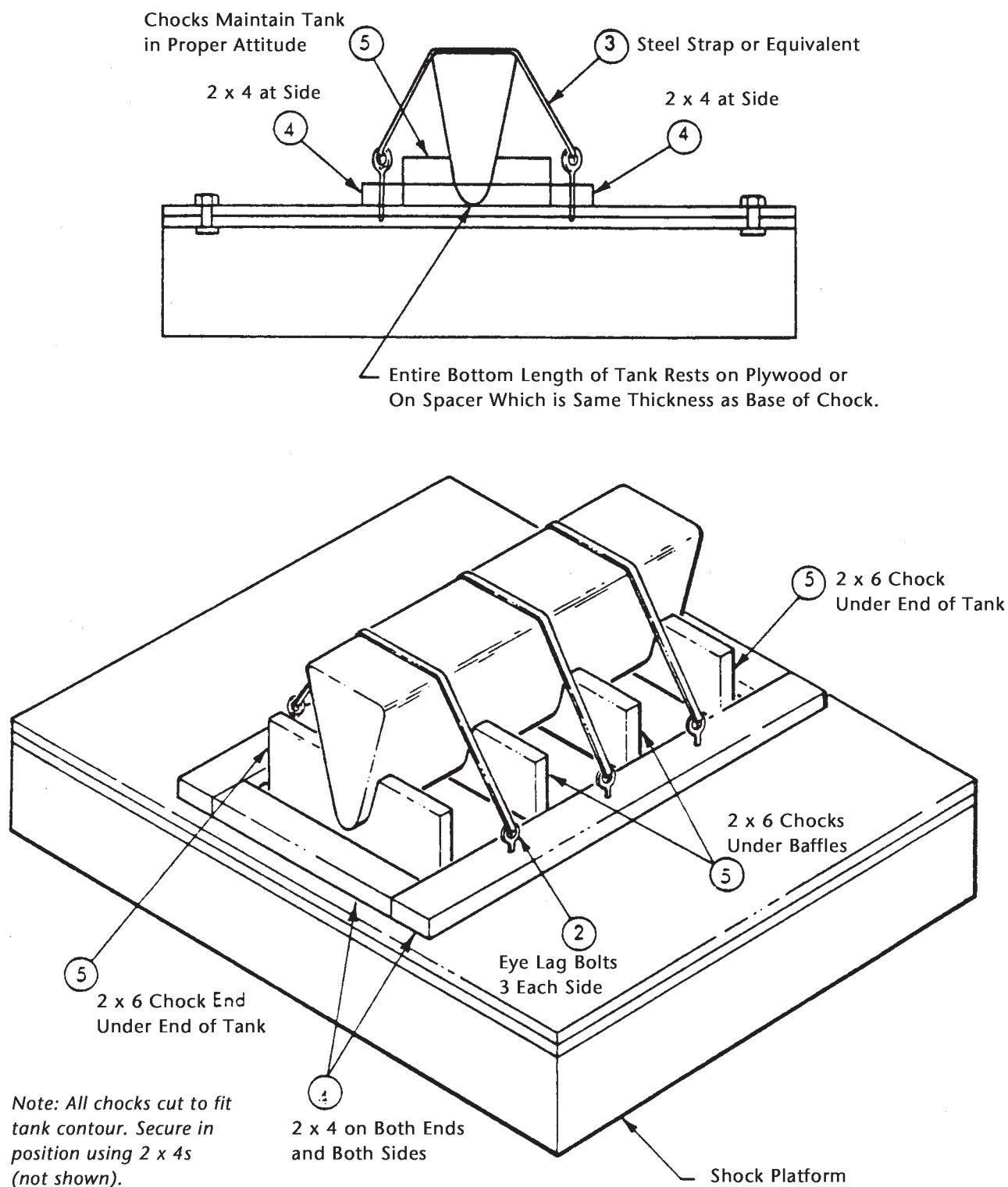
16.3.4 Non-metallic fuel tanks shall be filled to capacity with a gasoline that has at least a 50% aromatic content. ASTM Reference Fuel C meets this requirement. There shall be no evidence that the fuel tank has been adversely affected by the gasoline after 30 days at ambient pressure and temperature, but in no case less than a temperature of 70°F (21°C).

Shock Test — Typical Layout for Flat-Bottomed Tank

Test Schematic Procedure



Shock Test — Typical Layout for Non-Flat-Bottomed Tank Test Schematic Procedure



- 16.3.5** Flush or purge the fuel tank with water and/or GN₂ after the 30-day pre-conditioning test has been completed.
- 16.3.6** Verify that the shock machine to be used in this test has been calibrated to the specified g load and duration using a dummy load similar to the fuel tank to be tested.
- 16.3.7** Mount and secure the fuel tank to the platform of the impact test machine similar to an actual installation or similar to one of the following typical installations. Do not remove any attachments or fittings from the tank. Flat-bottomed tanks shall be mounted on a flat platform. Tanks with other than flat bottoms shall be mounted on chocks cut to fit under the ends of the tank and under the baffles, if any. See the Test Schematic for typical installations.
- 16.3.8** Fill in the tank with water to at least rated capacity. Cap and/or plug the fuel tank fill pipe and the fuel feed adapter. If a gasoline gauge is not installed, cap this opening. Leave the fuel tank vent pipe open to the atmosphere.
- 16.3.9** Fuel tanks installed in the forward half-length of the boat or labeled or intended for use in the forward half-length of the boat shall be subjected to 1000 cycles of 25 g vertical shock. Fuel tanks installed in the aft half-length of the boat or labeled or intended for use in the aft half-length of the boat shall be subjected to 1000 cycles of 15 g vertical shock. When in doubt about a fuel tank's installation or usage, subject the tank to 1000 cycles of 25 g vertical shock. The duration of the shock pulse, measured at the base of the shock envelope, shall be 10 ±4 milliseconds. The shock shall be applied at a rate of 80 cycles or less per minute. The test parameters shall be monitored by suitable instrumentation mounted as near to the center of gravity of the fuel tank as possible.
- 16.3.10** The fuel tank shall be visually inspected after each shock test has been applied. If any obvious failure has occurred, the fuel tank shall be rejected.
- 16.3.11** If the tank shows no indication of any leakage after 1000 shock applications, remove the tank from the shock machine and secure the system.
- 16.3.12** Perform the pressure test on the fuel tank and verify that the tank does not leak. If leakage is found during the test, the tank shall be rejected. If the tank successfully completes the pressure test, the tank shall be deemed acceptable according to the requirements of this procedure.

