# MARINE SAFETY: INSPECTION OF ENGINEERING SYSTEMS, EQUIPMENT, AND MATERIALS


**COMDTINST 16000.72**
**September 2021**

U.S. Department of Homeland Security
United States Coast Guard

Commandant
United States Coast Guard

US Coast Guard Stop 7501
2703 Martin Luther King Jr. Ave SE
Washington, DC 20593-7501
Staff Symbol: CG-CVC
Email: CG-CVC@uscg.mil

COMDTCHANGENOTE 16000
20 SEP 2021

COMMANDANT CHANGE NOTICE 16000

Subj: CH-3 TO MARINE SAFETY MANUAL VOLUME II, COMDTINST M16000.7B

1. PURPOSE. This Commandant Change Notice publishes the cancellation of Marine Safety Manual Volume II, COMDTINST M16000.7B, and replacement with separate Commandant Instructions, one for each chapter of the existing Manual.

2. ACTION. All Coast Guard unit commanders, commanding officers, officers-in-charge, deputy/assistant commandants, and chiefs of headquarters staff elements shall comply with the provisions of this Commandant Change Notice. Internet release is authorized.

3. DIRECTIVES AFFECTED. With the addition of this Commandant Change Notice, Marine Safety Manual Volume II, COMDTINST M16000.7B, is cancelled.

4. DISCUSSION. The content of Marine Safety Manual remains intact. The primary reason for this change is to allow for timely revision and re-publication of the individual Commandant Instructions.

5. DISCLAIMER. This guidance is not a substitute for applicable legal requirements, nor is it itself a rule. It is intended to provide operational guidance for Coast Guard personnel and is not intended to nor does it impose legally-binding requirements on any party outside the Coast Guard.

6. MAJOR CHANGES. Sections A though G of Marine Safety Manual Volume II, COMDTINST M16000.7B, are now individual and independent Commandant Instructions. They are listed below.

   a. Marine Safety: Marine Inspection Administration, COMDTINST 16000.70 (pages A1-1 - A7-43)

DISTRIBUTION - SDL No. 170

| | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u | v | w | x | y | z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | | x | | | x | | | | | | | | | x | | | x | | | | | | | | | |
| C | | | | | | | | | | | | x | | | | | | | | | | | | | | |
| D | x | x | x | x | | | | | | | x | | | | | | | | | | | | | | | |
| E | | | | | | | | | | | | | | x | | | | | | | | | | | | |
| F | | | x | | | | | | | x | | | | | | | | | | | | | | | | |
| G | | | | | | | | | | | | | | | | | | | | | | | | | | |
| H | | | | | | | | | | | | | | | | | | | | | | | | | | |

NON-STANDARD DISTRIBUTION:

b. Marine Safety: Domestic Inspection Programs, COMDTINST 16000.71 (pages B1-1 – B10-3)
c. Marine Safety: Inspection of Engineering Systems, Equipment, and Materials, COMDTINST 16000.72 (pages C1-1 – C5-31)
d. Marine Safety: Port State Control, COMDTINST 16000.73 (pages D1-1 – D7-38)
e. Marine Safety: International Conventions, Treaties, Standards, and Regulations, COMDTINST 16000.74 (pages E1-1 – E4-3)
f. Marine Safety: Carriage of Hazardous Materials, COMDTINST 16000.75 (pages F1-1 – F5-35)
g. Marine Safety: Outer Continental Shelf Activities, COMDTINST 16000.76 (pages G1-1 – G6-24)

7. ENVIRONMENTAL ASPECT AND IMPACT CONSIDERATIONS.

a. Commandant CG-47 reviewed the development of this Instruction, and the general policies contained within it, and determined that this policy falls under the Department of Homeland Security (DHS) categorical exclusion A3. No further environmental analysis is necessary in accordance with the U.S. Coast Guard Environmental Planning Policy, COMDTINST 5090.1 (series).

b. This Instruction will not result in any substantial change to existing environmental conditions or violation of any applicable federal, state, or local laws relating to the protection of the environment. It is the responsibility of the action proponent to evaluate all future specific actions resulting from this policy for compliance with the National Environmental Policy Act (NEPA), other applicable environmental mandates, and the U.S. Coast Guard Environmental Planning Policy, COMDTINST 5090.1(series).

8. DISTRIBUTION. No paper distribution will be made of this Commandant Change Notice. An electronic version will be located on the following Commandant (CG-612) web sites. Internet: http://www.uscg.mil/directives/, and CGPortal: https://cg.portal.uscg.mil/library/directives/SitePages/directives.aspx

9. PROCEDURE. Cancel Marine Safety Manual Volume II, COMDTINST M16000.7B and replace with COMDTINSTs 16000.70 thru 16000.76.

10. RECORDS MANAGEMENT CONSIDERATIONS. Records created as a result of this Instruction, regardless of format or media, must be managed in accordance with the records retention schedules located on the Records Resource Center CGPortal site: https://cg.portal.uscg.mil/units/cg61/CG611/SitePages/Home.aspx.

11. FORMS/REPORTS. The forms called for in this Commandant Change Notice are available in USCG Electronic Forms on the Standard Workstation or on the Internet: https://www.dcms.uscg.mil/forms/; CGPortal at https://cgportal.uscg.mil/library/forms/SitePages/Forms.aspx; and Intranet at https://www.dcms.uscg.mil/forms/.

12. REQUEST FOR CHANGES. Request for changes to the previous mentioned Commandant Instructions may be sent to Commandant (CG-CVC) at HQS-SMB-COMDT-CG-CVC@uscg.mil.

/J. W. MAUGER/
Rear Admiral, U. S. Coast Guard
Assistant Commandant for Prevention Policy

# CHAPTER 1: MARINE EQUIPMENT AND MATERIALS

## A. INTRODUCTION

This and the following two chapters contain those provisions of Title 46 Code of Federal Regulations (CFR) that apply to the inspection of equipment and materials for use aboard inspected vessels and also to certain items of equipment carried on uninspected vessels. The controlling regulations are contained in 46 CFR Subchapter Q. The Commandant's approvals of equipment and materials are published in the *Federal Register* and in Equipment Lists, COMDTINST M16714.3A. Terminations of approval are also published in the *Federal Register*. *Federal Register* and in Equipment Lists, COMDTINST M16714.3A includes a separate section listing formerly approved instruments, machines, and equipment that may continue to be used as long as they are in "good and serviceable" condition, unless otherwise noted. The marine inspector is responsible for determining that equipment and materials are manufactured and installed in accordance with the Commandant's standards as required by regulation. This responsibility is imposed because the public has a reasonable expectation that equipment and materials approved by the Coast Guard will perform as intended in an emergency. Some statutes provide penalties for failure of lifesaving equipment to meet the Commandant's requirements (see 46 U.S.C. 3318(a) and (b)).

## B. REPORTS OF UNSATISFACTORY EQUIPMENT

When a factory or shop inspection indicates that equipment or materials required to be Coast Guard-approved do not meet the applicable requirements, the situation must be reported to Commandant (CG-CVC) via the chain of command. If these conditions are serious, the Officer in Charge, Marine Inspection (OCMI) and district commander must take immediate steps to suspend approval, pending final action by the Commandant (see 46 CFR 2.75-40). Reports should be initiated when vessel inspections indicate problems associated with approved equipment and materials. Although a system exists to report equipment failures, relatively minor problems and those for which a report form is not appropriate may go unrecorded. In addition, the source of a problem may be a regulation or its interpretation. However, if several inspectors report similar experiences, further investigation by higher authority will be undertaken. The inspector is encouraged to discuss even minor types of problems with supervisors and other inspectors. Reports of unsatisfactory equipment or materials should clearly identify the problem, provide samples or pictures if possible, indicate impact, and offer recommendations for correction. This type of feedback is essential for regulations and inspection policies to remain effective.

## C. "ACCEPTED" EQUIPMENT AND MATERIALS

### 1. Introduction

The following parts describe the requirements for approved equipment and materials. Certain equipment and materials not required by regulation to be approved may be "accepted" by the Commandant for use aboard inspected vessels, uninspected vessels, and boats after certain control actions have been taken (e.g., submittal of an affidavit by the manufacturer that applicable standards will be/have been met). Unlike approved equipment and materials, accepted items are not normally published in the *Federal Register*. However, they are listed in Equipment Lists and in the Proceedings of the Marine Safety Council.

### 2. Marine Engineering Equipment

Certain marine engineering equipment, e.g., valves, fittings, and flanges, may be accepted on an affidavit basis if certain regulatory requirements are met.

### 3. Welding Filler Metals

For hull construction, foreign and domestically manufactured filler metals must be tested by the American Bureau of Shipping (ABS) and listed in its publication, Approved Welding Electrodes, Wire-Flux, and Wire-Gas Combinations. In those cases where limited application may preclude such listing, acceptance by the Commandant will be based upon a satisfactory procedure qualification by the fabricator. For lifesaving equipment, specific acceptance of the welding procedure must be obtained from Commandant (CG-CVC). Under 46 CFR 57.03-1(e), type E6012, E6013, E6014, E6024, E7014, and E7024 electrodes may be used only when the welding procedure used for a specific electrode is qualified by the Marine Inspector, in accordance with the requirements of 46 CFR Part 57. These electrodes may not be used in the following instances:

a. On lifesaving equipment.

b. In ship's hull fabrication or repairs that involve butt welds in the shell, strength deck, tank top, strength bulkhead, or longitudinal strength member.

c. On galvanized materials, unless the welding procedures used for the specific electrode are qualified by the inspector in accordance with the procedures outlined in Section 30, Part III of the ABS Rules for Building and Classing Steel Vessels.

Generally, these electrodes may be used in horizontal and flat fillet weld attachments of hull stiffening members, provided that the welding procedures are qualified in accordance with Section 30, Part III, of the ABS Rules. The inspector may require such workmanship tests as deemed necessary to determine that satisfactory welds are being produced. The use of E7024 electrodes is contingent upon periodic weld testing to ensure that adequate weld quality is maintained. Acceptable welds with E7024 rods cannot be determined by a one-time test.

### 4. Electrical Equipment

Manufacturers of electrical equipment may obtain prior acceptance of the products through the Underwriters Laboratories, Inc. (UL) Marine Listing Service. A UL "Marine Listing" or "Marine Listing For Use On Vessels Over 65 Feet" indicates that, in addition to meeting UL standards, a product meets applicable requirements of 46 CFR Subchapter J (Electrical Engineering). This arrangement resulted from "Marine Supplements" to certain UL electrical standards, which contain specifications meeting the applicable requirements of 46 CFR Subchapter J. The equipment must be marked "Drip-proof," "Watertight," or "Suitable For Use In Corrosive Locations" if it is to be used in a location where the regulations require such enclosures. In such cases, the UL label will indicate the particular listing for the equipment. Electrical equipment without a UL "Marine Listing" may be accepted by the Marine Safety Center (MSC) on a case-by-case basis.

### 5. Ships' Stores and Supplies

46 CFR Subchapter N, specifically 46 CFR Part 147, details items of ships' stores and supplies that must be tested and certificated by the Coast Guard before they may be stowed or used aboard inspected vessels.

## D. 46 CFR SUBCHAPTER Q SPECIFICATIONS

### 1. Introduction

During World War II, it was found that specifications for certain approved equipment and materials provided greater uniformity in their production by various manufacturers. Equipment that met neither the intent of the regulations nor the minimum standards was easily detected and eliminated from service. In 1945, the Commandant established the regulations in 46 CFR Parts 160-164 (Subchapter Q). Their purpose was to consolidate the specifications for equipment and materials that were required to be approved by the Commandant or to meet certain minimum standards. Also, requirements for the operation

and construction of inspected vessels were distinguished from specifications applicable to the manufacturers of approved equipment and materials used aboard vessels.

## 2. Application

Each item approved under 46 CFR Subchapter Q is assigned a basic approval number. This includes the number of the CFR subpart under which an item was approved, thus identifying the general requirements for its approval. No two specifications have the same number. 46 CFR Subchapter Q has been separated into six parts:

| TYPE | CFR CITATION |
|---|---|
| Approval of Equipment and Materials (general) | 46 CFR Part 159 |
| Lifesaving Equipment | 46 CFR Part 160 |
| Electrical Equipment | 46 CFR Part 161 |
| Engineering Equipment | 46 CFR Part 162 |
| Construction | 46 CFR Part 163 |
| Materials | 46 CFR Part 164 |

Each specification in 46 CFR Subchapter Q is complete, prescribing corollary specifications, materials permitted to be used, types and sizes of equipment, construction and workmanship requirements, markings and inspections required, and procedures for obtaining the Commandant's approval, if required. Although these specifications are intended primarily for the benefit of the manufacturer, the inspector also benefits from the consolidation of applicable requirements.

## 3. Certification of Approvals

Manufacturers of items considered satisfactory for the purpose(s) intended are issued an approval certificate by the Commandant. Notice of the approval and the item's approval number are published in the *Federal Register* and Equipment Lists. The approval number applies only to an item that is manufactured in accordance with approved plans, specifications, or other data submitted during the approval process. An item that is manufactured with changes in design, or with materials that are not previously approved by the Commandant, is not "approved" under the approval number listed for a particular item.

## E. COMMERCIAL DIVING EQUIPMENT

### 1. Introduction

The objective of the Coast Guard's commercial diving regulations, in 46 CFR Part 197, is to set minimum safety standards for the diving industry. Compliance is verified by Marine Inspectors coincident with other inspection activities. Inspection of diving equipment and facilities must be conducted when diving operations occur on--

a. Vessels inspected for certification;

b. Deepwater ports; and

c. Structures and Mobile Offshore Drilling Units (MODUs) operating on the Outer Continental Shelf (OCS) of the United States.

Marine inspectors must be familiar with the requirements of 46 CFR Part 197. Volumes I and II of the U.S. Navy Diving Manual, Naval Ship Systems Command (NAVSHIPS) 0994-001-9010, contain useful information about diving equipment and operations.

### 2. Equivalent Equipment, Materials, and Procedures

Under 46 CFR 197.206, the Coast Guard may accept equivalent equipment, materials, and procedures for use in diving operations. Such acceptances must be approved by Commandant (CG-CVC), which may be reached at (202) 372-1224.

### 3. Pressure Vessels for Human Occupancy (PVHOs)

a. To operate in U.S. jurisdiction without violating the regulations, PVHOs used in commercial diving operations must have acceptable certification in one of the following ways:

(1) PVHOs certified and stamped in accordance with 46 CFR Subchapter F.

(2) PVHOs certified and stamped in accordance with the American Society of Mechanical Engineers (ASME) PVHO-1.

(3) PVHOs contracted for or constructed before 1 February 1979 that were submitted to the Coast Guard for approval prior to 1 February 1984. Design drawings and calculations must have been submitted no later than 31 May 1984. If not, see E.3 below.

(4) Any other PVHO without Coast Guard or ASME PVHO-1 certification and stamping must have plans and specifications approved by the Coast Guard as meeting ASME PVHO-1 and be tested to the satisfaction of the cognizant OCMI before it may operate.

b. Inspection and testing by OCMIs of PVHOs not already certified per Subparagraph E.3.a, above, should include, as a minimum, a thorough visual exam, pneumatic or hydrostatic test, operational check, and appropriate Nondestructive Testing (NDT) of the welded joints. NDT would not normally include radiography unless MSC review indicates it is necessary to satisfy code requirements or OCMI inspection reveals information indicating such testing was necessary. This information could include material condition, operational history and repair history (e.g., heavy corrosion, surface defects in welds, exposure to high temperatures, etc.).

c. Following satisfactory review by the MSC and testing to the satisfaction of the cognizant OCMI, a letter must be issued by the OCMI identifying the PVHO and its operating parameters. This letter must be available at the dive location.

d. Technical review criteria developed by Commandant (CG-ENG) is available at the MSC. Questions regarding this criteria should be referred to the MSC.

e. Other approved PVHOs and diving system pressure vessels that are permanently installed must be considered as part of the vessel and likewise be inspected under Subchapter F.

f. Approved PVHOs and all other diving system pressure vessels that are temporarily installed must be considered to be separate from the vessel, and inspected under 46 CFR 197.462 (except for compressed gas cylinders).

g. U.S-made compressed gas cylinders may be accepted for use in a diving system, provided that they comply with 46 CFR 197.338. Those of foreign manufacture may be used, provided that:

(1) U.S.-made, Department of Transportation (DOT)-approved cylinders are not readily available.

(2) They have been hydrostatically tested within the past 5 years.

(3) They have been hydrostatically tested within the past 5 years.

(4) The standards of their manufacture must be compared with 46 CFR 173.34 and 49 CFR Part 178 to verify equivalence before they are accepted. The OCMI's analysis of foreign standards must be forwarded to Commandant (CG-CVC) for review.

h. Permanently installed diving system piping must be inspected under Subchapter F; temporarily installed piping must be inspected under 46 CFR Part 197.

---

**4. Dynamically- Positioned Vessels and "Liveboating"**

a. Introduction. When the commercial diving regulations were written in 1978, dynamically-positioned (D-P) vessels were not addressed. At that time, little, if any, interest was expressed in their use in U.S. waters. More recently, D-P vessels have gained in popularity; they are expected to become more widely used in the future. A problem has arisen in the application of 46 CFR Part 197, in that the definition of "liveboating" could be strictly interpreted to include D-P vessels, due to their use underway (i.e., not anchored or moored). However, the Commandant recognizes the unique characteristics of D-P vessels and their overall superior performance in North Sea operations.

b. Application of diving requirements. For purposes of applying the requirements of 46 CFR Part 197, a D-P vessel must be considered to be any vessel that uses an automated station-keeping device to operate its propulsion systems, so as to keep the vessel in a relatively stationary location. The following must be applied in interpreting the regulations relative to D-P vessels:

(1) The D-P and its propulsion systems must be fully operational under all conditions likely to occur during the diving operation.