17.0 LAB EXAMINATION NO. 13

FUEL TANK IMPULSE TEST AND SLOSH TEST

183.586 Pressure impulse test

A fuel tank is tested by performing the following procedures in the following order:

- (a) Perform the static pressure test under section 183.580.
- (b) If the tank is non-metallic, fill it to capacity with a gasoline that has at least a 50% aromatic content. Keep the fuel in the tank at 21°C or higher for 30 days prior to testing.
- (c) Mount the tank on a test platform.
- (d) Fill the tank to capacity with water.
- (e) Cap and seal each opening in the tank.
- (f) Apply 25,000 cycles of pressure impulse at the rate of no more than 15 impulses per minute varying from zero to three PSIG to zero inside the tank top from a regulated source of air, inert gas, or water.
- (g) Perform the static pressure test under section 183.580

Note:

The requirements of this test are prescribed by sections 183.510(d) and (e) and 183.588(b).

183.588 Slosh Test

A fuel tank is tested by performing the following procedures in the following order:

- (a) Perform the static pressure test under section 183.580.
- (b) Perform the pressure impulse test under section 183.586.
- (c) Secure the tank to the platform of a tank rocker assembly.
- (d) Fill the tank to one-half capacity with water.
- (e) Cap and seal each opening in the tank.
- (f) Apply 500,000 cycles of rocking motion 15 degrees to each side of the tank centerline at the rate of 15 to 20 cycles a minute. The axis of rotation of the rocker and fuel tank must be perpendicular to the centerline of the tank length at a level six inches or less above or below the tank's bottom.
- (g) Perform the static pressure test under section 183.580.

Note:

The requirements of this test are prescribed by section 183.510(e).

17.1 General Description — The tank shall be subjected to a static pressure test, if not previously accomplished, to verify that the tank has zero leakage. 25,000 pressure impulse shall be applied to the tank or until leakage is observed. If the tank successfully completes the pressure impulse test, it shall then be subjected to a slosh test for 500,000 cycles. The fuel tank shall have no leakage as a result of these tests as determined by the final static pressure test.

17.1.1 Test Article — The test article shall consist of a fuel tank as delivered by the manufacturer or as removed from an actual installation. The tank shall include all attachments and fittings as would normally be found in an installation such as a fuel gauge, fuel feed adapter, vent and fill pipes, etc.

17.1.2 Constraints —

- The pressure impulse test is only for fuel tanks which have a capacity of 25-gal. (94.6 l) or more.
- Tanks which have a capacity of 200-gal. (378.5 l) or more are required to pass the pressure impulse and slosh test.

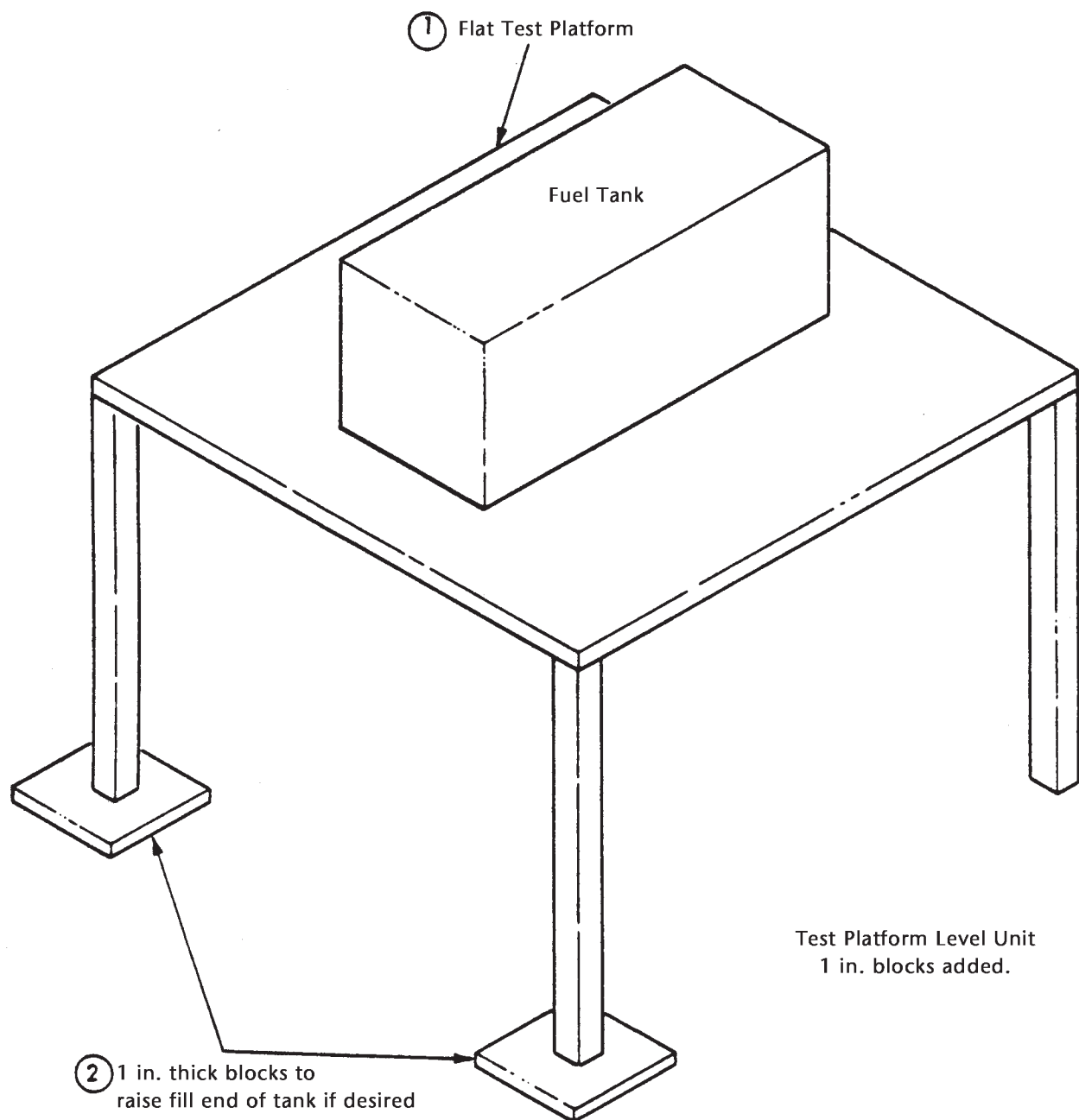
TANK SIZE

Less than 25-gal. (94.6 l)	25 to less than 100-gal. (94.6 l to < 378.5 l)	200-gal. (378.5 l) or more
NOT APPLICABLE	Pressure Impulse Test 25,000 Cycles	
		Slosh Test 500,000 Cycles

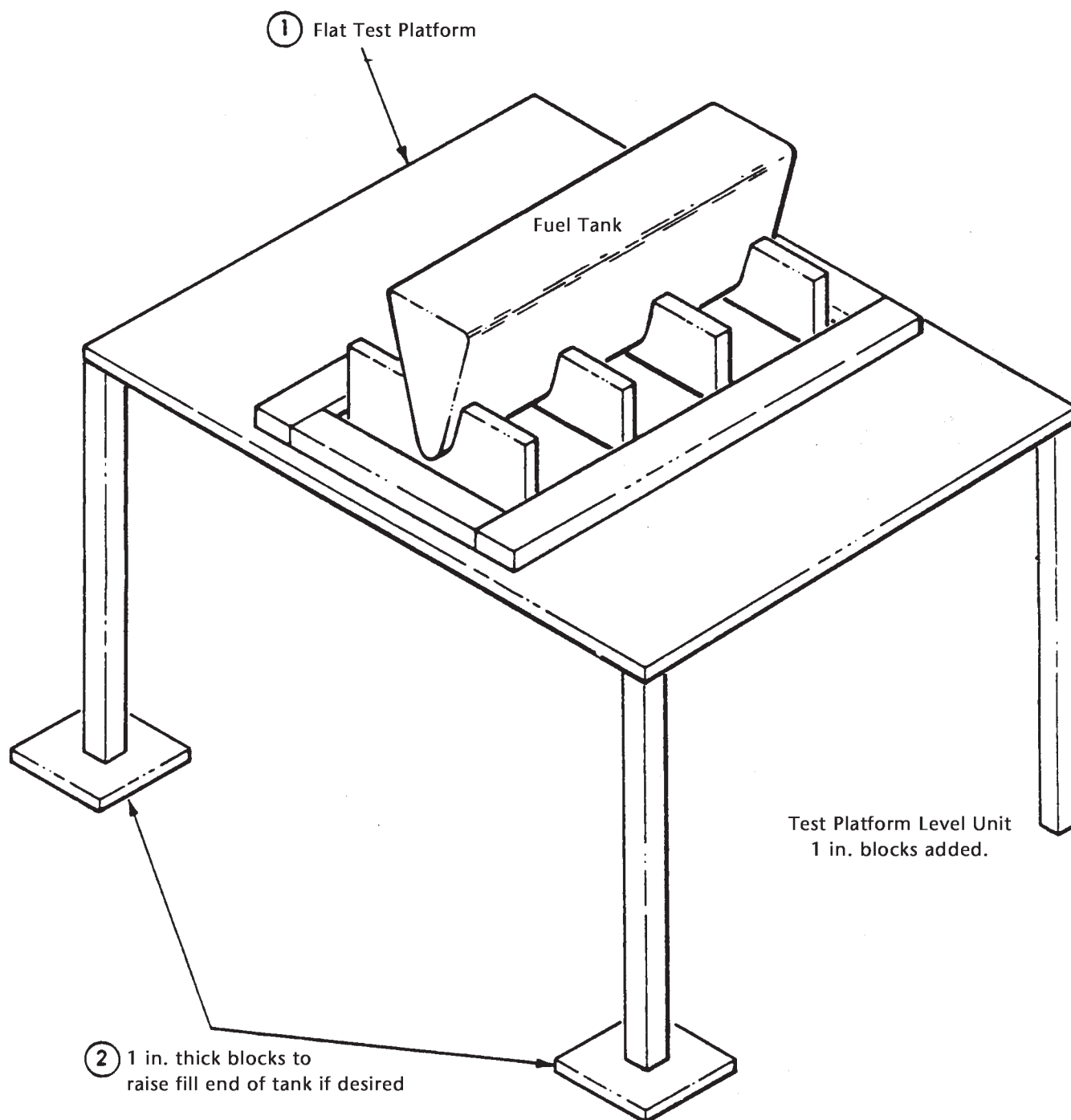
17.2.1 Pre-Test Conditions and Assumptions — The Static Pressure Test per section 183.580 shall have been completed successfully.

17.2.2 Test Media — Shop grade compressed air or gaseous nitrogen. No special analysis is required although the system used should be reasonably clean and not contaminated. Gaseous nitrogen is preferred, especially if gasoline has been used in the system prior to this test.

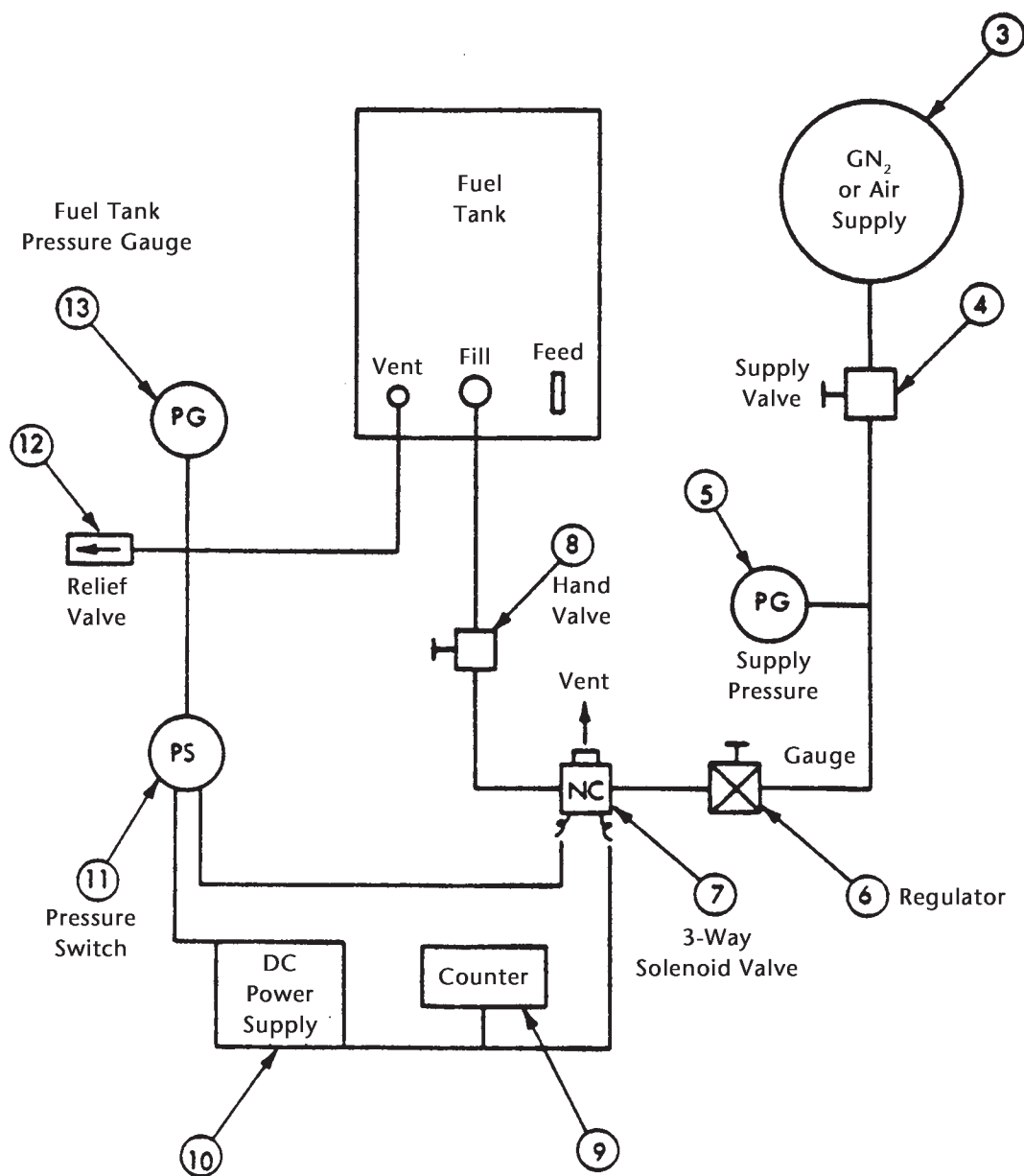
Pressure Impulse Test — Typical Layout for Flat-Bottomed Tank Test Schematic Procedure