(2) The master of the vessel must be experienced and thoroughly familiar with the vessel's installations, as well as the nature of the underwater work being conducted.

(3) All diving activities must employ a diving bell in a moon-pool arrangement. The bell's umbilical must be held in constant tension to prevent fouling the vessel's screws. Divers' umbilicals from the bell must be of sufficient length that they cannot foul the vessel's screws.

(4) Surface diving activities must not be conducted from D-P vessels.

c. Application of 46 CFR 197.436 requirements. Only the following provisions of these regulations apply to D-P vessels engaged in diving activities:

(1) 46 CFR 197.436(a)(1) Vessel station-keeping abilities.

(2) 46 CFR 197.436(a)(4) Rescue boat availability.

(3) 46 CFR 197.436(c)(2)-(7) Diving supervisor's responsibilities.

---

## F. MISCELLANEOUS INSPECTIONS OF EQUIPMENT AND MATERIALS

### 1. Introduction

Occasionally, Coast Guard Marine Inspectors are called upon to inspect boilers, pressure vessels, and other equipment and materials of Coast Guard units as well as those of Federal, state, and local agencies. For example, a hull inspector may be requested to assist in the survey of a Coast Guard small boat or a machinery inspector may be asked to investigate a boiler casualty aboard a government vessel. The Commandant desires inspection personnel to fulfill such requests as time and local resources permit. Records of such activities must be made on the forms supplied by requesting agencies or on forms produced locally. Reports must be made in accordance with policy.

### 2. Materials and Equipment Obtained for Coast Guard Use

a. General provisions

(1) Marine Inspectors will examine materials and equipment such as boilers, machinery, auxiliaries, related fittings, and other materials normally inspected for use in the marine industry.

(2) The inspector must interpret plans and specifications as fully as practicable; when questions or doubts arise, the matter must be referred to the OCMI, the district commander, or the Commandant, as appropriate.

b. The duties of the Marine Inspector are as follows:

(1) To become familiar with the contract and specifications for the material(s), and all related correspondence.

(2) To become acquainted with the flow of production and shipment so that progress of the work may be reported periodically.

(3) To assist the manufacturer in ensuring that Coast Guard requirements are met.

(4) To report any failure of the manufacturer to fulfill the requirements of the contract, purchase order, plans, specifications, or instructions for the work.

### 3. Definitions

a. Full Coast Guard inspection. This occurs when all materials purchased by a contractor are inspected and tested, in accordance with all requirements of the contract, work order, or other documentation. This type of inspection is rarely required, as it involves very close attention to the work and, probably, assignment of a full-time inspector.

b. Performance inspection. This type of inspection may require operation under "no load" conditions for a period required by the specifications, or demonstration of the load requirements.

**NOTE:** The work documentation must be explicit concerning such requirements.

c. Surface inspection. When this inspection is required, the material must be visually examined for appearances and imperfections and critical dimensions must be checked. No chemical analysis or physical tests need be conducted.

d. Shipping inspection. This requires materials to be packed, marked, and shipped in the proper quantities in accordance with the work documentation.

# CHAPTER 2: INSPECTIONS OF VESSEL EQUIPMENT AND MATERIALS

## A. GENERAL PRINCIPLES

### 1. Reasons for Coast Guard Control

All items of equipment installed on vessels subject to Coast Guard inspection and certification are subject to some degree of inspection and approval. Certain items are subject to inspection and approval even when they are carried aboard vessels not required to be inspected and certificated, such as fishing vessels and yachts. In judging the quality and suitability of equipment used on vessels, the primary considerations are as follows:

a. Safety of the vessel. To safeguard the vessel, equipment must be of good quality and suitable for its intended use. In judging suitability, the Marine Inspector must consider potential hazards of fire, explosion, failure of watertight integrity, and the risks involved if the equipment fails to function.

b. Safety of personnel. The vessel's equipment must provide the maximum practicable safety for passengers and crew. For example, cargo pumps and piping used in carrying dangerous liquids or gases must be designed, constructed, and maintained to transfer cargoes efficiently and safely.

c. Performance of a safety function. Many items, such as lifesaving equipment and firefighting equipment, are carried solely to perform a safety function. They are not used on a daily basis, but they must perform immediately and effectively in an emergency. It is essential that such items are of good quality, suitable for the intended use, maintained in good condition, and readily accessible.

### 2. What the Coast Guard Controls

a. Design. Various statutes and regulations provide for control of the design of equipment to be used aboard vessels. The degree of control exerted by the Coast Guard depends upon the potential hazards involved and is discussed in the inspection regulations. In approving a particular design, Marine Inspectors must consider the safety of the vessel and its personnel and the ability of the equipment to perform its intended function in the event of emergency.

b. Construction. The degree of control the Coast Guard exerts is specified in the applicable regulations. Depending on the hazards involved, such control might extend to specification of materials, methods of welding or riveting, and inspections and tests during and after construction.

c. Installation. Although certain qualities of equipment installation are controlled through construction and plan approval, the primary responsibility for ensuring the suitability of an installation rests with the inspector.

(1) Regardless of the general requirements of the regulations or specific approvals of plans and specifications, the inspector must determine at the initial inspection (during or following installation) that the installed equipment is safe and will perform as intended.

(2) Careful consideration is essential at this point, because approved installations normally should not be subjected to different requirements at later inspections. In considering the suitability of an installation, the inspector must consider security against movement, safeguards to personnel, and location with respect to other items on the vessel.

---

### 3. How the Coast Guard Controls

a. Standards. The standards for the design, construction, and installation of equipment on vessels may be specified in the regulations or contained in other recognized, published standards. When no specific standard is given, the Officer in Charge, Marine Inspection (OCMI) must determine if this equipment is suitable for its intended use.

b. Plan approvals. The Commandant may require plans for equipment of new, unusual, or potentially hazardous design.

c. Type approvals. Various regulations require equipment to be of types approved by the Commandant. When type approval is required, the Coast Guard establishes specifications or standards that must be met. Manufacturers must show that their products meet these standards before type approval is given.

d. Tests and inspections. Various regulations require certain tests and inspections of vessel equipment to determine its suitability. Depending on the hazards involved, tests and inspections may be conducted throughout the manufacturing process, during the installation, or both. These tests and inspections are intended to determine whether the equipment meets applicable standards, is safe for the vessel and personnel involved, and whether it will serve its function.

## B. RESPONSIBLE PARTIES

### 1. Manufacturers

Manufacturers of marine equipment have a basic responsibility to supply equipment that is satisfactory for its intended use and in compliance with applicable standards. Regulations contain specific requirements for manufacturers to follow in certain cases, but, for many items, only good commercial quality is required.

### 2. Vessel Owners

Owners are expected to supply and maintain the equipment aboard their vessels in accordance with applicable regulations. When the regulations do not specify requirements for vessel equipment, the vessel owner must supply equipment that is safe and suitable for its intended use. Equipment without regulatory specifications must be installed under the cognizance of the OCMI. The vessel owner is responsible for the equipment's continued maintenance.

### 3. Vessel Personnel

The vessel's officers and crew must maintain equipment in a satisfactory condition, ready to perform its intended function.

### 4. Classification Societies

Classification societies perform some equipment manufacture oversight and some survey responsibility for ensuring proper equipment.

### 5. Coast Guard Technical Personnel

Commandant (CG-CVC, CG-ENG, and the Marine Safety Center (MSC)) review plans and specifications for compliance with the regulations and suitability with the intended use of equipment.

### 6. Coast Guard Inspection Personnel

Marine Inspectors have the final responsibility for determining whether a piece of equipment complies with requirements and is suitable for its intended use.

## C. CATEGORIES OF ACCEPTABLE EQUIPMENT

### 1. Equipment Manufactured Under Coast Guard Control

Certain items of equipment are required to be manufactured under Coast Guard control. This control requires the submittal and approval of plans, materials, and methods of construction as well as tests and inspections by the Coast Guard during and after both manufacture and installation.

### 2. Approved Equipment

a. General approvals. Various items of lifesaving, firefighting, pollution prevention, and miscellaneous equipment used aboard inspected and uninspected vessels are required by statutes and regulations to be of types that are approved by the Commandant.

(1) To be an approved type, equipment must be manufactured in accordance with standards published in 46 CFR Subchapter Q (Specifications). To this end, the manufacturer must submit plans and specifications to the Commandant. After approval, the product must be labeled so that it can be identified as approved equipment.

(2) Alternatively, when specifically permitted by regulation, equipment must comply with the standards of a Commandant-recognized classification society, such as the American Bureau of Shipping (ABS). Equipment that is approved by a classification society without plan review by the Coast Guard must likewise be labeled to indicate compliance with required standards and approval.

b. Certification. Types of equipment that are considered to conform to 46 CFR Subchapter Q specifications are formally listed in the *Federal Register*.

(1) A certificate of approval is issued to the manufacturer of the equipment by Commandant (CG-CVC).

(2) Type-approved equipment that meets the specifications in Subchapter Q is listed in Equipment Lists, COMDTINST M16714.3 (series) and MISLE.

### 3. Equipment Acceptable Under Affidavit

a. The requirements that manufacturers must meet to have their products accepted on an affidavit basis and listed in Equipment Lists/MISLE are detailed in 46 CFR 50.25. Such items include certain valves, fittings, and flanges.

(1) Manufacturers of affidavit products that are not included in Equipment Lists may provide valves, fittings, and flanges for acceptance on an individual vessel basis.

(2) Other items, such as piping, tubing, standard pipe-joining fittings, bolting, castings, forgings, plates, and bar stock may be accepted on the basis of a manufacturer's or mill certificate. Such certificates contain the applicable standard society's specifications.

(3) 46 CFR Table 50.25-1(a) is an aid to the inspector in determining what is required of the manufacturer.

b. Verification of markings. A manufacturer typically makes some products that comply with the regulations and some that do not, simply because the marine market is generally a small percentage of its business.

(1) The manufacturer is required only to make one valve, fitting, or flange that complies with material requirements to receive an affidavit for the equipment and be listed in Equipment Lists/MISLE. Therefore, it should not be assumed that because a manufacturer is affidavited that its product is satisfactory.

(2) Products of affidavited manufacturers should be reviewed to determine acceptability in the same manner that products of non-affidavited manufacturers are reviewed.

(3) The Marine Inspector should check the markings on a component when installed to verify that it is of the required type, as indicated on the approved plans. In cases of discrepancies, the inspector must contact the MSC for guidance.

### 4. Equipment Acceptable After Type Tests

Equipment of a given design may be given general acceptance for use on inspected vessels after it has proven satisfactory by type tests. Coast Guard approval of plans and specifications may also be required prior to type tests. Under 46 CFR 58.30-15(f), hydraulic system components fabricated from certain ferrous or aluminum alloys which exhibit a low ductility must be impact-shock tested by an independent laboratory acceptable to the Commandant. Hydraulic components that have proven satisfactory by impact-shock tests are listed in Equipment Lists/MISLE. Inquiries as to whether a particular testing laboratory may conduct the required tests should be addressed to Commandant (CG-ENG).

---

### 5. Equipment Types Acceptable Upon Plan Approval

Equipment of a given design may receive approval for use on inspected vessels after Commandant (MSC) has examined all plans and specifications and determined that the equipment will meet applicable requirements. Approvals are limited to the installation(s) for which plans were submitted. Previously approved plans may be used in subsequent installations by following the requirements in 46 CFR 50.20-15. Type approvals are issued only under 46 CFR Subchapter Q (under 46 CFR Table 50.25(a) for hydraulic system components that require testing).

---

### 6. Portable Equipment

Portable electric equipment may be accepted in several ways. Portable cargo lights are covered under the Underwriters Laboratories, Inc. (UL) "Standards for Marine-Type Electric Lighting Fixtures." These lights are labeled to indicate UL approval as "marine types," portable items covered by this category are considered satisfactory. Portable items not labeled by UL must be checked to ensure compliance with 46 CFR Subchapter J. Portable fixtures should be referred to the MSC for determination. Approval of portable lighting devices by inspectors is not advisable, as temperature test data are needed to evaluate these fixtures properly. Portable tools can be accepted if the design appears to be commercially sound. This can be verified by a UL listing under the classification "Tools - Commercial Type."

---

### 7. Individual Items Accepted Under Society Standards

Individual items of equipment are acceptable for use on inspected vessels when they meet the standards of a classification society specified by the applicable regulations. For example, 46 CFR 58.01-5 provides for the acceptance of main and auxiliary machinery that meets the standards established by ABS. Lighting fixtures listed under the UL "Standard for

Marine-Type Electric Lighting Fixtures" are accepted for use on inspected vessels (see 46 CFR 111.75-20). Other electrical equipment, such as junction boxes and switches, with a UL Marine Listing or Marine Listing for Vessels Over 65 Feet are also acceptable for use on inspected vessels, provided they have the necessary rating and their enclosures are appropriate for the location in which they will be installed.

---

### 8. Equipment Required to Meet Installation Standards

Throughout the regulations, there are requirements covering the safe installation of equipment. In many cases, specific inspections and tests are required during or after installation.

---

### 9. Permitted Articles of a Dangerous Nature

Articles of a dangerous nature for ships' stores and supplies are prohibited by 46 CFR Subchapter N (Dangerous Cargoes), unless specifically permitted aboard. Certificates are issued to manufacturers of permitted articles that comply with these requirements.

---

### 10. Equipment for Which Standards are Not Specified

Items of equipment for which specific standards are not specified by law or regulation are required to meet an acceptable standard of safety, and must be suitable for the purpose intended.

Normally, such items that meet the standards of a recognized code or "good marine practice" will be considered suitable by the Commandant.

---

### 11. Equivalent Equipment

Throughout the regulations, there is authority for the Commandant, district commander, or OCMI to accept substitute equivalent equipment or materials, and alternate materials or methods of construction. For example, an equivalence has been filed with the International Maritime Organization (IMO) for substitution of life rafts for lifeboats on vessels under 1,600 Gross Tons (GT) making international voyages under certain conditions. The text of the equivalence notice is as follows: "Regulation 31 of Chapter III of the International Convention for the Safety of Life at Sea (SOLAS) provides that every cargo ship, with certain exceptions, must carry lifeboats on each side of the ship of such aggregate capacity as will accommodate all persons on board and, in addition, must carry life rafts sufficient to accommodate half that number. The Government of the United States of America gives

notification of acceptance of the following equivalent arrangement under the provisions of Regulation 5, Chapter I of the convention: Cargo vessels of 500 GT and over but less than 1600 GT, except tankers, may be equipped as follows:

a. On each side of the vessel, one or more davit-launched inflatable life rafts of sufficient capacity to accommodate the total number of persons aboard.

b. A minimum of one launching device on each side of the vessel. Operation of the raft launching device must not require anyone to remain aboard.

c. Sufficient float-free inflatable life rafts with capacity to accommodate not less than one half of the total persons allowed on board.

d. On a vessel for which persons aboard will have an escape route not requiring them to board inflatable life rafts by first entering the water nor to descend to them a distance in excess of 4-1/2 meters, float-free inflatable life rafts of sufficient capacity on each side of the vessel to accommodate the total number of persons aboard may be substituted for the davit-launched rafts and launching equipment required by a and b above.

e. A motor-propelled rescue boat suitable for ocean service with a davit or other suitable launching device capable of launch by no more than three persons.

f. In accordance with current regulations, only the Commandant can approve such an equivalent arrangement. Requests for such substitutions must be forwarded to Commandant (CG-CVC).

## D. REFERENCES

### 1. SOLAS 74, ILLC 66, and MARPOL

Safety of Life at Sea (SOLAS) 74 contains specific requirements for the equipment used on vessels making international voyages; these requirements are also in the regulations. The International Load Line Convention of 1966 (ILLC) contains provisions affecting equipment used on inspected vessels. MARPOL requires equipment to be approved.

### 2. Regulations

a. 33 CFR Parts 151-159 (Subchapter O) contains requirements for oil and hazardous substance equipment such as oil-water separators, oil content monitors and alarms, as well as Marine Sanitation Devices (MSDs).

b. 33 CFR Parts 173-183 (Subchapter S) contains safe powering and equipment requirements for recreational boats and boats carrying six passengers or fewer.

c. 46 CFR 2.75 and Part 159 contain requirements and procedures for equipment type approvals, filing of affidavits by equipment manufacturers, and requirements covering the acceptance of portable fire extinguishers.

d. 46 CFR 2.95-10 contains information and requirements concerning retention of records of approved equipment by manufacturers.

e. 46 CFR Parts 160-164 (Subchapter Q) contains specifications for equipment that is given type approval.

**NOTE:** Equipment that is not mentioned in these regulations must be acceptable to the Coast Guard.

---

3. **Equipment Lists, COMDTINST M16714.3A**

Equipment Lists, COMDTINST M16714.3 (series) contains listings of various lifesaving, firefighting, pollution abatement, engineering, electrical, and miscellaneous equipment used on vessels. These items are approved or accepted by the Commandant, as required by certain laws and regulations. Changes to this publication are issued in the *Federal Register* and reprinted in the Proceedings of the MSC. It contains four sections and addresses--

a. Approved instruments, machines, and equipment;

b. Manufacturers who have submitted affidavits for valves, fittings, and flanges;

c. Acceptable hydraulic components; and

d. Formerly approved instruments, machines, and equipment that are no longer manufactured as approved equipment. Unless otherwise noted, such items may be used as long as they are in good and serviceable condition.

---

**4. Industry Standards**

Federal regulations incorporate industry standards for various marine engineering equipment. Incorporation of industry standards reduced the need for detailed regulations. In some cases, regulations concerning the design, construction and testing of equipment have been removed. Manufacturers may continue to build and mark approved products affected by the regulations until their Certificate of Approval expires.