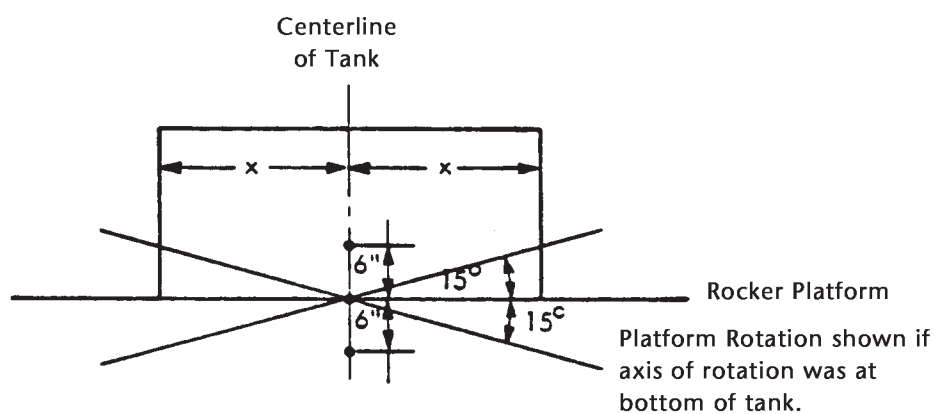
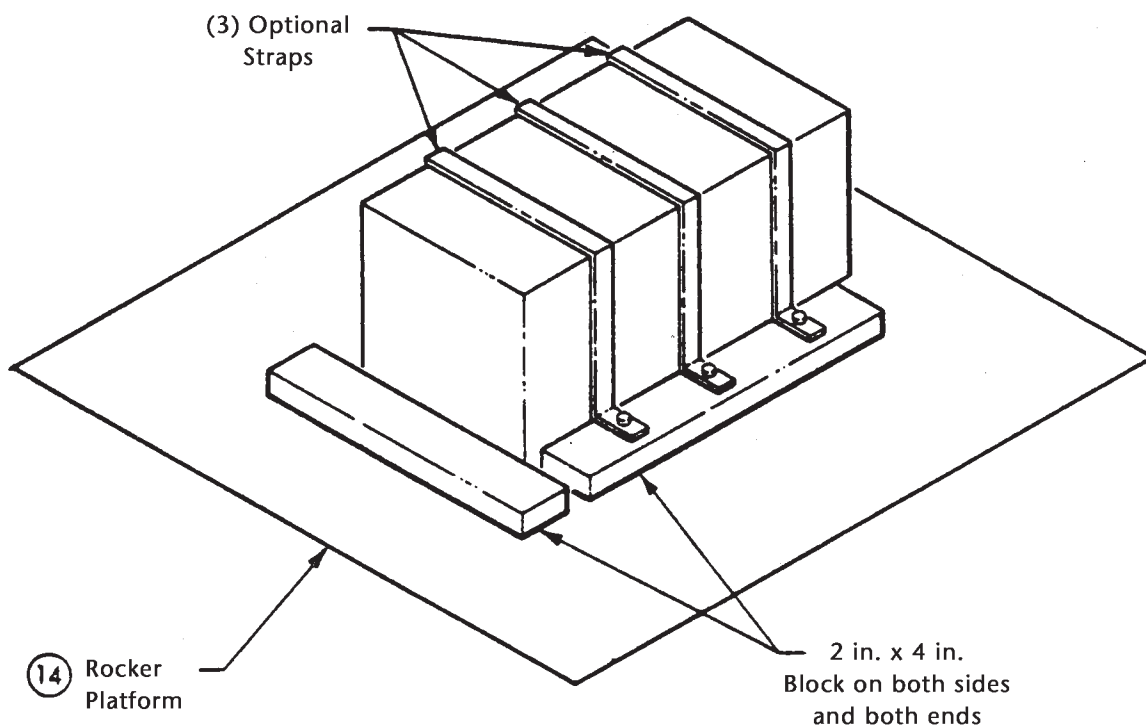
Pressure Impulse Test — Typical Layout for Non-Flat-Bottomed Tank Test Schematic Procedure