## E. MARINE ENGINEERING EQUIPMENT

### 1. Unfired Pressure Vessels

a. Construction standards. Pressure vessels must be designed, constructed, and tested in accordance with the requirements of 46 CFR Part 54, which modifies the rules of Section VIII (Pressure Vessels) of the American Society of Mechanical Engineers (ASME) Code. All pressure vessels intended for ships' service, such as compressed air tanks, heat exchangers, and refrigeration equipment are covered by these rules. (Refer to MSM Volume IV for details.)

**NOTE:** See MSM Volume II, Material Inspection, COMDTINST M16000.7A (series), Sec. A, Ch. 4 for further information on plan submittal.

b. Hydraulic accumulators. These components are inspected, stamped, and approved in a manner similar to pressure vessels, including the use of Manufacturers Data Report Boilers Pressure Vessels or Nuclear Pressure Vessels, Form CG-2936, the Manufacturer's Data Report for Boilers, Pressure Vessels, or Nuclear Pressure Vessels.

(1) Regulations dealing with the peculiarities of these accumulators are established in 46 CFR 58.30-25. Regulations regarding the general design, fabrication, inspection, testing, and stamping requirements for hydraulic accumulators are contained in 46 CFR Part 54.

(2) Accumulators must meet the applicable requirements of 46 CFR 54.01-5(c) (3), (c) (4), and (d), or the remaining requirements in 46 CFR Part 54.

(3) Existing installations that do not have Coast Guard stamped accumulators must be referred to Commandant (CG-ENG-3).

(4) To avoid damaging the internal parts of the inspection of accumulators, as required by 46 CFR 61.10- 5, must be limited to an operating test.

c. TAO 187 class vessels. The ram tensioners on the Fueling at Sea (FAS) and Replenishment at Sea (RAS) stations on the TAO 187 class vessels have been determined to be hydraulic accumulators. Periodic testing must be conducted as noted in Paragraph b above.

(1) The air receivers serving the ram tensioners for the FAS and RAS stations should be built in accordance with 46 CFR 54.01-5(c)(3) and properly marked and stamped in accordance with 46 CFR 54.10.

(2) If an inspector finds that these air receivers are not properly marked and stamped, the vessel owner must provide satisfactory evidence to the OCMI that the air receivers on board were built in accordance with 46 CFR Part 54.

(3) The air receivers may be examined internally in accordance with 46 CFR 61.10-5(e) (4). Use of a borescope, ultrasonic thickness testing or acoustic emission testing may be used to satisfy the internal and external inspection requirements of 46 CFR 61.10-5(b).

d. Compressed air cylinders/pressure vessels in totally enclosed lifeboats. Two types of cylinders/pressure vessels are approved for use in totally enclosed lifeboats on offshore platforms, Mobile Offshore Drilling Units (MODUs), and other vessels. These compressed air systems provide combustion air for the engine and breathing air for the crew when operating in a closed condition.

(1) One type of pressure vessel is approved by the Coast Guard under 46 CFR Subchapter F and the other type is approved under the Materials Transportation Bureau's (MTBs) regulations, 49 CFR Parts 173 and 178 Subpart C, which were formerly promulgated by the Interstate Commerce Commission (ICC). The type of device can be determined by its markings.

(2) Coast Guard-approved pressure vessels should be periodically inspected and tested as required by 46 CFR 61.10. MTB/ICC cylinders should be periodically inspected and tested as required by 49 CFR 173.34(e). (Refer to NVIC 3-95).

---

## 2. Welding Equipment

a. Electric welding equipment. There are no specific prohibitions of the installation of electric welding machines on vessels, including passenger, tank, and cargo vessels. However, 46 CFR 35.01-1, 50.05-10, 71.55-1, and 91.45-1(a) require the approval of the OCMI before repairs are undertaken with such systems. Installation of electric welding machines should be discouraged on tank vessels. When welding machines are permitted, adequate instructions for their safe use must be posted aboard the

vessel. These instructions should call attention to the Coast Guard regulations concerning repairs to vessels and their equipment.

b. Oxyacetylene welding equipment. Specific permission from the OCMI is not required for a vessel to carry such equipment. If such permission is granted, the oxyacetylene welding equipment must be stored in accordance with and in quantities not exceeding those allowed by 46 CFR 147.05-100.

(1) Suitable safety instructions on the use of this equipment must be posted on the vessel.

(2) Hard pipe oxygen and acetylene distribution systems are not authorized.

---

**3. Pipe Fittings**

a. Cargo hose couplings. Oil transfer hoses carried aboard vessels are subject to the requirements of 33 CFR 154.500.

(1) Each hose assembly must have fully threaded connections; flanged connections that meet the American National Standards Institute (ANSI) Standard B16.5 or B16.24; or quick disconnect couplings designed, constructed, and tested in accordance with American Society of Testing and Materials Standard (ASTM) F-1122.

(2) Quick disconnect hose couplings are divided into Standard Class and Class I. Vessels carrying hazardous material in bulk are required to use Class I quick disconnect couplings.

(3) Class I quick disconnect couplings and hose assemblies are subject to the requirements of 33 CFR 153.940.

(4) Quick disconnect couplings must be marked with the ASTM specification number and "CL I" if they are Class I adapters or couplers.

(5) The Coast Guard no longer maintains a list of quick disconnect couplings accepted under 33 CFR 154.500 and 153.940.

b. Aluminum flanges. Aluminum flanges were previously approved under 33 CFR 154.500 by reference to ANSI B16.31. This reference was removed from the regulations when ANSI dropped the standard for revision. In the interim, aluminum flanges manufactured and stamped under the old ANSI B16.31 standard are approved for oil transfer service as long as they remain in good condition and comply with the

testing requirements of 33 CFR 156.170. For new flanges not stamped ANSI B16.31, it is the operator's responsibility to provide documentation from the manufacturer that it is equivalent to the old standard.

c. Nickel flanges. Nickel alloy flanges (stainless steel), once part of the old ANSI B16.31 standard, were moved to ANSI B16.5.

d. Inspection of flexible hose assemblies. Nonmetallic flexible hoses must be designed, constructed and tested in accordance with Society of Automotive Engineers (SAE) J-1942. This standard refers to SAE 1475 for fitting standards.

(1) Hoses that meet the requirements of 46 CFR 56.60-25(c) are approved as long as they remain in good condition.

(2) These hoses have exterior coverings that, when damaged, could allow moisture to enter the inner tube material and wire braid, causing rapid corrosion and failure of the hose. When replacement is necessary, they should be replaced with hoses meeting SAE J-1942 standards.

(3) Use of flexible hoses. The use of the flexible hoses is restricted to vital and non-vital fresh and salt water systems, non-vital pneumatic systems, lube oil, fuel systems, and fluid power systems.

(a) To ensure the reliability of these systems, a thorough examination of these hoses must be made at the regular inspection period.

(b) Minor breaks, cuts, or abrasions in the covering may be allowed. However, the hose must be replaced if corrosion of the interior material is found.

(4) Markings. The list of approved hoses should be checked to determine the acceptability of a specific hose.

(5) The Coast Guard is negotiating for SAE to assume responsibility for maintaining an up-to-date list.

(a) Hoses and hose assemblies meeting SAE-J1942 must be marked with the maximum operating pressure, manufacturer’s name and part number, and hose size.

(b) Hoses may be marked in accordance with SAE J-517 standards. SAE J-517 is the basic standard for hydraulic hoses. The markings must include the following:

e. SAE hose specification number (including type designation where applicable).

f. Maximum operating pressure.

g. Manufacturer's name, part number.

h. Hose size.

i. To expedite inspections, hoses may also be marked with the propeller symbol followed by the appropriate alphanumeric code. An example is "SAE J-517, ABC Co. P/N A35, 100R2AT-8 FEB 89 HF." This example describes a hose that is 1/2 in. I.D., 2-Wire, Type AT, 3500psi hydraulic service rating, acceptable for All Services applications."

j. Identifying the recommended service is optional. However, hoses may be marked with the following codes from SAE-J1942:

| | |
|---|---|
| HF | All Services |
| H | Fluid Power |
| F | Lube Oil and Fuel Oil Systems |
| VW | Vital and Nonvital Fresh and Salt Water |
| NVW | Nonvital Water and Pneumatic |

k. Identifying hoses as acceptable for the intended service may be complicated, especially since use of the service code is optional. For instance, hoses marked HF may have different pressure ratings for different services. Often, only the highest pressure rating is marked on the hose.

l. Also, hoses marked as complying with SAE J-517 may not have undergone the fire test required by SAE J-1942 and are not acceptable for fuel/lube oil service. The suitability and pressure rating for the intended service should always be verified with the manufacturer.

m. Flexible pipe couplings. The regulations in 46 CFR 56.30-35 and Part 40 describe the limitations and installation requirements for the various types of flexible pipe couplings.

(1) Flexible couplings should be equipped with positive restraints to limit angular deflection and to keep the pipe from "creeping."

(2) Couplings should not be used as a vibration dampener or as a way to correct excessive misalignment.

(3) Pipe brackets and supports should be included in the inspection of flexible couplings and their restraining devices.

(4) Damaged or deteriorated gaskets must not be reinstalled. Indications of excessive or premature wear must be further investigated and steps taken to correct the cause before placing the joint back in service. The OCMI must be satisfied that new and existing flexible pipe couplings are suitable for the service intended.

---

**4. Spark and Flame Arresters**

a. Spark arresters in exhaust lines. Requirements for spark arresters in gasoline and diesel engines are contained in 46 CFR 58.10-5 and 58.10-10. The Coast Guard does not have a specification for such spark arresters. They must be accepted after installation and a demonstration that the spark arrester will prevent the emission of glowing embers.

b. Flame arresters for gasoline engines. Manufacturers must comply with the requirements contained in SAE 1928 for backfire flame arresters and engine and fuel air induction systems or UL 1111 for backfire flame arresters.

(1) Engine air induction systems. 46 CFR 58.10-5(b)(3)(iii) has been revised to allow a manufacturer to incorporate an engine air induction system without formal approval and labeling if it meets the flame dispersal, construction, and installation criteria contained therein. The difference between this type of system and a system that is required to meet an adopted standard is that the flame is dispersed outside the vessel.

(2) Two-cycle engines with reed valve assembly. Two-cycle engines using a reed valve assembly do not require backfire flame arresters. Reed valves inherently protect against backfire. They are not subject to Coast Guard approval. Owners must provide satisfactory evidence of reed valve installations, such as a manufacturer's certificate or a proper maintenance manual.

(3) Markings. Permanent markings attesting to compliance with either standard must be clearly evident. The marking must include the following:

(a) Manufacturer's name or trademark.

(b) Identification by style, type or model number.

(c) The word "MARINE".

(d) The marking for engine and fuel air induction system will probably be located on the carburetor cover.

c. Tank vent flame arresters. Tank vent flame arresters must be designed, constructed, and tested in accordance with ASTM F-1273. Arresters are classed either Type I (end of line) or Type II (in line). The markings must include the following:

(1) Manufacturer's name or trademark.

(2) Style, type, model or other manufacturer's designation.

(3) Size of the inlet or outlet.

(4) Type of device.

(5) Direction of flow.

(6) Test laboratory and report number.

(7) Lowest Maximum Experimental Safe Gap (MESG).

(8) Ambient air temperature range.

(9) ASTM designation F-1273.

---

**5. Equipment Using Liquefied Petroleum Gas (LPG) or Compressed Natural Gas (CNG)**

A regulation change may permit the use of LPG and CNG for cooking appliances aboard all uninspected vessels, provided American Boat and Yacht Council (ABYC) Standards A-1-78 or A-22-78 and pertinent National Fire Protection Act (NFPA) standards (for CNG) are met, in addition to other requirements of the proposed regulations.

---

**6. Keel Coolers**

Most keel coolers are integral parts of the hull (generally, extra-heavy pipe halves or structural angles welded to the bottom of the vessel). Independent units known as grid coolers have also been utilized.

Keel coolers must be fitted with shut-off valves located at the skin of the vessel, as required by 46 CFR 56.50-96(a), with the exception that a shut-off valve may be omitted if the requirements of 46 CFR 56.50-96 (a) (1) and (2) are met.

---

**7. Sliding Watertight Doors**

a. Sliding watertight doors must be designed, constructed and tested in accordance with ASTM F-1196. The requirements for controls and operating mechanisms associated with the watertight doors are contained in ASTM F-1197. ASTM F-1196 and F-1197 apply only to Class 2 and Class 3 sliding watertight doors. The watertight door must pass the following installation tests described in the standard:

(1) Visual inspection of the sealing surface for surface defects.

(2) Feeler gauge test - a test of the tightness of the door closure using a 0.003 inch feeler gauge.

(3) Hose test - water at a hose pressure of 50 psi at a distance of not more than 5 feet from the door.

(4) Closure test - Using a maximum force of 25 pounds (50 pounds during wedging, if applicable).

(a) A watertight door must close in not less than 20 seconds or more than 40 seconds in power operation mode.

(b) All watertight doors must close in less than 90 seconds in the manual operation mode.

(c) All power operated doors must be closed in less than 60 seconds after activation of the master mode switch.

b. The watertight door must have a nameplate permanently attached to the door, on which is stamped the name of the manufacturer, manufacturer's serial number, ASTM specification designation (ASTM 1196), pressure head, and date. The nameplate must also include the following phrase: “Suitable for installation in subdivision bulkheads aboard vessels inspected and certified by the U.S. Coast Guard.”

c. Watertight doors installed in these locations which do not meet the minimum ASTM standard for a 20 foot design head will be approved by Commandant (CG-522) on a case-by-case basis.

## 8. Spill Valves

Spill valves must be designed, constructed, and tested in accordance with ASTM F-1271 – 90(2006). ASTM F-1271 prohibits positive closure of spill valves as a means to prevent the opening of spill valves due to sloshing. For new valves, the old practice of dogging the valves closed while en route is no longer acceptable. Since 46 CFR 39.20-9(c) requires a means to prevent spillage due to sloshing, an alternative means must be provided. Valves which are presently installed are still acceptable and dogging is still permitted for these valves. However, new ones meeting the ASTM standard are to be installed when replacement is required. The provisions of both the ASTM standard and this regulation may be satisfied by either valve design or design of the valve installation (i.e. tank baffling or stilling well not part of the valve assembly).

a. During the installation of vapor recovery systems, spill valves must be replaced with new ones meeting the ASTM standard. Spill valves are often the limiting factor for a vessel's maximum allowable transfer rate.

b. Markings. The spill valve markings must include the following:

(1) Manufacturer's name or trademark.

(2) Style, type, model or other manufacturer's designation.

(3) Direction of flow.

(4) Maximum rated flow.

(5) ASTM designation F1271.

(6) Relief pressure setting at full flow rating.

(7) Set (opening) pressure.

(8) Indication of the proper orientation of the valve, if critical.

## F. MISCELLANEOUS DECK EQUIPMENT

### 1. Air Breathing Apparatus

a. Introduction. Title 46, CFR, Subchapters D, H, I, I-A, R, and U require Self-Contained Breathing Apparatus (SCBA) as required equipment on certain vessels. These SCBA must be of the pressure-demand, open-circuit type, approved by the Mine Safety and Health Administration and by the National Institute for Occupational Safety and Health. They must have a full facepiece and an air supply of at least 30 minutes. SCBA not meeting these criteria may be allowed to remain on board, depending on the grandfather clause in the applicable subchapter. Replacements for grandfathered SCBA must be as described above.

b. Fresh air breathing apparatus. Such appliances approved under 46 CFR 160.011 were required equipment on most tankships. They may continue in use until November 23, 1994, if they were part of the vessel's equipment on November 23, 1992, and as long as they are maintained in good condition to the satisfaction of the OCMI. An examination of such appliances should include the following items:

(1) Is the facepiece cracked or is the faceplate lens badly scratched? Is there a loss of flexibility? Is the faceplate lens incorrectly mounted?

(2) Are there breaks in the head straps? Is there a loss of head strap elasticity? Do the head straps have broken or malfunctioning buckles? Do the head straps have excessively worn serrations that may permit slippage?

(3) Are there breathing tubes broken or missing? Do the breathing tubes have loose connectors? Are there missing or loose hose clamps? Is there deterioration? (The inspector should stretch the tubes and look for cracks.)

(4) Are the crank bellows hose connections tight? Is there a crank available? Is operation successful?

(5) The inspector should examine the entire length of the air hose for pliability and signs of deterioration, cuts, or cracks. The inspector should also examine connectors.

(6) Although vessel requirements specify 45.72 meters (150 ft) maximum lengths, fresh air lines of up to 91.44 meters (300 ft) have proven satisfactory in tests.

(7) Fresh air breathing appliances that become unserviceable must be replaced by SCBA described in 46 CFR 35.30-20(c) (1).

c. SCBA. An examination of such appliances should include the following items:

| EXAMINING A SELF-CONTAINED BREATHING APPARATUS (SCBA) |
|---|
| **CYLINDERS** |
| • Is the cylinder fully charged?<br>• Has the cylinder been hydrostatically tested within the prescribed interval?<br>• Does the cylinder show visible signs of corrosion or damage?<br>• Are they properly stowed? |
| **HOSES** |
| • Do they show signs of deterioration?<br>• Are they properly connected? |
| **FACE MASK** |
| • Is the faceplate cracked/badly scratched?<br>• Is there loss of flexibility?<br>• Cracking at edges of seal?<br>• Incorrectly mounted lens? |
| **HEAD STRAPS** |
| • Are there breaks?<br>• Loss of elasticity?<br>• Broken or malfunctioning buckles?<br>• Excessive wear of head harness serrations that might permit slippage? |

**2. Reflectorized Signs**

Prior approval is not required for the use of "Scotchlite" signs on merchant vessels. The Commandant has no objection to the use of reflectorized signs to mark emergency equipment, instructions, and escape routes. However, such signs must comply with the intent and specifics of the applicable regulations governing required markings. The use of reflectorized signs is subject to any special limitations that may be imposed by the OCMI within whose jurisdiction the vessel is inspected.

## G. ELECTRICAL EQUIPMENT

### 1. Cartridge Fuses

On 4 December 1959, 46 CFR 111.53 was amended to require cartridge fuses, if used, to be of a nonrenewable type; however, this requirement is not retroactive. Thus, inspectors must encourage the use of nonrenewable cartridge fuses in all cases. Replacement of renewable link cartridges is only required for those vessels contracted on or after 4 December 1959.

### 2. Marine-Type Lighting Fixtures

The Commandant will accept marine-type light fixtures listed by UL for installation on inspected vessels. However, the Commandant may reject any fixture not considered suitable for a specific application. Submittal of drawings to the Coast Guard for approval is not required for fixtures listed and labeled by UL. However, just because a particular lighting fixture has a UL marine label does not mean that it may be installed anywhere aboard an inspected vessel. For example, in hazardous locations, the fixture must be of suitable explosion proof construction, and must be so labeled. UL listings are divided into three classes, as follows:

a. "Outside," used where the fixture will be exposed to the weather or sea conditions.

b. "Inside-drip-proof," installed in other wet or damp locations.

c. "Inside." Where the regulations permit only incombustible materials in passageways and stairway enclosures, materials such as metal and glass must be used in fixture housings. Cables used to connect UL marine-type lighting fixtures must have UL listed insulation, to ensure that they are suitable for the operating temperatures of the fixtures.

### 3. Television and/or Radio Antennas and Radar Installations

The Coast Guard does not regulate installation of television and radio antennas on vessels. Federal Communications Commission (FCC) inspectors may require changes in an antenna installation if it will likely interfere with the proper operation of the vessel's main radio transmitter or receiver. Television antenna installations on inspected vessels are considered to be under the cognizance of the master or a competent crewmember designated by the master (likewise, the FCC has jurisdiction over marine radar installations). Coast Guard inspections are normally limited to spot-checking for unsafe conditions and overall safety.

## H. LIFESAVING EQUIPMENT

### 1. General Requirements

a. Equipment approvals. The navigation and vessel inspection laws require life preservers, exposure suits, ring buoys, lifeboats, life rafts, and certain other types of lifesaving equipment to be approved by the Commandant. This approval must be granted before the equipment is placed aboard the vessel to fulfill requirements for lifesaving equipment. Tests and inspections of lifesaving equipment at the inspection for certification are prescribed in the various regulations. This section and NVIC 2-63, "Guide for the Inspection and Repair of Lifesaving Equipment," should be used as further guides.

b. Alterations of approved equipment. In every case when lifesaving equipment or appliances directly connected with them, they cannot be manufactured to the approved design or specification; substitutions must not be made until they have been first accepted by Commandant (CG-CVC).

c. Penalties. It has become evident that certain lifesaving equipment has been manufactured and sold under approved labels despite its failure to conform to the material specifications or design, or both, as originally approved by the Coast Guard.

(1) In the past, such equipment failed to function properly in an emergency or was found to be deficient under service conditions. Such practices will not be tolerated. Those found by a Marine Inspector must be brought to the attention of the OCMI and district commander immediately. Steps will be taken to suspend the approval, as provided by 46 CFR 2.75-40 and 2.75-50, or to invoke the various penalties and sanctions provided, including prosecution under 46 U.S.C. 3318(b).

(2) Under 14 U.S.C. 639, manufacturers may be prosecuted for advertising items that have never received Coast Guard approval as having done so.

d. Lifesaving installations and plans for boat deck approvals. These are discussed in the MSM Volume IV, Technical, COMDTINST M16000.9 (series).

(1) The approval of the lifesaving and emergency plan is the responsibility of the OCMI.

(2) Particular attention should be given to lifeboat locations. Lifeboats should be located away from cargo tanks and preferably in a sheltered location. In addition to embarkation concerns, the lowering and retrieval should be considered. Boat location in relation to the ship's propellers is also addressed in the MSM Volume IV, Technical, COMDTINST M16000.9 (series).

e. SOLAS equivalency. The lifesaving equipment requirements in the l983 Amendments to SOLAS may be considered as an equivalent for all U.S. vessels.

(1) Proposals to use the 1983 Amendments to SOLAS may be accepted by the OCMI, without specific Commandant approval in cases where there is a conflict between the U.S. regulations and the 1983 Amendments to SOLAS.

(2) Lifesaving equipment provided in accordance with SOLAS requirements must still bear a Coast Guard approval number if it is an item subject to approval under 46 CFR Part 160.

---

**2. Lifeboats**

a. Recertified lifeboats. Requests for a reduction in the number of persons a lifeboat is certified to carry are sometimes made to avoid overloading the davits, or because the owners do not wish to equip a boat with food and water beyond the requirements for the personnel aboard the vessel. In such cases, the OCMI may accept such a request if the following requirements are met:

(1) The reduced capacity of the lifeboats is adequate to accommodate the personnel aboard.

(2) The old capacity painted on each bow and the thwarts is deleted and replaced by the new capacity.

(3) An additional nameplate is affixed to the bow, showing that it has been recertified for a different number of persons. The plate must also contain the boat's serial number, date of change, port, and the inspector's initials.

(4) The Certificate of Inspection (COI) for the vessel is amended.

(5) A request for an increase to the original number of persons for which a lifeboat was approved should be handled similarly. However, the weight of the fully equipped and loaded lifeboat must not exceed the approved working load of the davits. The lesser capacity that was painted on each bow and the thwarts must be deleted and replaced by the greater capacity. The original nameplate showing the

reduced capacity must be removed and the vessel's COI must be amended to reflect the increased lifeboat capacity.

b. Lifeboat releasing gear**.**

(1) Mills-type. The Mills-type releasing gear was approved on 12 January 1943 for installation by the Imperial Boat Co.

(a) This releasing gear has no retaining device to prevent the accidental release of the hook attachment if the lifeboat should become momentarily waterborne during launching operations in rough seas.

(b) When such arrangements are found on a vessel, they must be corrected. One satisfactory remedy is to weld a small flat bar to the cheek plate of the lower block.

(2) Steward-type. The Steward-type releasing gear presents problems similar to the Mills-type releasing gear. It should be likewise checked during each inspection.

(a) Retaining devices attached to installations of this type have been found in defective condition or entirely broken off due to neglect or misuse.

(b) New retaining devices, similar to those originally approved for this type of gear, should be installed when unsatisfactory conditions are found.

(3) Rottmer-Type. In some instances, examination of the Rottmer-Type of gear has revealed that lifeboat footings had been placed over the releasing gear lever for the disengaging apparatus. This arrangement required the lifting of the footings before the releasing gear could be operated. This practice is unsafe and requires correction.

(a) A clear, open space must be provided in the way of the releasing gear lever. The footings must be removed from this space and should be well secured elsewhere in the lifeboat until the lifeboat has been launched and is clear of the ship. A stenciled notice to this effect must be placed on the footings.

(b) At all annual inspections of Rottmer-type installations, particular attention must also be directed to the center pieces of the universal joints in the releasing mechanism. If the center pieces indicate any undue stress, such as bent lugs or hairline cracks, they must be replaced with center pieces made from solid bronze.

(c) The upper and lower guide bearings of the releasing gear should be thoroughly lubricated. The entire releasing mechanism must be tested for satisfactory operation. Ship personnel must be instructed to lubricate the upper and lower guide bearings periodically.

4. Installations in existing lifeboats. When releasing gears are to be welded to the stem, sternpost, or keel of an existing lifeboat, the welding details must conform to the approved drawings for the new installation.

(a) The welding must be performed by a qualified welder.

(b) The plating must be removed in way of welds to permit the welder to have a clear lead, and to ensure a proper weld.

(c) All galvanized surfaces within 5 cm (2 inches) of the work area be ground to bare steel.

(d) Areas in the way of the welded and ground surfaces must be given two coats of "red lead," zinc chromate, or a similar coating.

c. Hand-propelled lifeboats. These are fitted with hand-operated propelling gear that meets the requirements set forth in Regulation 10, Chapter 3 of the SOLAS Convention. They should not be confused with motor lifeboats, which have different specifications and requirements under SOLAS. An oar-propelled lifeboat does not qualify as a hand-propelled lifeboat.

d. Steel wire sea painters. The Commandant does not approve the use of steel wire in lieu of manila line for sea painters. Such wire is not as easy to handle, may be difficult to release under tension, and can develop short ends of wire ("fishhooks") that are injurious to bare hands.

e. New nameplates for lifeboats. When a lifeboat nameplate is no longer legible, the inspector must require it to be replaced.

(1) The new plate should normally be obtained from the manufacturer of the lifeboat, and should be similar to and contain the same information as the original.

(2) When the replacement cannot be obtained from the manufacturer, a new one should be fabricated under the cognizance of the OCMI.

(3) The inspector must check the installation of the new nameplate, make an appropriate entry in the vessel's inspection files, and stamp the new nameplate

with his or her initials. The replacement plate should be made of brass or bronze, and stamped as follows:

| | | | |
|---|---|---|---|
| Manufacturer's Name | | | Serial No. |
| Length | Beam | | Depth |
| Capacity | Cu. Ft | | Persons |
| Air Tanks | Cu. Ft | | Built |
| Weight of Boat in Condition A | | | and Condition B |
| REPLACEMENT NAMEPLATE | | | |
| Inspector | | (initials) | CG Port |
| Date | | | |

f. Plastic buoyancy units. Accepted plastic buoyancy units must be used to replace metal air tanks in lifeboats used on inspected vessels. These units are accepted on the basis of samples, plans, and affidavits submitted by the manufacturer; tests of the product by the Coast Guard; and a check of the manufacturing procedure by the MSC. When authorized by the Commandant, the MSC may issue an acceptance letter to the manufacturer. Such units are not given approval certificates.

(1) Nameplate. Inspectors may recognize accepted units by the nameplate in the following format:

Type (or Model) _____
Lifeboat Buoyancy Unit
Cu. Ft. _____ Date _____
Wgt
Name and Address of Manufacturer
_____
_____

(2) Acceptance requirements. Plastic buoyancy units may be accepted for use in lifeboats, subject to the following two conditions:

(a) When used as replacements for metal air tanks in existing lifeboats, the buoyancy units must be the same size and shape as the metal tanks they replace.

(b) Each installation must be satisfactory to the cognizant OCMI.

g. Repairs to built-in side tanks by foam-in-place materials. Certain types of these materials, such as rigid polyurethane, have been authorized for use in repairs to lifeboats with built-in side tanks, as well as for other types of lifeboats, when accepted by the OCMI. Such repairs must be made in accordance with NVIC 2-63.

---

3. Life Rafts, Lifefloats, **a**nd Buoyant Apparatus

a. Repairs and reconditioning. No lifefloats or buoyant apparatus may be repaired or rebuilt for use on inspected vessels without having the original builder's nameplate affixed.

(1) This plate must contain the initials of the Marine Inspector who passed the equipment.

(2) Lifefloats or buoyant apparatus must be examined by a Marine Inspector before any repair or rebuilding to determine what work is necessary. If considered necessary, the canvas wrapping may be required to be completely removed for examination of the buoyant material.

(3) Periodic inspections must be made as the work progresses; a final inspection must be made when the work is completed.

(4) Any lifefloat or buoyant apparatus requiring complete or partial recovering or renewal of the wooden platform must have an additional nameplate affixed that bears the following data:

REBUILT BY
(Name and Address of Company)

_____

_____

_____

Date _____

Inspected by (Inspector's initials) _____

(5) Lifefloats or buoyant apparatus requiring only painting, renewal of netting, lines, seine floats, etc., must not be fitted with this additional nameplate. All materials used and procedures followed must conform to the specifications in 46 CFR 160.027 or 160.010, as applicable.

(6) When large numbers of lifefloats or buoyant apparatus are reconditioned, at least one in every lot of 25 must be subjected to a drop test and a buoyancy test, as described in the applicable specification.

(a) When small lots are reconditioned, one of the items should be tested in this way.

(b) If the inspector determines that the condition of the renovated equipment is adequate, the drop and buoyancy tests may be dispensed with. However, the inspector must require all such tests as deemed necessary, regardless of the number of floats or buoyant apparatus involved.

(c) See NVIC 12-61 for the inspection procedures for approved inflatable life rafts that have been stored for extended periods of time since their manufacture or last servicing.

b. Substitutions for lifeboats.

(1) For vessels not making international voyages, 46 CFR 33.07, 75.10-25, 94.10-55, and 192.10-55 permit substitutions of inflatable life rafts, in varying quantities, for other types of life rafts, lifeboats, and buoyant devices. When substitutions are made in accordance with these provisions, a vessel must be equipped with the following:

(2) Each side of the vessel must have one or more davit-launched inflatable life rafts of sufficient capacity to accommodate the total number of persons aboard.

(3) Each side of the vessel must have at least one launching device, the operation of which must require no one to remain aboard. Installations must meet the requirements of 46 CFR 75.27 and 75.37.

(4) Sufficient float-free inflatable life rafts to accommodate at least half of all persons aboard. On vessels with after and forward accommodation spaces, these rafts must be divided between the two spaces in proportion to the number of persons normally berthed at each location.

c. Alternate arrangements. On vessels where persons aboard have an escape route that will not require them to board inflatable life rafts by entering the water or descending farther than 4.5 meters (14.9 feet), float-free inflatable life rafts may be substituted for the davit-launched rafts and launching equipment. In addition, a motor-propelled rescue boat, suitable for ocean launching by no more than 3 persons with a davit or other suitable gear, may be accepted in lieu of one lifeboat aboard vessels of 1,600 GT or smaller.

d. Liferaft launching apparatus. The number of raft launching devices installed on the vessel and the number of rafts assigned to each launching device must be sufficient to put all persons aboard the vessel into life rafts in the water in no more than 30 minutes in calm weather.

(1) Rafts must be distributed equally on each side of the vessel. They must be stowed in the immediate vicinity of the launching devices, protected from weather and damage.

(2) Operation of launching devices must not interfere with embarkation aids and emergency lighting.

e. Requests for substitutions. Under the regulations, all requests for substitutions aboard vessels of 3,000 or more GT must be forwarded to Commandant (CG-CVC) for consideration.

(1) OCMIs should inform vessel owners and operators that the Commandant will review any request for substitution in light of these requirements.

(2) For vessels not making international voyages, equipment that meets equivalent standards are acceptable.

---

**4. Life Preservers**

a. Cork and balsa wood preservers. The SOLAS Convention requires a life preserver capable of supporting the wearer's head and turning an unconscious wearer face-up in the water. Cork and balsa wood life preservers manufactured under 46 CFR 160.003 and 160.004 do not meet these requirements.

(1) Manufacture of these life preservers ended on 1 July 1965, and all approvals for these items have been terminated.

(2) Cork and balsa wood life preservers manufactured prior to 1 July 1965 must have been retired from service by March 11, 1999, regardless of whether or not they remain in serviceable condition.

(3) Cork and balsa wood life preservers may not be used on any passenger, cargo, or tank vessel built or contracted after 26 May 1965 that is engaged in international voyages and is subject to SOLAS. Further, they may not be cleaned or repaired.

b. Numbers of preservers required. On tank, cargo, and miscellaneous vessels, the OCMI must require one life preserver for each person carried, plus an additional life preserver for each person on watch in the engine room, pilothouse, and the bow lookout station. For example, if the total number of persons carried on a vessel is 43, with three persons carried on watch on the bridge and three on watch in the machinery space, the entry on the COI must be: "50 life preservers, adult."

c. Stowage on tank, cargo, and miscellaneous vessels. Life preservers must be stowed aboard these vessels in accordance with applicable regulations. For additional life preservers provided for watchstanders in the engine room, pilothouse, and bow lookout station, any method of stowage that reasonably meets these requirements must be accepted (i.e., they must be stowed so as to be readily accessible).

d. Stowage on small passenger vessels. Life preservers must be stowed aboard "T-boats" in accordance with 46 CFR 180.78. An appropriate number of these life preservers must be stowed so as to be readily accessible to all hands at their operating stations.

e. Alternate marking for certain life preservers. Standard adult kapok and foam life preservers have been tested and determined to be suitable for children over 1.45 m (57 in) tall or weighing over 34 kg (75 lb).

(1) NVIC 14-92 specifies the manufacturers, model numbers and Coast Guard approval numbers affected by this determination. Since, for standard designs, the 1.45 m/34 kg (57 in/75 lb) cutoff has now superseded the old limit of 41 kg (90 lb), manufacturers will be incorporating this change into their required device markings.

(2) The new markings for these select models will now state that these devices are "approved for use on all vessels by persons over 57 in tall or weighing over 75 lb." These alternate markings supersede those previously required by 46 CFR 160.002 and 46 CFR 160.055.

f. Military-type life jackets. The military-type life jacket differs markedly in construction from that of the commercial, Coast Guard approved type. It has numerous leg and collar straps, removable pads in zippered compartments, and twice the number of strap adjustments. Also, the envelope, webbing, and tie tapes are not mildew inhibited. Finally, they are not generally available through commercial sources except as government surplus equipment; as such, their true condition will be questionable. Military-type life jackets are not Coast Guard approved and may not be used in lieu of Coast Guard approved Personal Flotation Devices (PFDs). For the use of military-type life jackets aboard Military Sealift Command (MSC) vessels and

Department of Defense (DOD)/National Aeronautics and Space Administration (NASA) instrumentation vessels.

---

5. Exposure Suits

   a. Walk stations. Certain vessels operating in ocean, coastwise, and Great Lakes service are required to carry exposure (survival) suits for all personnel on board, plus additional suits for each work station, except where quarters are readily accessible.

   (1) There is a difference in wording between the "work stations" requirement for exposure suits and the "persons on watch" requirement for life preservers. The older language for life preservers ignores the possibility that people may be on watch or at work in locations away from their quarters other than in the pilothouse, engine room, or the bow lookout station.

   (2) For non-typical vessels, such as an oceanographic research vessel with on board laboratories or a service vessel with shop facilities, each work station must be evaluated to determine the number of exposure suits required for persons who work there, but do not live in adjacent quarters. The logic behind each calculation of exposure suits required should be documented in the local vessel file.