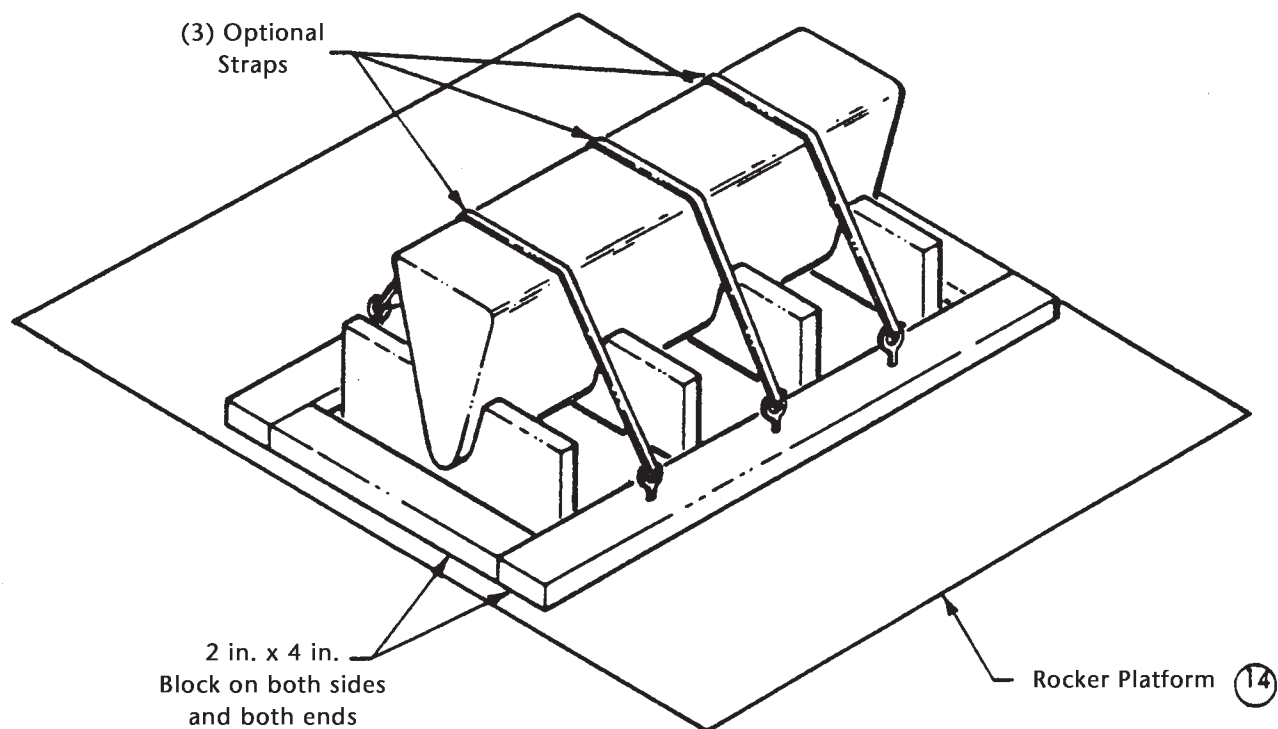
Pressure Impulse Test — Typical Setup Test Schematic Procedure



Slosh Test — Typical Layout for Flat-Bottomed Tank Test Schematic Procedure



Slosh Test — Typical Layout for Non-Flat-Bottomed Tank Test Schematic Procedure



17.3 Test Equipment and Schematic

Component Find No.	Title	Description
1	Test Platform	A flat level platform for mounting the fuel tank during the pressure impulse test.
2	Positioning Blocks	One-inch (2.5 cm) thick blocks or equivalent used to raise the fill end of the tank to facilitate adding water to the tank.
3	GN ₂ or Air Supply Bottle	Shop grade compressed air or high purity grade GN ₂ .
4	Pressurant Supply Valve	Manually adjustable relief valve to prevent fuel system overpressurization.
5	Supply Pressure Gauge	A pressure gauge to monitor the inlet supplies GN ₂ or air pressure to the system. Range 0–100-psig.
6	Regulator	A hand regulator used to regulate the inlet pressure to the required test level (3-psig).
7	3-way, 2 position NC Solenoid Valve	A solenoid valve used for cycling the pressure to the fuel tank. Controlled by Pressure Switch (see #11).
8	Hand Valve	A hand operated shutoff valve used to isolate the fuel tank from pressure supply system.
9	Electronic Counter	A counter tied in electrically to the 3-way Solenoid Valve such that every time the valve cycles the counter registers. 25,000 capability.
10	DC Power Supply	A DC power supply for operating the 3-way Solenoid valve and counter.
11	Pressure Switch	A 0–20-psig range with a 1.0-psig maximum deadband used for controlling the pressure cycles to the tank.
12	Relief Valve	An overpressure valve used for relieving excess pressure to the fuel tank in case a failure occurs in the supply system. Set at 4.25 ±0.25-psig.
13	Pressure Gauge	A gauge used for monitoring the pressure supplied to the fuel tank during each pressure pulse.
14	Rocker Platform	A flat level platform capable of having a fuel tank mounted on it and rocking ±15 degrees at a rate of 15–20 cycles per minute.

17.4 Test

- 17.4.1** This procedure shall be used to perform a pressure impulse test on fuel tanks which have a capacity of 25-gal. (94.6 l) or more. For fuel tanks which have been subjected to the pressure impulse test and have a capacity of 100-gal. (378.5 l) or more, an additional slosh test shall be performed as specified in this procedure. Verify the applicability of this procedure to the tank being tested before proceeding.
- 17.4.2** Visually inspect the fuel tank. Review the results of the Receiving Inspection and verify that the component is acceptable and ready for testing. Tanks that would obviously leak have failed the pressure test or do not have a proper label, shall be rejected.
- 17.4.3** Verify that the fuel tank to be tested has successfully completed the static pressure test as specified in the pressure test. If it has not been accomplished, the pressure test shall be completed at this time. Record whether the pressure was previously accomplished or is being completed at this time.
- 17.4.4** Non-metallic fuel tanks shall be filled to rated capacity as specified on the fuel tank label, with a gasoline that has at least a 50% aromatic content. ASTM Reference Fuel C meets this requirement. The fuel tank shall bear no evidence that it has been adversely affected by the gasoline after 30 days at ambient temperature and pressure but in no case less than a temperature of 70°F (21°C). Accomplish Paragraph 17.4.5 and terminate the test.
- 17.4.5** Flush and/or purge the fuel tank with water and/or GN₂ after the 30-day pre-conditioning test has been completed.