   (3) Although many vessel regulations still use the term “exposure suit,” the current approval category for these suits is “immersion suit” and the terms may be used interchangeably.

   b. Exposure suits in exempt areas. If a vessel normally operates in an exempt area, but its COI does not restrict operations to the exempt area the COI must be endorsed to require carriage of exposure suits when the vessel is operating in an area where exposure suits are required. The purpose of such suits is to prevent hypothermia through the use of closed-cell foam insulation and watertight integrity of the suit. They should be inspected during the vessel inspection to ensure that they will perform adequately.

   c. Exposure suit drills. 46 CFR 97.15-35 and 46 CFR 199.180 require the master to ensure that each crewmember wears an exposure suit in at least one fire and boat drill per month. The master may conduct lifeboat drills without requiring the donning of exposure suits at his or her discretion, based on existing conditions. However, if the wearing of exposure suits is not required at lifeboat drills, the master must conduct an exposure suit drill immediately afterward.

d. Scope of drill. An effective exposure suit drill requires each crewmember to don a suit and receive a training lecture. Following the donning of the suits, the master should have two or three crewmembers perform some relevant physical action, such as moving a life raft, to demonstrate the reduced mobility while in such suits. Such exposure suit drills ensure that--

(1) Each crewmember can don an exposure suit properly;

(2) Each suit is in satisfactory condition and fits properly; and

(3) The correct number of suits is aboard.

e. Unapproved exposure suits. A number of questions have been raised regarding unapproved exposure suits that are identical to approved suits except for lack of inflatable collars. The inflatable collar is not necessary for buoyancy, but keeps the wearer's head in a more upright position. This is considered to lessen the wearer's fatigue and, therefore, increase the wearer's chances for survival.

(1) As the inflatable collars are not essential to the buoyancy of an exposure suit, existing suits that do not have them should be accepted for purposes of compliance with 46 CFR 94.415(d). This regulation permits unapproved suits in use before 1 November 1980 to remain in service if they are otherwise similar to approved exposure suits.

(2) Owners of suits that can be altered by attaching inflatable collars should be encouraged, but not required, to provide them.

---

## 6. Davits, Winches, and Falls

a. Boat falls. The Commandant has no objection to the use of nylon or polypropylene line for lifeboat falls, provided that the requirements of 46 CFR 33.10-10, 46 CFR 75.33, or 46 CFR 94.33 (as appropriate) are met.

(1) All installations must be acceptable to the OCMI.

(2) Installation tests must demonstrate that the operation and handling properties of such line are satisfactory for the purpose; strength comparable to the original manila line is required.

(3) Polypropylene line is acceptable as a substitute for manila line on a size-for-size basis. Both polypropylene and nylon should have black or blue pigments dispersed in them to resist ultraviolet sunlight deterioration.

(4) 3-inch circumference polypropylene is acceptable in lieu of 3-1/2 inch manila. Stainless steel wire is not acceptable.

b. Lifeboat winch system over-ride clutches. If a winch is observed to be operating in an unsatisfactory condition, an internal examination of the over-ride clutch system should be required by the inspector.

(1) Examples of unsatisfactory winch operation could include—

(a) If the winch's hand brake is allowing the load to slip or fails to stop a load when hoisting either by power or hand-cranking; and

(b) If the winch's hand break is failing to stop a load when lowering a load under the force of gravity.

(2) In general, it would be unreasonable to expect Coast Guard inspectors to perform anything more than a cursory examination of the internal workings of over-ride clutches. The focus of the inspector's attention should be on the operational performance of the lifeboat winch system.

(3) Once a faulty over-ride clutch has been identified by an inspector, action to correct its defects will require the participation of factory experts and servicing technicians.

(4) After overhaul of a faulty clutch mechanism, the presence of a Marine Inspector will again be necessary to observe that the problems have been corrected.

c. Davit stopper-bars for gravity davits. A primary concern in the arrangement of davit stopper-bars is their ability to be unshipped without having to raise the boat by handcrank or electric power.

(1) An acceptable arrangement is one in which the stopper-bars are freed simultaneously with the gripes, as the bars pivot at one end and swing outboard parallel to the tracks when released by a lever on each davit arm. Free and unimpeded lowering from the stowed position must be ensured.

(2) Certain arrangements have been proposed to reduce the likelihood of damage by raising the davits against a stopper-bar in place. These should not be used because the stopper-bar cannot be freed easily if the davit arm bears upon it.

(3) Clips that do not permit the stopper-bars to be unshipped without lifting the lifeboat are unauthorized modifications to approved equipment, contrary to the regulations, and should be removed whenever found.

d. Fiege wire sockets. A fiege clevis socket assembly is installed by seizing the wire near the end, driving a sleeve onto the rope, unlaying the end of the rope, fanning out the strand ends, cropping the hemp core, inserting a tapered fluted plug between the strands, and driving the plug to a solid seat inside the sleeve. The strands are compressed between the plug and sleeve by the tightening action of a covering socket, after which the seizing is removed. There is an inspection hole in the side of the socket through which the wire can be viewed to see if it is fully in place.

(1) Marine Inspectors must pay close attention to these sockets. Inspection of fiege clevis sockets must include a determination as to the tightness and condition of the sleeve and a sighting of the inspection hole to ensure that the wire is well up into the socket.

(2) If the sleeve is found to be loose or worn, the fitting should be removed and inspected, the wire cropped, and the socket refitted. If the sleeve is worn or distorted, it should be renewed. Care should be taken that the new sleeve is sufficiently long, or has been fitted far enough back on the wire, that the wire end extends to the limit of the socket cavity. The fitting should be proof tested after installation.

(3) For further details, see the Aids To Navigation Manual - Seamanship.

(4) The use of fiege fittings is discouraged. Poured sockets and swaged fittings are more reliable when made up professionally and load tested before use.

e. Davit span wires and manropes. Gravity and mechanical davits are required to have manropes suspended by a davit span wire. However, for davits used for launching enclosed lifeboats, the davit span wires and manropes may be omitted, as they cannot be properly used.

f. Limit switches for gravity davits. Under 46 CFR 160.0153 (k) (2), limit switches must be installed on all gravity davits. Their purpose is to bring the davit winch to a stop before the davit arm strikes the inboard limit of its travel. The final 12 inches of travel are then hand cranked. This avoids straining or breaking of the falls.

(1) Under 46 CFR 160.0153(i), the safety factor provided by limit switches is necessary on gravity davits whether the motors for their winches are built-in or portable.

(2) The use of a portable powering unit (such as an air or electric drill) does not exempt a gravity davit from the requirement for two limit switches.

---

7. **Considerations for Lifeboat Handling Equipment**

a. Blocks. The sheave enclosures of lifeboat davits and the blocks of their falls require regular examination for evidence of corrosion and excessive sheave clearance. This must include the floating blocks and the lower part of the tackle attached to the lifeboat.

(1) In one reported casualty, extensive corrosion of the steel becket strap on an upper tackle block caused the strap to part when the lifeboat was swung out for a drill. Outwardly, the block appeared satisfactory; however, the strap behind a cheek plate had wasted away. Hidden corrosion of this kind can be detected only through close examination and hammer testing.

(2) If the clearance between a sheave and its enclosing cheek plates is excessive, an opening may exist in which the wire rope fall can become wedged. Sheaves on the davit arms and tackles should be viewed through the opening of the enclosure to determine if this condition exists. If so, it is sufficiently serious to require corrective action.

b. Gravity davits. Examination of gravity davits aboard one vessel revealed an incorrect coil retainer replacement that might have short-circuited the master control switch and a rearrangement of the controller wiring that might have rendered operation of the limit switches useless. As a result, power to the hoisting motor could have been secured only by opening the emergency disconnect switch. It was also reported that trackway switches were so gummed by paint that the springs that would normally return them to the open position were unable to operate, wheels on the limit switch arms were frozen with paint and rust, rollers on the davit arms were frozen with rust, and that the lettering on the various switches indicating "on" and "off" positions were obliterated by paint. Inspectors must be satisfied that the ship's crew maintains gravity davits in safe operating condition (see 46 CFR 111.95-7 concerning main line emergency disconnect switches, master switches, and limit switches).

c. Rottmer-type releasing gear on Globe American Lifeboats. During World War II, the Globe American Corporation manufactured many 24 by 8 foot steel, oar, and motor propelled lifeboats with built-in tanks. These lifeboats were fitted with Rottmer-type releasing gear, manufactured under license, and most were installed aboard "Victory" ships. Since the war, some of these lifeboats may have found their way to other types of vessels.

(1) The Globe American releasing gear employed the use of so-called "aluminum bronze" for the hook lock, upper guide bearing, and lower guide bearing. This particular alloy has an ultimate tensile strength exceeding 100,000 pounds per square inch, but is subject to stress corrosion cracking in the marine environment. This cracking, not always readily discernible, may cause failure of the gear with only the weight of the light boat on the hooks.

(2) Requirements. Vessels fitted with 24-foot Globe American lifeboats must have all Rottmer-type releasing gear carefully inspected at each inspection for certification. This inspection requires complete dismantling so that all parts of the gear may be carefully examined. Of particular concern are the hook lock and the upper and lower guide bearings. Any fracture in these items, however slight, is sufficient cause for replacement of the part. Such fractures must not be brazed; any part found to have been previously repaired by brazing must be replaced.

---

8. **Upkeep of Wire Lifeboat Falls**

a. A review of casualties involving lifeboats and associated equipment has revealed a number of material problem areas. Failure of wire lifeboat falls accounted for more than 50 percent of these casualties. Recent statistics show that the number of casualties involving the failure of wire lifeboat falls is increasing.

(1) The most common cause of wire fall failure is lack of maintenance in areas that are normally inaccessible. Careful examination of these casualties showed that falls parted at inaccessible points in the vicinity of sheaves and guards, or where they remained stationary on the davit sheaves.

(2) Additionally, wire falls may be exposed to severe atmospheric conditions, frequent inundations by salt water and spray, and corrosive soot and stack gases. These elements combine with uneven wear to promote excessive deterioration of lifeboat falls.

b. Maintenance and lubrication. Wire rope falls must be free of broken strands and damaging corrosion, and must be well lubricated along their entire length. Particular attention should be paid to areas where the falls pass through blocks, sheaves, and other obstructed areas.

(1) The exposed portions of the wire falls can be lubricated without lowering the lifeboats. However, in places where falls are hidden by blind sheaves or guards, they cannot be properly lubricated without lowering the lifeboats and exposing all sections of the wire rope.

(2) Wire rope that has a fiber core may absorb moisture, which causes internal corrosion.

(3) Even after lowering the lifeboats, there may be sections of the wire rope that do not move and where it is impossible to lubricate the surface riding hard against the sheave.

**(**4) Lubricating options. One way to lubricate unexposed areas of the wire lifeboat falls is to lower the boat a few feet so that these critical spots are clear. Another is to take the load off the falls and free them from the hidden areas in the blocks. These parts of the wire rope should have lubricant thoroughly worked into and completely around the strands. The best lubricants are lightbodied compounds, with rust inhibitors, that have good penetrating properties. These lubricants can be dipped, swabbed, or sprayed onto the wire rope.

c. All lifeboat falls must be thoroughly examined at least once every 2 years. The Marine Inspector must require the lifeboat to be cradled or stopped off with the load taken off the falls.

(1) The surface of the wire rope must be checked for wear and for the presence of "fishhooks" or splinters. A marlinspike can be passed into the lay of the wire and backed to expose the interior of the wire rope.

(2) If there is any doubt about the condition of the falls, they must be replaced.

(3) If the falls are deemed satisfactory for continued service, but there is some question as to their maintenance in those areas that have been in contact with sheaves or covered by guards, the falls should be end-for-ended.

(4) If it is more practicable to cut a few feet from the standing end of the wire falls to reposition those questionable areas, the inspector may accept this action.

d. Workbooks. All maintenance performed on lifeboat falls should be recorded in the vessel's workbook. The inspector should examine these records to determine the age of the falls and whether any shipboard maintenance has been performed since the falls were last renewed.

9. **Hydraulic Starting Systems for Survival Craft**

a. Good safety practices require lifesaving equipment to be properly maintained and ready for immediate use.

(1) Under the regulations, the motors of lifeboats aboard inspected vessels must be operated for at least 5 minutes, once a week (see 46 CFR 33.01-15, 33.25-20, 78.17-60, 97.15-45, and 196.15-45).

(2) Certain motor lifeboats and survival capsules are equipped with hydraulic starting systems that store power in pressurized accumulators. Occasionally, a system leak occurs when an accumulator loses pressure and becomes ineffective. If the leak is external and allows oil to be lost from the hydraulic system, pumping may not restore system pressure and starting of the engine will be impossible.

b. Inspection requirements. Masters and Persons in Charge should routinely examine such hydraulic systems during weekly fire and boat drills to ensure that they do not have leaks that allow the accumulators to discharge.

(1) Each accumulator should be at full pressure at the conclusion of the engine test and not lose pressure between tests. A short-term check of the system can be made by bringing the accumulator up to full pressure. After several hours, there should be no noticeable loss registered on the pressure gauge. A minimal interval of 4 hours between tests is recommended, although a 24-hour interval is more effective.

(2) Marine Inspectors must check the condition of the hydraulic systems of lifeboats and survival capsules during regular inspections.

---

**10. Emergency Water and Provisions for Survival Craft**

Emergency water, provisions, and condensed milk, like all other items of survival craft equipment, are required to be “of good quality, efficient for the purpose they are intended to serve, and kept in good condition.” Emergency water, provisions, and canned milk that are overage or in leaking, rusting, bulging, or otherwise damaged containers do not meet these standards and must be replaced.

a. Emergency water. Canned water should be checked for vacuum retention by the slap test. Any clicking sound is evidence of an acceptable vacuum.

(1) Doubtful cans can be checked by opening some of them. If a hiss is heard consistently as these cans are opened, the rest of the doubtful cans may be accepted, and only the opened cans need to be replaced.

(2) Water in flexible pouches should be checked by squeezing the pouch. Any leaking water or air is cause for rejection.

(3) All approved water containers are marked with a packing date, and some may have an expiration date. All containers past their expiration date should be replaced. Containers without an expiration date should be replaced if they have been packed more than 5 years before the date of inspection.

(4) Lifeboats meeting the 1983 SOLAS Amendments (those with approval numbers starting with "160.135") must carry 3 liters (3.17 quarts) of water per person.

(5) Inflatable liferafts meeting the 1983 SOLAS Amendments (those with approval numbers starting with "160.151") must carry 1.5 liters (1.58 quarts) per person.

(6) Approved desalting apparatus may replace up to 1/3 of the water carried in survival craft. In addition to chemical treatment systems, manually operated reverse osmosis desalinators are approved to replace the quantity of water they are rated to produce in 48 hours, up to the limit of 1/3 or the water required.

b. Emergency provisions.

(1) Canned emergency provisions can be checked only by visual examination of the condition of the container.

(2) Emergency provisions in vacuum-packed flexible pouches should have packaging material tightly compressed against the contents. Loose contents indicate a loss of the vacuum seal, and such pouches should be replaced. Non-vacuum-packed pouches should be squeezed to check for air leakage, as with flexible water pouches.

c. Expiration dates. Approved emergency provisions are marked with a packing date, and some may have an expiration date.

(1) All packages past their expiration date should be replaced. Packages without an expiration date should be replaced if they are more than 5 years old.

(2) Canned provisions with no dates are well over 5 years old and should be replaced. None of these undated cans were vacuum-packed, therefore air in the container will cause fats in the provisions to turn rancid over time.

(3) If an operator objects to the rejection of old provisions, the operator should be given the option of submitting a sample of the provisions in question to a food laboratory to determine fitness for human consumption.

(4) Lifeboat regulation. Lifeboats that meet the 1983 SOLAS Amendments (those with approval numbers starting with "160.135") must carry provisions equaling at least 10,000 kJ (2,400 calories) per person.

(5) International liferaft regulation. Inflatable liferafts with "SOLAS A" Packs that meet the 1983 SOLAS Amendments (those with approval numbers starting with "160.151") must carry provisions equaling 10,000 kJ (2,400 calories) per person.

(6) Calorie counts. In order to be consistent with new SOLAS requirements, many emergency provisions will be packed in sizes other than multiples of 3,600 calories (1 lifeboat ration) and 1,800 calories (1 liferaft ration). Total calorie counts, rather than package counts or weights, should be used to determine the minimum amount of provisions required.

(7) Emergency provisions have approval numbers starting either with "160.026" or "160.046." Both are acceptable and may be used interchangeably.

(8) Canned condensed milk. Unless otherwise indicated on its container, canned condensed milk is not intended for long term storage and should be replaced each year during the annual stripping and cleaning of the lifeboat.

(a) An operator may be given the option of submitting samples to a food laboratory for determination of fitness for human consumption if the operator feels that the milk can be carried for an additional year.

(b) An operator should also be given the option of replacing canned condensed milk with approved emergency rations, using 1,400 calories as the equivalent of 1 lb. of canned milk.

(c) Lifeboats meeting the 1983 SOLAS Amendments are not required to carry condensed milk.

c. Substitutions. Lifeboats other than those meeting the 1983 SOLAS Amendments should not be permitted to substitute the 1983 SOLAS emergency water and provision quantities unless all equipment in the lifeboat is to the 1983 SOLAS Amendment Standards. Substitutions should not be made in inflatable liferafts, unless they are part of an approved modification to the manufacturer's servicing manual.

## I. FIRE PROTECTION EQUIPMENT

### 1. Introduction

Tests and inspections of firefighting equipment during the inspection for certification are prescribed in the regulations. The regulation covers situations requiring particular attention or further explanation.

NVIC 6-72 and its Change 1 provide additional guidance for the design and review of fixed firefighting equipment aboard merchant vessels. In particular, Change 1 specifies the conditions under which Halon 1301 extinguishing systems are equivalent to $CO^2$ systems. For several years, small Halon 1301 systems have been approved for use on recreational boats and on uninspected vessels such as tugs and fishing vessels. These units are so marked and bear an approval No. "160.029/--/--." Halon 1301 is not a hazardous vaporizing liquid, so it is not prohibited by 46 CFR 25.3010(e). Halon 1301 is approved under 46 CFR 25.15 as equivalent to the $CO^2$ system required by 46 CFR 25.3015(a). These systems should be installed in accordance with approved manufacturers' installation manuals.

Fixed mechanical foam systems are required to have a foam analysis completed to certify that the foam concentrate remains within acceptable parameters established by the manufacturer. At each Inspection for Certification, it is incumbent upon the vessel owner/operator to obtain documentation from the foam manufacturer or his authorized representative that details the specific gravity, pH, percentage of water dilution and solid contents of the foam. The documentation must also certify that the foam is suitable for firefighting per requirements detailed in 46 CFR 31.10-18, 46 CFR 107.235(b)(2)(iii), and NVIC 6-72.

### 2. Excess Equipment

a. Inspected vessels. For uniformity in the listing of firefighting equipment carried aboard inspected vessels, the COI must record only the fire hose, fire extinguishers, and other gear required by law and regulations. The recording of excess equipment would effectively compel its carriage on all voyages, even though the regulatory requirements might be considerably exceeded. However, all excess firefighting equipment that is carried aboard an inspected vessel must be of approved types (as required by 46 U.S.C. 3306), tested at inspections, and kept in good operating condition.

b. Uninspected vessels. Under 46 CFR 25.30-5(b), all fire extinguishing equipment aboard uninspected vessels must be of approved types.

---

### 3. Portable Fire Extinguishers

a. Identification. Portable fire extinguishers can be identified as an approved type by the presence of one of the following:

(1) A UL, UL of Canada (ULC), or Factory Mutual Research (FM) label on the extinguisher bearing a marine-type marking such as "Marine Type USCG B-1," "Marine Type USCG Type B:C, Size II," or "Marine Type USCG Type B:C, Size I, Approval No. 162.028".

(2) A make and model number that corresponds to the listing under the manufacturer's name in the "Formerly Approved" section of Equipment Lists.

(3) Extinguishers that cannot be identified as types that are approved or previously accepted on a case-by-case basis must be removed.

b. Coast Guard Certificates of Approval for portable fire extinguishers. The Coast Guard no longer issues Certificates of Approval for portable fire extinguishers. All outstanding certificates were terminated on 1 January 1962. From that date, portable extinguishers have been given approvals based on UL listings. All fire extinguishers manufactured while Certificates of Approval were in effect may be used, provided they are in serviceable condition. However, the use of vaporizing liquid fire extinguishers manufactured after 1 January 1962 is prohibited.

c. Acceptance of UL-listed fire extinguishers. UL-listed fire extinguishers that do not bear Coast Guard marine-type markings are acceptable as equivalent to those bearing such markings, provided that they are of the appropriate types and sizes for their service. NVIC 13-86 provides a table comparing appropriate types and sizes of extinguishers.

---

### 4. Semiportable Fire Extinguishers

a. Substitution. Substitution of a required, minimum sized, semiportable fire extinguisher with smaller units totaling equal or greater capacity is not authorized, because the time required to position and activate a second extinguisher may be too long to prevent a fire from reflashing.

b. Outside use. Footnotes to 46 CFR 34.50-5(c) and 108.495(b) require doubling the quantity of agent if the unit is used outside. This double capacity must be provided by a single unit.

---

**5. Carbon Dioxide Systems**

a. Small passenger vessels and uninspected vessels.

(1) 46 CFR 181.20-5 contains provisions for the use of a single portable or semiportable $CO^2$ fire extinguisher as a fixed system on small passenger vessels, under certain conditions.

(2) Vessels built before 1 June 1958 are permitted to use up to two such extinguishers for this purpose, provided controls were capable of discharging both units simultaneously. These installations may remain in use, provided they are maintained in good condition.

(3) 46 CFR 25.30-15 contains provisions for fixed $CO^2$ systems on uninspected vessels.

b. Potential hazards and means of escape. Fixed $CO^2$ systems pose a potential hazard to vessel personnel and Marine Inspectors.

(1) One casualty at sea, which was given widespread notice in Commandant Notice (COMDTNOTE) 16711 of 23 August 1978, illustrated the need to ensure adequate means of escape from $CO^2$-served spaces. In this casualty, the chief engineer inadvertently discharged $CO^2$ in a space with an inward-opening door. Crewmembers were unable to open the door until pressure in the space subsided, and some were asphyxiated. Similar accidents have occurred during system testing and servicing.

(2) The inspector should ensure that adequate precautions are taken.

(3) During servicing, no one should be permitted in spaces served by $CO^2$ unless all $CO^2$ bottles are completely disconnected.

(4) During inspections, $CO^2$ storage provisions and means of escape must be evaluated. Recommended protective measures include outward-hinged doors, kick-out panels in doors or bulkheads, a stenciled warning to lock the door open when the space is occupied, and sufficient vent openings to the atmosphere.

(5) Regulation 5.1.13, Chapter II-2 of SOLAS 74/78 also acknowledges these hazards by requiring outward-opening access doors in $CO^2$-served spaces aboard subject vessels.

---

**6. Fire Hose**

a. Markings. 46 CFR 34.1010 (l), 76.1010 (l) (3), and 95.1010 (l) (4) includes specifications as to the proper marking and testing of fire hoses.

(1) The prescribed marking consists of the words "Underwriters Laboratories, Inc., Inspected, Rubber Lined (or Unlined) Fire Hose," followed by a serial number. These words must appear on a cloth or rubber label permanently affixed to the fire hose.

(2) If a fire hose does not bear the UL label, the vessel owner must provide the OCMI with certified copies of a test report by an independent laboratory, showing that the fire hose conforms to the appropriate specifications noted in the above regulations.

b. Testing. Questions have arisen over the recommendations of both UL and the NFPA that lined fire hoses never be wetted except for use at a fire. The Commandant believes that the benefits derived from the periodic pressure tests required by regulations outweigh any harmful effects of wetting, provided the hose is properly dried before stowage. Therefore, inspectors should caution shipboard personnel that particular care is necessary to dry fire hoses thoroughly after each wetting to avoid deterioration. All new hoses placed aboard vessels must be tested in accordance with the regulations at regular inspection intervals.

c. Length. UL standards allow some leeway in hose length; designated “50-ft” hoses must be at least 48 feet, and designated “75-ft” hoses must be at least 71 feet. On approximately one out of every ten lengths, a UL inspector will conduct a burst test. The sample used in the burst test will be cut off and used for physical and chemical tests. This sample will not be greater than 40 inches in length.

d. Fire hose. In general, 2-1/2 inch hoses should be limited to use in exterior spaces or large cargo holds, such as on Roll-On/Roll-Off (RO/RO) vessels. When a 4-foot applicator is required at the fire station, only 1-1/2 inch hoses should be used.

e. Defective hoses. Under 46 U.S.C. 3305, a fire hose that is too defective to be repaired must be destroyed in the presence of the inspector.

---

**7. Combination Fire Hose Nozzles**

a. New installations. New installations and replacements of combination nozzles must be of approved types, as required by 46 CFR 34.10-10, 76.10-10, and 95.10-10.

(1) The approved types are listed in the Equipment Lists.

(2) The 1-1/2 inch/4 ft. applicators are intended for use with 1-1/2 inch combination nozzles in propulsion machinery spaces that contain oil-fired boilers, internal combustion machinery, or oil fuel units. Because of orifice sizes on approved nozzles, neither self-cleaning line strainers nor internal strainers are required.

b. Existing installations. Certain combination solid stream and water spray fire hose nozzles were previously accepted, pending development and adoption of new designs. Those installed on vessels prior to the approval of combination nozzles under 46 CFR 162.027 may continue in service, provided that they are in serviceable condition. Self-cleaning line strainers are required with these nozzles, unless they are fitted with internal self-cleaning strainers. The accepted nozzles are--

(1) Types SG-40 and SG-47, manufactured by the Rockwood Sprinkler Co., Worcester, MA; and

(2) FOGNOZL 4-AN and 4-NAP, manufactured by the Akron Brass Manufacturing Co., Inc., Wooster, OH.

---

8. **Fire Main/Foam Cut-Out Valves**

a. Identification. Regulations require that fire main cut-out valves must be sealed open, except when closed to prevent freezing.

(1) The original provisions for cut-out valves and drains in the fire main were intended to prevent freezing in parts of the fire main system located on weather decks. In more clement weather, the cut-out valves were to be kept open for efficient use of the fire main system in event of emergency. With the advent of dual-purpose ships (those built for easy conversion to military use), the trend has been toward the use of cut-out valves to isolate or cross-connect different sections of fire mains. Therefore, a means for quickly identifying that fire main or foam cut-out valves are maintained in an open position has become necessary.

(2) All isolation or cut-out valves should be conspicuously marked and labeled (see 46 CFR 34.10-15(c)). In addition, the fire control plan must show all isolation or cut-out valves, and must be permanently displayed for use in an emergency.

b. Regulatory intent. The intent of the word "sealed" in the regulations is that a seal cannot be easily broken without the use of a key, axe, or chisel, and will indicate that the valve should normally remain open. In addition, it is easy to see whether sealed valves are open or closed. The sealing of these valves in an open position is a function of the vessel's operators. It is not intended that the valves be sealed open by the Marine Inspector. Therefore, the inspector must accept seals provided by the vessel's operators to obtain the results intended by 46 CFR 76.10-10(e) and 95.10-10(e).

---

9. **Sprinkler Systems**

a. Introduction. Many instances have been found where the operation and maintenance of vessel sprinkler systems have not met required standards. Reports of deficiencies for various sprinkler systems show failure in every category, including corroded and shorted electrical fittings; frozen and deteriorated mechanical items; piping that was corroded, completely plugged (including the pump suction line), fractured, and air-bound; plugged sprinkler heads and systems secured at the pump so as to prevent automatic operation.

b. Inspection procedures. On small passenger or excursion vessels, tests and examinations of the sprinkler systems must be made during the inspection for certification.

(1) On large vessels operating on fixed schedules, such tests and inspections may be spread out over the 12-month period under conditions and schedules established by the OCMI and the vessel's owners or operators.

(2) All automatic features of wet or dry-pipe systems must be tested and examined to ensure efficient operation. Each zone must be thoroughly flushed out with fresh water for a sufficient period of time to clear the system of scale and sediment. The flushing discharge must be routed through drain valves, test vents, or openings from which sprinkler heads have been removed. As many drain openings must be provided as necessary to clean the entire system.

c. Examination of sprinklers. Dry-pipe and manually operated sprinkler systems must be thoroughly drained after tests have been completed. Scheduled checks for accumulated water in dry-pipe systems should be made after the vessel is returned to service. Regardless of the system type, a sufficient number of sprinkler heads must be

removed for examination of both the head and piping, with particular emphasis on dropped heads and low branch lines. The conditions found in this examination will determine to what extent additional removals should be made. After checking and examining the heads, the system should be reassembled, inspected, and checked to ensure satisfactory operation.

d. Potential problems and corrections.

(1) If there are closed valves in the system, have the chief engineer chain and lock them open, if necessary. No action of the crew should be necessary for system operation.

(2) If the pump won't come on automatically, consider detaining the vessel until the problem is determined and repaired.

(3) If there is no emergency power to the pump, consider detaining the vessel until emergency power is available.

(4) If the flow sensors are inoperative, thus incapacitating one zone of the fire detection system, the appropriate correction varies. If the vessel has an additional fire or smoke detection system to cover the same area, the appropriate correction is to require timely repair of the problem. If the vessel does not have an additional fire or smoke detection system to cover the same area, consider detaining the vessel and requiring immediate repair.

(5) If the distribution system piping wasted and holed (discovered because system was not charged to the sprinkler heads), consider detaining the vessel and requiring immediate repair of the piping so that sprinkler system can be fully pressurized. If repairs must be accomplished at a shipyard, consider removing passengers and extraneous crew, requiring extra precautions and patrols to protect the crew members who will be remaining on board for the transit.

---

**10. International Shore Connection**

International shore connections are subject to the requirements of ASTM F-1121.

Fabrication either on board a vessel, in a shipyard, or other shore facility is not precluded by the standard.

The ASTM standard does not require any specific marking.

## J. NAVIGATION EQUIPMENT

### 1. Inland and International Rules

Vessels must be equipped with navigation lights and sound-producing devices, as prescribed in 33 U.S.C. 1601-1608 (International) and 33 U.S.C. 2001-2072 (Inland). Penalty provisions are contained in 33 U.S.C. 1608 and 2072.

Vessels operating seaward of the demarcation lines described in 33 CFR Part 80 must comply with the International Regulations for Preventing Collisions at Sea, 1972 (72 COLREGS). The 72 COLREGS became effective on 15 July 1977.

Vessels that are in compliance with the construction and equipment requirements of the International Rules are in compliance with the Inland Navigation Rules Act of 1980 ("Inland Rules"). The Inland Rules, enacted on 24 December 1980, became effective on 24 December 1981, except for the Great Lakes, where they became effective 1 March 1983.

Specifications for lights and sound signal appliances are prescribed in the Navigation Rules, reprinted in Navigation Rules, International - Inland, COMDTINST M16672.2D.

### 2. Navigation Lights

a. Light specifications. Annex I of the International and Inland Rules specifies navigation light requirements in terms of colors, arcs, ranges of visibility, and position.

b. Fixtures. 46 CFR 111.75-17 contains the regulations applicable to electric navigation lights. There are no regulations that specifically prohibit the use of non-electric lights, except where the use of open flames is prohibited. However, the requirement in the regulation for a navigation light indicator panel generally precludes use of non-electric lights.

### 3. Sound Signal Appliances

Annex III of the International and Inland Rules contains sound-producing appliance requirements which are aimed at increasing a mariner's ability to identify targets audibly through the use of different sound characteristics for vessels of different lengths.

The sounds produced by whistles, bells, and gongs should all be distinctive so that they are not confused with each other. The sound produced by most whistles is generally shrill, and is accomplished by forcing a stream of air or steam through a circumferential slot into a cylindrical chamber. The tone and sound of a bell must not be confused with those of a gong. Under the Navigation Rules, a fog horn is no longer specified as part of the signaling equipment. A fog horn may not be substituted for the whistle required by those rules.

a. Electronic sound devices. Annex III 2. (b) specifies that bells must be made of corrosion resistant material and further specifies bell mouth diameter. However, electronic devices which meet the sound requirements may be substituted for the mechanical equivalent if a manual back-up is provided.

b. Fog gongs. The Navigation Rules require fog gongs aboard vessels of 100 or more meters (328 ft.) in length.

   (1) The sound produced by the gong must be easily distinguished from that of the ship's fog bell, at an equally audible range. The gong must meet the specifications in Annex III to the Navigation Rules.

   (2) When there is doubt about the suitability of an instrument, a demonstration must be conducted under the supervision of the OCMI and a report submitted to Commandant (CG-CVC) via the chain of command.

c. Vessels less than 12 meters in length. These vessels are not required to carry whistles and bells that meet the technical standards in Annex III of the Navigation Rules. However, if no such equipment is carried, the vessel must be provided with some other means of making an efficient sound signal. Whistles and other sound-producing mechanical devices (e.g., a Freon-operated horn) may be accepted for use aboard vessels less than 12 meters in length, provided they are in proper working condition and produce an efficient sound signal.

---

**4. Technical Requirements**

Specific requirements for navigation lights, which are similar for Inland and International Rules, are contained in Annex I to the 72 COLREGS and the Inland Rules. Annex III of the Rules provides technical details of sound-producing appliances.

---

## 5. Definitions and Interpretations

The following definitions or interpretations are in addition to those listed in the Navigation Rules (Rule 3 or Annex I):

a. At or near the side of the vessel, in Annex I 3. (b), means not more than 10 percent of the breadth of the vessel inboard from the side, up to a maximum of 2 meters.

b. Existing vessel means a vessel built (keel laid or corresponding stage of construction) prior to the effective date of the 72 COLREGS (15 July 1977) or enactment of the Inland Rules (24 December 1980).

c. Forward masthead light is interpreted as describing either a single masthead light or the forward most masthead light on vessels with more than one masthead light (Annex I 2. (g) or 3. (b)).

d. In front of means forward of. Sidelights may be in line with the forward masthead light, but not in front of it.

e. Length means Length Overall (LOA).

f. Masthead light is used in the Annex for vessels less than 20 meters in length which are unlikely to have 2 masthead lights.

g. Measurements; all vertical height measurements are to be taken from the center of the lens; horizontal measurements are to be taken from or along the centerline of the vessel.

h. Normal conditions of trim in Annex I 2. (b) means all conditions either loaded or ballast for ocean voyages.

---

## 6. Extensions

To facilitate the transition from the old International, Inland, and Western Rivers to the new International and Inland Rules, certain exemptions or extensions were provided.

Rule 38 in both Rules authorized an extension period of 4 to 9 years from the effective date of the Rules to bring the vessel into compliance with some of the more significant rule changes.

The time allowed by these extensions has been considered sufficient to bring existing vessels into compliance. There are no provisions in the Rules for further extensions or exemptions. The Coast Guard does not have the authority, except as provided for under Certificates of Alternative Compliance (CACs), to waive any requirements.

---

**7. Exemptions**

a. There is an exemption available from the requirements of International Rule 23 (a) for certain vessels, provided they comply with the Inland Rule 23 (a) (i) by carrying a masthead light as far forward as practicable. This exemption has been issued to all commercial, recreational and public vessels less than 20 meters which fit into one of the following categories:

(1) Inspected vessels.

(2) Federally documented vessels.

(3) Vessels registered with a state.

(4) Public vessels.