17.5 Pressure Impulse Test

- 17.5.1** Verify that the fuel tank has a capacity of 25-gal. (94.6 l) or more.
- 17.5.2** Mount and secure the fuel tank to a test platform similar to an actual installation or similar to one of the following installations. A flat-bottomed tank shall be mounted on a flat platform. Tanks with other than flat bottoms shall be mounted on chocks cut to fit the tank contour, and located at the ends of the tank and at the tank baffles, if any. In any of the above installations, the platform at the end of the tank with the fill and vent fittings may be raised slightly to facilitate filling with water. Do not remove any attachments or fittings from the tank. See the Test Schematic for a typical installation.
- 17.5.3** Fill in the fuel tank with water to at least rated capacity. The fuller the tank is the faster the cycle rate will be. Cap or plug the tank fuel feed adapter. If a gasoline gauge is not installed, cap this opening. Connect a regulated source of air or GN₂ to the tank fill pipe. Connect a calibrated pressure gauge to the vent fill pipe to monitor the tank pressure. Connect a pressure relief valve into the pressure gauge line. Adjust the relief pressure to 4.0 to 4.5-psig. Record the relief valve setting.

Also, connect a pressure switch control line into the pressure gauge line. The PS should have a range of no more than 0–20-psig with a 1.0-psig maximum deadband. The pressure supplied to the tank fill pipe shall be controlled and cycled by a 3-way, 2 position N.C. (vent position) solenoid valve. A counter cable of 25,000 cycles shall be tied into the solenoid valve to record the number of cycles completed. See the Test Schematic for the setup described above.

Note:

This is a typical test setup to accomplish the pressure cycles required, but it is not the only acceptable setup for the test. Any equivalent combination of valving and arrangement of components can be used.

- 17.5.4** Vary the pressure in the fuel tank from zero psig to 3–3.4-psig at a rate not to exceed 15 cycles per minute. Zero psig shall be defined for the purposes of this test as 0.5-psig or less. The cycle's rate will vary depending on the following conditions:
- Supply pressure
 - Air volume in tank after water is added
 - Line sizes
 - Valve sizing, especially the vent port
 - The actual pressure setting used

Any of the above may be varied within reasonable limits to give the desired cycle rate up to the maximum of 15 cycles per minute. Record the upper and lower pressure settings and the cycles per minute. Record the upper and lower pressure settings and the cycle rate at the start of the test.

- 17.5.5** Apply 25,000 cycles of pressure to the fuel tank. Periodically (approximately once per hour) check the pressure and cycle conditions and adjust the system if required to stay within the requirements. The fuel tank shall not leak after the application of 25,000 cycles.
- 17.5.6** If the tank should start to leak prior to 25,000 cycles, the tank shall be rejected. Secure the test setup and do not accomplish the slosh test.
- 17.5.7** If the tank shows no indication of any leakage after 25,000 cycles, remove all the water from the tank and secure the system.
- 17.5.8** Perform the pressure test on the fuel tank and verify that the tank does not leak. If leakage is found during the pressure test, the tank shall be rejected. Secure the test setup and do not accomplish the slosh test. If the fuel tank successfully completes the pressure test, the tank shall be deemed acceptable according to the requirements of this procedure for the Pressure Impulse Test. Proceed to the Slosh Test.

17.6 Slosh Test

- 17.6.1 Verify that the fuel tank has a capacity of 100-gal. (378.5 l) or more. Verify that the pressure impulse test portion of this procedure has been completed successfully.
- 17.6.2 Mount and secure the fuel tank on a rocker platform similar to the installation used for the pressure impulse test. In addition, wood blocks should be mounted to the test platform at the forward and aft ends of the tank to prevent any longitudinal movement of the tank. Wood blocks should be mounted to the platform along the sides of the tank to prevent lateral movement. Straps or clips may be required to prevent vertical movement of the tank. See the Test Schematic for a typical installation.
- 17.6.3 Fill the tank with water to 50% of rated capacity.
- 17.6.4 Cap and/or plug the fuel tank fill pipe, the fuel tank vent pipe, and the fuel feed adapter. If a gasoline gauge is not installed, cap this opening.
- 17.6.5 Apply 5000,000 cycles of rocking motion 15 degrees to each side of the tank centerline at a rate of 15 to 20 cycles per minute (one cycle equals 30 degrees of motion). The axis of rotation of the fuel tank shall be perpendicular to the centerline of the tank length at a level within six in. (15.2 cm) above or below the bottom of the tank. See the Test Schematic for a view of the rotation required. Record the cycles per minute and locate the axis of rotation.
- 17.6.6 If the fuel tank should start to leak prior to the completion of 500,000 cycles, the tank shall be rejected. Secure the test setup and terminate the test.
- 17.6.7 If the tank shows no indication of any leakage after 500,000 cycles, remove all water from the tank and secure the system.
- 17.6.8 Perform the pressure test on the fuel tank and verify that the tank did not leak. If leakage is found during the pressure test, the tank shall be rejected. If the fuel tank successfully passes the pressure test, the tank shall be deemed acceptable according to the requirements of this procedure for both the Pressure Impulse Test and the Slosh Test.
- 17.6.9 Secure the test setup.

18.0 LAB EXAMINATION NO.14

FIRE TEST OF FUEL SYSTEM COMPONENTS

183.590 Fire Test

- (a) A piece of equipment is tested under the following conditions and procedures:
 - (1) Fuel stop valves, "USCG Type A" hoses, clips, straps, and hose clamps are tested in fire chamber.
 - (2) Fuel filters, strainers, and pumps are tested in a fire chamber or as installed on the engine.
 - (3) Fuel tanks must be tested filled with fuel to one-fourth the capacity marked on the tank in a fire chamber or in an actual or simulated hull section.
- (b) Each fire test is conducted with free burning heptane and the component must be subjected to a flame for 2-1/2 minutes.
- (c) If the component is tested in a fire chamber —
 - (1) The temperature within one inch of the component must be at least 648°C sometime during the 2-1/2 minute test;
 - (2) The surface of the heptane must be eight to ten inches below the component being tested; and
 - (3) The heptane must be in a container that is large enough to permit the perimeter of the top surface of the heptane to extend beyond the vertical projection of the perimeter of the component being tested.
- (d) If the component is being tested as installed on an engine, heptane sufficient to burn 2-1/2 minutes must be poured over the component and allowed to run into a flat-bottomed pan under the engine. The pan must be large enough to permit the perimeter of the top surface of the heptane to extend beyond the vertical projection of the perimeter of the engine.
- (e) If a fuel tank is being tested in an actual or simulated hull section, the actual or simulated hull must be of sufficient size to contain enough heptane to burn for 2-1/2 minutes in a place adjacent to the tank.

Note:

The requirements of this lab are prescribed by sections 183.510(b), 183.524(a), 183.528(b), 183.532(b), and 183.534.