(5) Vessels built in the United States and intended for sale in the United States or its territories.

b. This exemption applies retroactively to vessels built before issuance of this waiver. Specific information about this exemption is contained in COMDTINST 16672.4 of 11 May 1993.

---

**8. Problems in Compliance with Light Requirements**

The new Rule requirements have posed certain problems relative to existing vessels:

a. Ranges. The range requirements for most lights have increased under the Rules. The relationship between range of visibility and luminous intensity has also changed. However, many lights on existing vessels were much brighter than originally required and may meet the new Rules.

b. Color. Color coordinates for green lights have been narrowed from those required for existing vessels. This has resulted in a shift toward a bluish tint in the manufacturing of green dyes for navigation light lenses. The most commonly manufactured green plastic dyes do not have good ultraviolet stabilization; constant exposure to solar ultraviolet radiation will alter the green tint in a few years. This may be beneficial, in that it moves the color coordinates of an older light lens into the region required by the new Rules. It may also move them beyond the acceptable region. Tests will determine the color coordinates of the lens only at the time of testing, as navigation lights are constantly exposed to ultraviolet radiation.

c. Horizontal sectors. Annex I of both sets of Rules gives specific arcs in which certain intensities of light are required.

(1) For example, sidelights, as fitted on the vessel, must show the minimum required intensities in the forward direction. The intensity must decrease to reach "practical cut-off" (i.e., one-eighth of the minimum required sector intensity) between 1 and 3 degrees outside the prescribed sectors.

(2) Prior to adoption of the 72 COLREGS and Inland Rules, lights were "eyeballed" for a reasonable decrease in intensity at the sector boundaries; no values were assigned to the intensity in the cut-off region.

(3) The Rules state that the lights must achieve the specified cut-off as fitted. In the forward direction, the 72 COLREGS require sidelights, as installed, to reach practical cut-off between 1 and 3 degrees outside the prescribed sector. The 72 COLREGS require the intensity between 0 and 1 degree outside the prescribed sector to be greater than the practical cut-off value. This allows both sidelights to be visible dead ahead of the vessel at a distance dependent upon their separation.

(4) This may present a problem for some vessels. For example, containers stacked forward of the sidelights could act as large screens, preventing the 1 degree spillover. A CAC is not appropriate in such cases; the lights should be relocated or the obstruction removed.

d. Vertical sectors. Annex I of both sets of Rules also establishes requirements for vertical sectors of navigation lights. Previously, this parameter was not even considered. Consequently, "existing vessels" may not be in compliance.

e. Masthead separation. Masthead lights must be separated by a horizontal distance of one-half the length of the vessel but need not be more than 100 meters (Annex I 2. (b)).

(1) Most vessels with a midship house were built with the after mast located amidships and will not be able to meet this separation requirement without moving the mast(s). Also, moving the after mast from the midship house to the after house generally requires the after mast to be higher than original to meet height separation requirements. For this reason, Rule 38 exempted vessels under 150 meters (492.1 ft.) and gave larger vessels 9 years to comply.

(2) This extension was made with two-house vessels in mind and in consideration of the economic hardships involved with moving/raising masts. Therefore, CACs should not be granted for masthead separation unless moving the masts would interfere with the special purpose of the vessel.

f. Sidelight placement. Sidelights must not be in front of the forward masthead light (Annex I 2. (g), 3. (b)). This rule also applies to single masted vessels and will require sidelight repositioning on many vessels in the 20-50 meter range. Some vessels (i.e., tugboats, workboats, or fishing vessels) may qualify for CACs due to the special purposes of the vessels.

g. Sidelight screens. Sidelight screens must be painted matte (flat) black to comply with the 72 COLREGS/Inland Rules. Under Inland Rules, a vessel less than 20 meters in length needs to be fitted with screens only if they are necessary to bring the sidelights into compliance with the horizontal sector requirements of the Inland Rules.

---

**9. Certificates of Alternative Compliance (CACs)**

Regulations give provisions for alternative compliance with the 72 COLREGS in 33 CFR 81.5 (International) and 33 CFR 89.5 (Inland). CACs are intended only for U.S. vessels that cannot fully comply with the Navigation Rules. CACs are available for vessels of special or unique design that cannot meet the Rules without interfering with their mission. CACs cannot be used as a means for granting an extension of time for compliance.

a. Issuance of CACs. The authority to issue CACs has been delegated to the chief, marine safety division at each district office for the purpose of permitting closer review of the actual vessel and to make Headquarters available for appeals.

(1) Since the potential for a lack of uniformity between districts exists, communication between districts is strongly encouraged.

(2) Certificates should include the information required in 33 CFR 81.9 or 89.9. A copy of the certificate must be forwarded to Commandant (CG-CVC-2), along with a copy of the *Federal Register* notice required by 33 CFR 81.18. After

review by Commandant (CG-CVC-1), the certificates will be filed with Commandant (CG-PSA).

(3) Any questions or unusual cases should be referred to Commandant (CG-PSA)for Rules (both Inland and COLREGS) interpretation, Commandant (CG-CVC-1) for inspection and compliance, or Commandant (CG-ENG-3) for technical assistance and fixture approvals.

b. Class certificates. When an owner has several vessels of the same general configuration which would qualify for a CAC, a class certificate may be issued. For a class certificate, the CAC should be issued listing a representative vessel name and class with an addendum listing all other vessels in the class. The vessel owner is responsible for posting certified copies of the certificate on the bridge of each vessel.

c. Typical vessel types.

(1) Offshore Supply Vessels (OSVs). The majority of CACs have been issued to OSVs where full compliance would have required placement of the after masthead light on the centerline between the midpoint of the vessel and the stern. This would severely interfere with the vessel's purpose.

(2) Tugboats, workboats, and fishing vessels. The forward mast (or only mast) of smaller workboats, like tugs and fishing vessels, is often required to be located behind the deckhouse due to the special nature of the vessel. Full compliance would require placing sidelights aft of the foremast. This could present glare problems or otherwise interfere with the special nature of the vessel. A CAC may be issued when the vessel owner adequately demonstrates that sidelights are in the closest possible compliance without interfering with visibility or the purpose of the vessel.

(3) Other vessel types. Other vessel types that warrant alternative compliance may include a ferry with an off-center deckhouse, an aircraft carrier, or certain Mobile Offshore Drilling Units (MODUs).

**10. Compliance Responsibility**

Compliance with 72 COLREGS and the Inland Rules is the responsibility of the vessel operator/owner. Under international treaty, each signatory nation is responsible for enforcing the Rules consistently. Therefore, the Coast Guard will take corrective action whenever discrepancies are noted.

---

**11. Inspection Enforcement Action**

Special inspections to determine compliance are not required and Coast Guard resources are generally insufficient to conduct special examinations solely for Rules verification. However, when Rules discrepancies are noted or reported, they must be further investigated. During routine inspections (annual or COI), inspectors should include Rules requirements in the inspection scope and assess compliance by interviewing the master/vessel representative and by visual/audible verification.

---

**12. Compliance Verification**

Individual testing of sound and light appliances, as installed, is the best means of verifying compliance. Obviously, this is not practical in all situations nor is it possible without sophisticated measuring equipment and/or extensive surveys. For example, bells or gongs may comply with the Annex III requirements at the time of manufacture, but placement, mounting, and painting all affect final sound emissions. Therefore, demonstration of compliance will be the owner's responsibility when compliance is in question. The following guidelines for compliance acceptance/examination apply:

a. Foreign vessels. Foreign vessels holding valid SOLAS Safety Equipment Certificates (SECs) will be considered in compliance with the 72 COLREGS, unless obvious discrepancies are noted.

b. Existing U.S. vessels. Existing U.S. vessels will be considered to comply unless obvious discrepancies are noted. Rules inspections will be conducted as a part of regularly scheduled inspections. Special plan review or equipment affidavits will not normally be required for existing vessels.

c. New U.S. vessels. Plan review for new U.S. vessels will include navigation light placement and equipment approvals. Review or approval by ABS is considered acceptable evidence of compliance.

---

**13. Non-Compliance Actions**

Vessels not in compliance should be issued deficiency notifications. Appropriate entries must be made in the Marine Information for Safety and Law Enforcement (MISLE). Deficiencies for foreign vessels and U.S. vessels should be issued via a violation report (MISLE Marine Violation Report Recommendation (MVRR) Product). In general, the unit may issue a letter of warning within the first year of the violation if corrective action is already scheduled. Stronger action may be warranted based on the operator's prior deficiency record, prior notice of the Rule requirements, and/or no planned corrective action. Unless the violation is considered a safety hazard, a reasonable time should be allowed for corrective action (i.e., next drydocking or yard period) before imposing operating restrictions.

### 14. Approved Equipment

Listings of approved navigation light fixtures and sound devices for vessels over 20 meters in length may be obtained from Commandant (CG-ENG). Some approved "white" lights utilize a grayish tint lens to help prevent excess spillover and glare.

## K. MARINE SANITATION DEVICES (MSDS)

### 1. Introduction

Section 312 of the Federal Water Pollution Control Act (FWPCA), as amended (33 U.S.C. 1322), requires marine sanitation devices (MSDs) to prevent the discharge of untreated or inadequately treated sewage into U.S. waters. The FWPCA requires a certified operable MSD on every vessel with an installed toilet. Installed toilets that are not equipped with an MSD, and that discharge raw sewage directly over the side, are illegal. Section 312(g) (2) of the FWPCA directs the Coast Guard to certify MSDs and 33 CFR Part 159 sets out equipment construction and operation requirements. The MSD must be in operable condition to the satisfaction of the Coast Guard boarding officer. A vessel with no installed toilet is not subject to the provisions of section 312 of the FWPCA. MSDs are certified, not approved, for two reasons. First, MSDs are required on all vessels, not only Coast Guard-inspected vessels. Second, MSDs are tested for compliance with the Environmental Protection Agency (EPA) effluent regulations and standards as required by the FWPCA, and do not always meet the Coast Guard marine and electrical engineering regulations of 46 CFR Subchapters F and J. MSD certifications will note whether the MSD is certified for inspected vessels or uninspected vessels.

## 2. Classification

The Coast Guard recognizes three MSD equipment classes. It is vital to recognize that an MSD type is based on the equipment installation. For example, a malfunctioning flow-through discharge device that has a closed overboard discharge valve is not a no-discharge device, it is a broken machine. The three MSD equipment classes are as follows:

a. Type I. A flow-through discharge device that, under the test conditions described in 33 CFR 159.121, produces effluent having a fecal coliform bacteria count no greater than 1,000/100 milliliters, and no visible floating solids. A Type I MSD is commonly a physical/chemical type (macerator/chlorinator).

b. Type II. A flow-through discharge device that, under the test conditions described in 33 CFR 159.121, produces effluent having a fecal coliform bacteria count no greater than 200/100 milliliters and suspended solids no greater than 150 milligrams/liter. A Type II MSD is commonly a biological (aerobic digestion) plant, but several physical/chemical plants are certified as Type II MSDs.

c. Type III. A device designed to prevent the overboard discharge of treated or untreated sewage, or any waste derived from sewage. Most Type IIIs are holding tanks, but there are also vacuum collection systems, incineration systems, recirculation systems, and a composting system.

3. **Applicability**

Vessels with installed toilets must install an operable, certified MSD, as follows:

a. Vessels 65 ft or less in length. Vessels 65 feet or less in length must have a Type I, II, or III device. Type I MSDs are still permitted on new installations because of a Coast Guard waiver issued by *Federal Register* notice on Monday, 10 July 1978.

b. Vessels over 65 ft in length. Vessels over 65 feet in length must have a Type II or III MSD. Type I MSDs are permitted on these vessels only if--

(1) The construction of the vessel was begun on or after 30 January 1975 and the MSD was installed prior to 31 January 1980; or

(2) The construction of the vessel was begun before 30 January 1975 and the MSD was installed before 31 January 1979. (Extended from 1978 to 1979 because of a Coast Guard waiver issued by *Federal Register* notice on Monday, 28 November 1977).

---

**4. U.S. Coast Guard Certification**

Certification questions should be directed to Commandant (CG-CVC). All modifications to certified MSDs must be reviewed and accepted by Commandant (CG-CVC). Initial certification is accomplished in accordance with 33 CFR Part 159 by one of three methods:

a. Label certification. MSDs manufactured after 30 January 1976 have been process tested by the Coast Guard and have a label that identifies the certification number (as in "Certification No. 159.15/xxxx/xx/[I, II, III]"). This label will indicate whether the MSD is certified for use aboard inspected or uninspected vessels. Equipment Lists, COMDTINST M16714.3, identifies label-certified devices.

b. As of January 4, 1990, the MSD certification information has been incorporated into the MISLE computer database. This means that new certification numbers had to be assigned in the same format as Coast Guard approval numbers e.g., 159.15/1005/4/II is now 159.015/504/0 and 159.15/1105/4/II is now 159.015/584/0; see Figure 18-1. Model names have not changed and formerly assigned numbers are still acceptable for use.

c. Letter certification (33 CFR 159.12). MSDs made on or before 30 January 1976 were not process tested to the FWPCA requirements. These older plants, and some custom-built systems, may be certified under 33 CFR 159.12(c), by Coast Guard letter to the manufacturer or vessel owner. A copy of the letter should be kept aboard the vessel as evidence of compliance. These MSDs cannot be labeled under 33 CFR 159.15.

**FIGURE C2-1: MSD CERTIFICATION NUMBER**

**CONVERSION SYSTEM**

For certification numbers for 159.15 / 1001 / - / - to 159.015 / 1099 / - / - :

Old certification #: 159.15 / 1005 / 4 / II

(delete): : : : : : x x : : : x x

(add): : : : 0 : : : : 0 : 0

New certification #: 159.015 / (0)504 / 0 = 159.015 / 504 / 0

or certification numbers for 159.15 / 1100 / - / - to 159.15 / 1199 / - / - :

Old certification #: 159.15 / 1105 / 4 / I I

(delete): : : : : : x x : : : x x

(add): : : : 0 : : : : 8 0 0

New certification #: 159.015 / (0)584 / 0 = 159.015 / 584 / 0

c. Certification by regulation (33 CFR 159.12a). Type III MSDs that store only sewage and flushwater at ambient air pressure and temperature are certified by definition.

(1) There will be neither a label nor a letter, so the inspector should verify that the installation is as it is claimed.

(2) The tanks should be adequate to retain the wastewater generated while the vessel is within U.S. waters. Gray waters and galley wastes should not be directed to such a system, because the rotting food can cause the tank contents to putrefy, worsening the situation.

(3) The following are not acceptable as a Type III MSD:

(a) The use of piping as a holding tank; or

(b) Securing the direct overboard discharge piping from the head with a valve.

**NOTE:** Type III systems installed on a vessel before 30 January 1975 are certified under 33 CFR 159.12(b). These devices were not reviewed; no certification letter or label is necessary.

---

**5. IMO Certificate of Type Test**

A foreign flag vessel that has a "Certificate of Type Test" under MARPOL Annex IV indicating that its sewage treatment plant meets the test requirements of Resolution MEPC.2(VI) of the International Maritime Organization (IMO) will be accepted by the Coast Guard as being in compliance with 33 CFR 159.7(b) or (c). Such a plant will be considered fully equivalent to a Coast Guard certified Type II MSD as long as the unit is in operable condition (NVIC 9-82, CH-1, dated 8 October 1988). U.S. registered vessels will continue to be required to have Coast Guard certified MSDs per 33 CFR Part 159.

---

6. **Pre-construction Technical Review**

a. Label-certified MSD. If the label indicates certification for installation on inspected vessels, no further review of the unit itself is required, but any surge tanks or transfer station components should be examined prior to installation. If the label indicates that the MSD was certified initially for installation aboard uninspected vessels only, it must undergo plan review by the Marine Safety Center (MSC), the office responsible for the plan review of the particular vessel.

b. Capacity of the MSD. The regulations let the manufacturer determine how MSD capacity is stated. As a result, MSD manufacturers have used widely varying per capita sewage estimates in calculating the capacity of their equipment, from 35 liters per day to 35 gallons per day. In a proposed new installation, verify that the unit is large enough, based on hydraulics and waste load, not numbers of people, to process the wastewater expected to be generated on board the vessel. Installing too small an MSD will allow the discharge of partially treated sewage, which violates the FWPCA.

c. Modifications. All modifications to fixed sanitary plumbing or the MSD system must be accepted by the cognizant OCMI.

d. Jurisdiction for review. The vessel owner is responsible for complying with other agencies that may have jurisdiction. The Public Health Service (Interstate Transportation Sanitation Service) also conducts pre-construction reviews on U.S. vessels.

---

## 7. Inspection of Installed MSDs

Marine Inspectors should accept certified, operable MSDs that meet the requirements of 33 CFR Part 159. Ensure that all MSDs on the vessel are included in the inspection. Large vessels may have several MSDs, both holding tanks and flow-through MSDs. When conducting MSD inspections, the Marine Inspector should do the following:

a. Certification. Verify that a device is certified by checking labels, letters, manuals, etc.

(1) A copy of the certification letter for an existing MSD should be kept on the vessel for review by a boarding officer. This system is imperfect at best.

(2) A foreign flag vessel should keep a copy of the IMO Certificate of Type Test aboard.

(3) If a letter or IMO Certificate of Type Test is not available, contact Commandant (CG-CVC). They may be able to identify the MSD as one that has been letter certified or listed with IMO.

b. Operation of Type I or II MSDs. The Marine Inspector should verify that an MSD is operable.

(1) For flow-through discharge MSDs (Type I or Type II), the Marine Inspector should verify the following:

(a) Instruction manuals are on board and available to the operating crew.

(b) Disinfectant chemicals or other consumable supplies needed to operate the device are stocked on the vessel. Hazardous substances (46 CFR 147) used to process sewage must be labeled and handled as such.

(c) All components are in good operating condition. Some ships may install the treatment tank in a separate compartment from the pumps and aerators, due to space constraints.