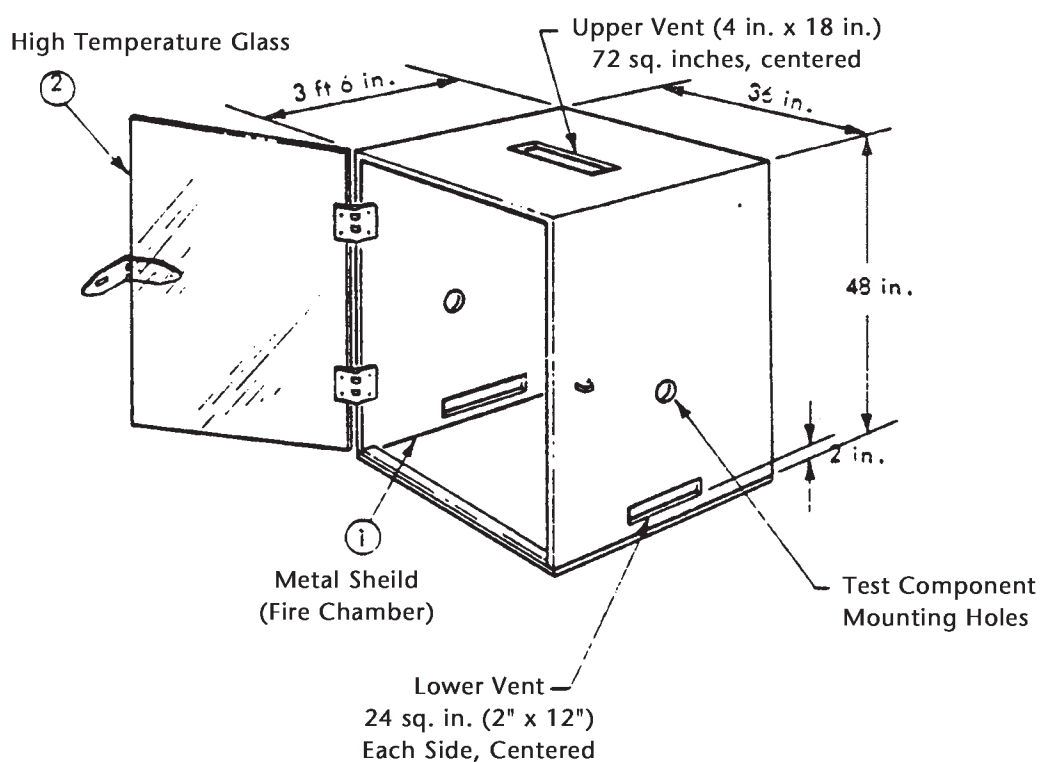
18.1 General Description — The fuel system component shall be mounted in a fire chamber as shown in the Test Schematic and subjected to a 2-1/2 minute fire using heptane as the fuel. The component shall not leak any fuel during or after the test, except as allowed in section 183.534. An entire fuel system or individual components may be tested in an installed configuration by this procedure of desired. In this case the component(s) would be mounted on an engine and subjected to a 2-1/2 minute fire.

18.1.1 Test Article — The test article shall consist of either an individual fuel system component to be tested in a fire chamber, or a component(s) mounted on an engine similar to an actual installation. This procedure is applicable to fuel strainers, fuel filters, fuel pumps, Type A fuel hoses, and any other component not specified in the Test Procedures. Individual component tests in a fire chamber shall be installed similar to a typical installation in a boat.

18.1.2 Constraints — Components which have been qualified as individual components using the fire chamber are acceptable for use in any fuel system, however, components and/or systems which have been qualified while installed on an actual engine shall be acceptable for use only on that model engine on which they were tested.

18.2 Test Equipment and Material

Component Find No.	Title	Description
1	Metal Shield (Fire Chamber)	16 gauge sheet metal housing 36 in. x 48 in. x 42 in. (0.9m x 1.2m x 1.2m) with one end open. This protects the test unit from the environmental elements.
2	Test Viewing Cover	High temperature glass approximately 42 in. x 54 in. x 0.25 in. (1.1m x 1.4m x 0.6cm) used as fourth side of metal shield. Should be capable of completely sealing off this side and withstanding approximately 1600°F (871°C).
3	Fuel Pan	Sheet metal pan approximately 8.5 in. x 14 in. x 1.5 in. (0.2m x 0.4m x 3.8 cm) for holding fuel in metal shield. Sides of pan should be outside perimeter of test component.
4	Thermocouple	Thermocouple with remotely readable indicator for temperatures to 2000°F (1093°C) (Two required). The thermocouple shall be an open tip chrome-alumel thermocouple probe with bare thermocouple tip with stainless steel tubing and Formica insulation. The thermocouple wire size shall be smaller than 22 gauge.
5	Fuel Tank	Holding tank for fuel to be passed through test units.
6	Shutoff Valve	Fuel tank shutoff. <i>Note: This may be an integral part of the fuel tank, it is not mandatory that it be installed, however, it is recommended as a safety precaution.</i>
7	3-way Fuel Valve	Three-way, two-position valve for supplying fuel to the test component and then venting test component fuel fill line to atmosphere
8	Discharge Valve	Fuel discharge shutoff valve to verify the test component is filled with fuel and then stop fuel flow through the discharge line.
9	Receiving Pan	Open top pan to collect the fuel flowed through the test component.



18.3 Test

18.3.1 This procedure shall be used to perform a fire test on fuel system components, such as but not limited to, fuel strainers, fuel pumps, fuel filters, and any other components specified in section 183.590. The three fuel system components identified above may be tested either in a fire chamber or as installed on the engine.

18.3.2 Visually inspect the component to be tested. Review the results of the Receiving Inspection and verify that the component is acceptable for testing.

18.3.3 Verify the applicability of this purpose to the component being tested before proceeding.

18.3.4 Fire Chamber Test

18.3.4.1 Mount and secure the component in a fire chamber as shown in the Test Schematic, Paragraph 18.2, and similar to a typical boat installation. Connect an inlet and outlet copper line to the component.

18.3.4.2 Connect the other end of the inlet line to a 3-way, 2-position valve and fuel supply tank as shown in the Test Schematic.

Note:

Although a 3-way valve has been shown in the Test Schematic, any equivalent combination of valves may be used to accomplish the same result.

18.3.4.3 Connect the outlet line to a shutoff valve over a receiving tank as shown in the Test Schematic (not applicable to carburetors).

18.3.4.4 Position an 8-1/2 in. x 14 in. x 1-1/2 in. (21.6 cm x 35.6 cm x 3.8 cm) (approximate) fuel pan directly under the test component. The bottom of the test component shall be 9 ± 1 in. (22.9 ± 2.5 cm) above the liquid surface of the fuel. The perimeter of the fuel pan shall extend beyond the vertical projection of the perimeter of the component being tested.

18.3.4.5 Two thermocouples shall be positioned even with the lowest point of the test component, one on each side, within one inch (2.5 cm) of the component, as shown in the Test Schematic. The thermocouple shall be capable of measuring 1200°F (648°C) at a remote station.

18.3.4.6 With all control valves in the closed position fill the fuel supply tank with a quantity of pump gasoline (regular) sufficient to fill the test system (approximately 2 or 3 gal, (7.6 or 11.4 l)). Closed position for the three-way valve is in the vent position.

18.3.4.7 Open the tank shutoff valve, the 3-way valve, and the discharge shutoff valve and allow a sufficient amount of gasoline to flow through the test setup to insure the system has been bled of all air and that the test component is filled with gasoline. Some components may have to be electronically or mechanically operated momentarily to accomplish this.

- 18.3.4.8** With the system full of gasoline close the discharge shutoff valve and perform a visual leak check of the system. There shall be no leakage of gasoline. Then close (vent position) the 3-way supply valve. In this position the fuel supply tank is isolated and the test component is vented to the atmosphere.
- 18.3.4.9** Remove the fuel pan from the fire chamber and fill it with technical grade or better heptane to a depth sufficient to burn for at least 2-1/2 min. (approximately 1/2 in. (1.3 cm)). Carefully replace the fuel pan (no spillage allowed) back into the fire chamber in the proper position. Measure the height from the bottom of the test component to the liquid surface. This height shall be 9 ± 1 in. (22.9 ± 2.5 cm).
- 18.3.4.10** Verify that the system is ready for the test and that all safety precautions are in effect. A CO² fire extinguisher or equivalent should be ready.
- 18.3.4.11** Place the Pyrex glass shield into position and secure it.
- 18.3.4.12** With all personnel at a safe distance from the fire chamber ignite the heptane in the fuel pan through one of the vent holes using a three-foot (0.9 m) torch and allow it to burn for 2-1/2 min. It is desirable to continually record the temperatures encountered during the burn period, however, in no case should the recording interval exceed five seconds. During the 2-1/2 min., one temperature indication of at least 1200°F (648°C) shall be required at one of the two positions. Record the highest temperature observed during the test. Visually monitor the test system during the burn period for any indication of gasoline leakage. No leakage is allowed.

Note:

Even though leakage is observed during this part of the test, the rest of the test shall be accomplished to verify the actual point of leakage is in the component and not part of the test setup.

- 18.3.4.13** After 2-1/2 min. of burn time, extinguish the fire with CO² or other suitable means. Do not disturb the test component or discharge the CO² directly on the component.
- 18.3.4.14** Immediately after the fire has been extinguished, open the discharge shutoff valve and then the 3-way supply valve. Gasoline may not flow from the discharge part immediately, depending on the component being tested, the temperature and the degradation resulting from the fire. Close the discipline shutoff valve after there is a steady flow of gasoline. Leave the 3-way supply valve open and verify that the level of gasoline in the fuel supply tank is 36 ± 1 in. (91 ± 2.5 cm) above the inlet line to the fire chamber. Add pump gasoline (regular) as necessary.
- 18.3.4.15** Perform a visual check of the test component and the inlet fittings. There shall be no leakage of gasoline. If any indication of leakage is observed, the test component shall be rejected. If no leakage is observed, the test component shall be deemed acceptable according to the requirements of this procedure.

Note:

A leakage of 5 oz. in 2-1/2 minutes is allowed from the fuel pump, filter, strainer, and fuel line combined.

18.3.4.16 Secure the test system as required and safe the area.

18.3.5 Installed Test

18.3.5.1 Fuel pumps, fuel filters and fuel strainers may be tested as installed on the engine, either singularly or all at the same time.

18.3.5.2 Position the engine in a level position in a container. The container shall be large enough to permit the perimeter of the top surface of the heptane to extend beyond the vertical projection of the perimeter of the engine.

18.3.5.3 Verify that the component (or components) to be tested is full of gasoline. The system may have to be operated momentarily to accomplish this.

18.3.5.4 Remove, de-energize or disconnect all potential sources of ignition (fuel and electrical).

CAUTION:

Verify that all safety requirements are in effect before proceeding.

18.3.5.5 Pour a quantity of heptane sufficient to burn for 2-1/2 min. over the components to be tested with the excess being caught in the container under the engine. In addition, the quantity shall be sufficient to cover the entire bottom area of the container for the entire test. To meet this requirement, the container bottom should be as flat and level as possible.

18.3.5.6 The heptane shall be ignited at all locations and allowed to burn for 2-1/2 minutes. Visually monitor the test system during the burn period for any indication of gasoline leakage. No leakage is allowed. Extinguish the fire with CO₂ or other suitable means. There is no minimum temperature requirement for this test.

18.3.5.7 Perform a visual leak check of the test component(s) as soon as the fire has been extinguished. There shall be no leakage of gasoline. If any indication of leakage is observed, the test component shall be rejected. If no leakage is observed, check for leak in accordance with Paragraph 18.3.4.14.

18.3.5.8 Secure the test system as required and safe the area.

APPENDIX B — References and Resources

The following standards are referenced in this regulation:

- ASTM D 471 “Test Method for Rubber Property — Effect of Liquids”. Applies to section 183.516.
- ASTM D 1621 “Test Method for Compressive Properties of Rigid Cellular Plastics”. Applies to section 183.516.
- MIL P-21929B “Plastic Material, Cellular, Polyurethane, Foam in Place (2 pounds per cubic foot)”. Applies to section 183.516.
- SAE J1527 “Marine Fuel Hose”. Applies to section 183.540.
- UL 1114 “Marine Flexible Fuel-line Hose”. Applies to section 183.540.

ASTM standards are available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, (610) 832-9585.

MIL standards are available from Document Automation and Production Service, 700 Robins Ave, Bldg 4, Section D, Philadelphia, PA 19111-5094, (215) 697-2179.

SAE standards are available from the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096, (412) 776-4841.

UL (Underwriter Laboratories) standards are available from COMM 2000, Inc., 1414 Brook Drive, Downers Grove, IL 60515, (888) 853-3503.

The United States Coast Guard Compliance Test Procedures — Fuel System Standard Test Procedure, published Jan/78 is available from:

American Boat & Yacht Council Inc.
3069 Solomons Island Road
Edgewater, MD 21037-1416
(410) 956-1050
www.abycinc.org
Email: info@abycinc.org