(d) Capacity is adequate for the vessel's wastewater load.

(e) The MSD receives only drains that it can handle. MSDs are tested only with sewage. Gray water drained to the plant can displace partially treated sewage.

(f) There are no suspicious accumulations of liquid or leaks around the treatment plant.

(g) Any disinfectant dosing openings are accessible and can be easily opened.

(h) Vents from the MSD do not cross-connect with other vents.

(2) Operation of Type III MSDs. For holding tanks (Type III), the Marine Inspector should verify the following:

(a) Capacity is adequate for the time the vessel will have to retain sewage and flushwater.

(b) The tank is used solely to store sewage and flushwater. In older ships, toilet drains may be combined with deck, sink and shower drains, to help flush the overboard drains. This installation was never intended to store sewage and may not be plumbed to prevent the back-venting of fumes from a holding tank.

(c) The tank does not receive gray waters or galley wastes. Adding these wastes can greatly increase the hazards of putrefied material accumulating in the tank.

(d) The tank operates at ambient pressure. Vacuum collection systems therefore cannot be certified under 46 CFR 159.12(a) and must be submitted for engineering review.

(e) The tank operates at ambient temperature.

(f) Vents from the MSD do not cross-connect with other vents.

(g) The overboard discharge valve ("Y" valve) for the tank is adequately secured to prevent the discharge of raw sewage while the vessel is in U.S. waters.

(3) MSD capacities. Check that the MSD can successfully operate in the installation. These calculations must be used as guidelines, as 33 CFR Part 159 does not mandate capacities. Each MSD should be evaluated in terms of the vessel's size, route, service, and particular circumstances. These capacities consider only "black-water" toilet drains. (On the average, each person will produce 1.5 liters of waste per day.)

(a) Flush rate. Figure C2-2 estimates the water used per flush by different toilet systems.

(b) Wastewater produced. Figure C2-3 estimates the liters of wastewater produced per person per day, based on the plumbing type, and the way the boat operates.

(c) Gray water. Figure C2-4 estimates the liters of "gray water" from galleys, showers, and sinks produced per day, based on the way the boat operates. Gray water discharge is prohibited only in the Great Lakes. Gray water is not sewage and may be discharged overboard without passage through an MSD or a holding tank.

(d) Draining galley wastes into the MSD is not recommended, because food waste is much more difficult to decompose than the human sewage which the marine sanitation device is intended to handle.

(e) If retained, gray water must be included in the waste retention capacity for the vessel.

(f) Operation in excess of certified rating. A flow-through (Type I or II) system may be overloaded. This "short circuits" the MSD and wastewater flows through the unit too quickly to be treated, allowing the direct overboard discharge of untreated sewage through the MSD.

**FIGURE C2-2**

**APPROXIMATE FLUSH CAPACITIES FOR VESSEL TOILETS DRAINING TO MARINE SANITATION DEVICES (MSDS)**

| System Type | Liters per flush |
|---|---|
| Conventional (Flushometer) | 18.9 |
| Recirculating | 0.38 |
| Vacuum | 1.1 |
| Hand Pump | 1.9 |
| Electric Pump | 3.8 |

**FIGURE C2-3**

| LITERS OF WASTEWATER PER PERSON / PER DAY BASED ON PLUMBING TYPE | | | | | | |
|---|---|---|---|---|---|---|
| Trip Length | LONG[1] | | MEDIUM[2] | | SHORT[3] | |
| User | Crew | Passenger | Crew | Passenger | Crew | Passenger |
| Plumbing System Type | | | | | | |
| • Conventional | 96.10 | 96.10 | 96.10 | 31.40 | 48.10 | 24.00 |
| • Recirculating | 1.90 | 1.90 | 1.90 | 0.64 | 0.95 | 0.95 |
| • Vacuum | 7.20 | 7.20 | 7.20 | 7.20 | 3.60 | 1.90 |
| • Hand Pump | 11.00 | 11.00 | 11.00 | 3.80 | 7.40 | 2.70 |
| • Electric | 20.40 | 20.40 | 20.40 | 6.80 | 10.20 | 5.10 |

Note 1: Crew and passengers aboard 24-hour/day.

Note 2: Crew aboard 24-hour/day; two groups of passengers aboard for 4 hours each (two trips/day), each passenger using facilities once.

Note 3: All crew aboard 12 hr/day; six groups of passengers aboard for 2 hours (six trips per day), one fourth of passengers using facilities once.

**FIGURE C2-4**

| LITERS OF GRAY WATER PER DAY | | | | | | |
|---|---|---|---|---|---|---|
| Duration | LONG[1] | | MEDIUM[2] | | SHORT[3] | |
| User | Crew | Passenger | Crew | Passenger | Crew | Passenger |
| Gray Water | 113.6 | 113.6 | 113.6 | 56.8 | 11.4 | 5.7 |

Note 1: All crew and passengers aboard 24-hour/day.

Note 2: All crew aboard 24-hour/day; two groups of passengers aboard for 4 hours each (two trips per day), each passenger using facilities once.

Note 3: All crew aboard 12 hr/day; six groups of passengers aboard for 2 hours (six trips per day), one fourth of passengers using facilities once.

c. Stability of small passenger vessels. Vessel stability must be considered in MSD installation aboard a small passenger vessel. This is especially important for vessels fitted with holding tanks, which, when partially full, may add significant free-surface effect. The OCMI should ensure that the requirements of Subchapter T are met.

d. Vessel operations.

(1) Time within U.S. waters. An MSD is required while the vessel is within the 3 mile limit.

(a) A Type III MSD can have a through-hull "Y" valve, but it must be opened only when the vessel is beyond U.S. waters. The valve must be adequately secured in all U.S. waters to prevent all discharges of raw sewage.

(b) Use of a padlock, non-releasable wire-tie, or removal of the valve handle would be considered adequate securing of the device. The method chosen must be one that presents a physical barrier to the use of the valve.

(2) No discharge zone. Operation in EPA-designated No Discharge Zones affects the MSD installation on every vessel that enters or stays in those waters.

(a) Flow-through devices are permitted if they are adequately secured to prevent discharges of any sewage, treated or untreated. Closing the seacock and padlocking, using a non-releasable wire-tie, removing the seacock handle would be sufficient means of securing. Locking the door to the head with a padlock or a door handle key lock is another acceptable method of securing the MSD while in a No Discharge Zone.

(b) Type III MSDs are recommended for long-term operation in a No Discharge Zone. Owner/operators should determine whether the intended area of operation is a No Discharge Zone.

(3) Plumbing system leakage. A greater capacity MSD may be necessary to accommodate the water from leaky toilet valves. Fixing the plumbing is often easier.

(4) Effluent sampling. Under the law, it may be necessary to take a sample of the MSD effluent if the Marine Inspector suspects that the MSD is no longer operable. If this is necessary, the Marine Inspector should instruct the vessel owner to have the effluent sample taken by a qualified wastewater laboratory, with the results reported to the Coast Guard

(a) These analysis results may form the basis of an enforcement action resulting in a civil penalty, so only qualified personnel should take, transport, or analyze the MSD effluent.

(b) The Coast Guard can use any wastewater lab that is state-certified.

e. Jurisdiction. The vessel owner/operator is responsible for complying with other agencies that may have jurisdiction. For example, foreign passenger vessels calling at U.S. ports are subject to Coast Guard quarterly control verification boardings. The Public Health Service (Centers for Disease Control) also inspects the sanitation of passenger vessels calling at U.S. ports.

---

## 8. Precautions for Inspections of MSDs

a. One must exercise confined space entry precautions when working around an open or possibly damaged MSD. If samples must be taken by a boarding officer, the boarding officer should wear disposable gloves to protect from possible contamination from the effluent. One must use “Not Safe for Hot Work” precautions around MSDs and holding tank. Use confined space entry precautions if it is necessary to open a holding tank or MSD. An MSD that has broken while containing sewage can be a hazard to all involved in its repair or inspection. Both methane and hydrogen sulfide can be generated in a treatment plant once aeration is lost.

b. A properly operating aerobic digestion MSD does not have a bad smell. A bad smell indicates that part of the system is leaking or septic.

c. A Marine Inspector examining an MSD should be alert for discolored metal fixtures. Hydrogen sulfide gas will blacken brass or other metal, even where it is seeping from the MSD at extremely low (not lethal) concentrations.

d. Inspectors are not expected to risk their health to check the MSD. If the MSD is too filthy at the time of inspection, get somebody else to clean it up before proceeding with the inspection.

e. Effluent sampling should be done only by personnel who are trained in collecting and handling the water samples. If effluent sampling is advised, inspectors should require the vessel operator to have samples taken by personnel from a qualified water quality laboratory.

---

## 9. Portable Toilets

a. Introduction. Portable toilets or "porta-potties" use no installed water, power, etc. Portable toilets are not considered installed toilets and are not subject to the MSD regulations.

(1) Portable toilets are subject to disposal regulations which prohibit the disposal of raw sewage within territorial waters (3 mile limit), the Great Lakes, or navigable rivers.

(2) The use of portable toilets combination with a direct discharge toilet will not bring a vessel into compliance. Vessel owners may remove the vessel's installed toilets and use portable toilets instead. If a vessel is fitted with and is using a portable toilet, any fixed toilets aboard that do not comply with 33 CFR Part 159 must be made permanently inoperable.

(3) Only when total removal of the system would be impractical or unsafe may the toilet be rendered "permanently inoperable," meaning that all parts of the toilet are removed (unless removal of a particular part would be impractical or unsafe).

b. Temporary MSDs. The MSD requirement is intended to remove all uncertified toilet installations aboard vessels. This policy must not be construed to permit installation of a spectacle flange on discharge valves, or blanking off of discharge lines on direct discharge toilets. These are temporary means of preventing overboard discharge that do not render the system permanently inoperable. They do not change the installed system, and the reasonable conclusion is that the vessel owner intends to use the uncertified, installed system later.

c. Installation. Portable systems on inspected vessels must meet the following criteria:

(1) The device must be manufactured of a durable material, such as molded plastic, aluminum, etc., that facilitates its removal ashore. Collapsible units with disposable bags are not acceptable, because the bag can tear and release sewage into the vessel or into the water.

(2) The vessel operator must follow the manufacturer's instructions for waste disposal, chemical additives use, etc.

(3) The device must be securely fastened to the vessel with straps, wooden framing, or similar materials.

---

**10. Waiver of MSD Requirement**

Some unique vessels may be granted a waiver of the MSD requirement. Such waivers are limited and are granted only by Commandant (CG-CVC). Requests for waivers will be considered only on the basis of space or power constraints that prevent the installation of any commercially available MSD. A lack of pump-out facilities in the vessel's immediate area of operation is not sufficient grounds for a waiver, unless the vessel regularly travels outside

U.S. territorial waters, where overboard discharge of raw sewage is permitted. Portable toilets may then be substituted.

## L. UNIQUE VESSEL EQUIPMENT AND MATERIALS

### 1. Introduction

Modern technology and automation are markedly changing shipbuilding practices. Every new vessel contains some novel feature that requires attention at certain intervals after the initial certification. Such items include--

a. Reheat boilers;

b. High expansion foam systems;

c. Carbon monoxide analyzers;

d. Special steels; and

e. Certain automated systems.

This situation is also true for existing vessels that have been rebuilt, converted, or modernized to a limited extent by periodic alterations. The inspector must have access to the information concerning such features, as well as proper inspection and testing data.

### 2. Records

A description of any unique equipment or materials must be listed in MISLE. For each piece of equipment or material, an appropriate entry should indicate where information on proper inspection and testing procedures is located. The entries must be made when the equipment is installed, on the occasion of a new vessel's initial inspection for certification, or whenever necessary.

## M. POWER-DRIVEN FASTENERS

### 1. Introduction

Power-driven fasteners are frequently used aboard commercial vessels to attach nonstructural items such as cables, cable trays, electrical fixtures, and pipe hangers to stiffeners, beams, frames, and nontight structural bulkheads. Power-driven fasteners are, basically, small-arms projectiles with stud threads on one end. These projectiles are shot into steel members to provide mountings similar to welded studs. Since they pierce the steel members, power-driven fasteners may lead to crack-initiation sites, areas of localized corrosion, or sources of leaks. The possibility of loosening the fastener also exists, since the bond between the fastener and the structure is mechanical, not cohesive. Power-driven fasteners must not be used in areas that are sensitive to stress patterns or corrosion. The only practical way to control their use is to grant specific approval for their use on a case-by-case basis. This is best done when construction plans for new vessels, or revised plans for existing vessels, are submitted for approval. When used, power-driven fasteners must be attached at least 1 inch from the edge of any member.

### 2. Acceptable Uses (Subject to Approval)

a. The following are acceptable possible uses of power-driven fasteners within machinery spaces:

(1) On main girder webs, other than primary longitudinals.

(2) On webs of watertight bulkhead primary stiffeners.

(3) On flanges and webs of beams on flats.

(4) On pillars.

(5) On plating on flats.

b. The following are acceptable possible uses of power-driven fasteners outside machinery spaces:

(1) On nontight bulkheads.

(2) On decks other than weather decks.

3. **Unacceptable Uses**

The following are unacceptable possible uses of power-driven fasteners:

a. Inside shells.

b. In strength decks or primary stiffeners.

c. In tank tops.

d. In tight bulkheads (W.T., O.T., etc.).

e. In flanges of primary structural members.

f. In any weather location.

g. In webs of primary longitudinals.

h. In pipe hangers for systems where thermal stresses are significant and hanger placement is important (e.g., high temperature).

i. In any member in which failure would create a personnel hazard, such as a handrail or ladder.

j. On members less than 0.25 inches thick.

k. On members whose operating temperature is normally below 1C.

l. On materials other than mild steel.

m. As grounding devices.

n. To fabricate composite beams.

# CHAPTER 3: FACTORY AND SHOP INSPECTIONS OF EQUIPMENT AND MATERIALS

## A. INTRODUCTION

This chapter contains guidance relative to factory and shop inspections of equipment and materials required to be used on merchant vessels. These instructions implement the requirements of 46 CFR Part 159. Most factory and shop inspections are now conducted by independent laboratories, so assignment of inspectors on a continuing basis is unnecessary. However, Coast Guard inspectors should periodically visit manufacturers. Manufacturers of approved equipment must grant access to inspectors as a condition of approval.

## B. SERVICING OF LIFERAFTS

### 1. Carpeting in Service Facilities

Liferaft service facilities should be advised against the use of carpeting in their service areas. Carpeting absorbs moisture from the rafts, and is extremely difficult to dry out and disinfect. Fungi that attack rubber-coated fabric rafts may breed in carpeting and damage rafts that are serviced later. Also, carpeting can develop brass fitting contamination, known as "copper oxidation." Although neoprene-coated rafts are not affected by this oxidation, rubber-coated fabric rafts and their metal fittings will be contaminated and deteriorate rapidly. Also, carpeting can lodge small splinters and bits of metal that can puncture and damage rafts.

### 2. Facilities that Service Foreign Rafts

The Commandant has received numerous requests to inspect U.S. facilities that service foreign rafts. Such requests may be honored by the Officer in Charge, Marine Inspection (OCMI), provided that the following are true:

a. The facility operators agree to abide by the provisions of 46 CFR 160.051-6 (except for the stamping provisions of 46 CFR 160.051-6(e), which do not apply) and the Annex to the International Maritime Organization (IMO) Resolution A.333(IX). Upon such agreement, the facility's activities must be spot-checked. Annual reviews must be made of all such facilities within the OCMI's zone.

b. The facility must obtain written authorization from raft manufacturers for servicing their products, and must agree to have the items indicated in Paragraph 1(n) of the IMO Annex.

c. The facility must maintain servicing records for review by the Coast Guard. It must also provide to Commandant (CG-CVC) an annual summary of deficiencies found on the rafts that were serviced. This survey will allow the Commandant to comply with the requirements of Paragraph 3 of the Annex to the IMO Resolution A.333(IX).

---

### 3. Letters of Acceptance

At the completion of a satisfactory evaluation, the OCMI will issue a letter of acceptance to the servicing facility and forward a copy to Commandant (CG-CVC). The Commandant, in turn, will list the facility in Equipment Lists, COMDTINST M16714.3 (series) and notify the home Administrations of raft manufacturers that the particular facility has been accepted. Notices of withdrawal will follow the same procedure. The Annex to IMO Resolution A.333(IX) is reprinted in Figure C3-1.

---

### 4. Liferaft Hydrostatic Release Testing

It is not necessary for a Marine Inspector to attend every liferaft servicing. Accordingly, Marine Inspectors need only witness the testing, and stamp the inspection tag, of hydrostatic release units that are tested concurrently with a “spot check” liferaft servicing attended by an inspector. For testing of those hydrostatic release units not witnessed by a Marine Inspector, the facility performing the test will stamp its three-digit facility identification code in lieu of the IMO identification letters and “USCG” (46 CFR 160.62). Facility codes may be found on all recent liferaft servicing approval letters and in Equipment List, COMDTINST M16714.3 (series).

---

### 5. Liferaft Inflation Systems

a. Servicing of approved inflatable liferafts. Approved inflatable liferafts must have their inflation systems tested for compliance with 46 CFR 160.151).

b. These regulations require inflation systems to meet time and temperature range limitations.

c. The method presently used for compliance is pre-charging the Carbon Dioxide ($CO^2$) inflation cylinder with nitrogen gas to an approximate 10-percent volume. The nitrogen is relatively unaffected by external temperature changes, and acts as a catalyst to release the $CO^2$.

d. Coast Guard-approved service facilities must follow the manufacturer's service procedures to pre-charge cylinders.

e. The use of nitrogen to meet this requirement is the industry's standard technique; other methods may be used upon Coast Guard acceptance.

f. Servicing of non-approved liferafts. Uninspected vessels may be equipped with non-approved rafts or rafts that are not serviced at approved facilities. These rafts may not have received a temperature compensation pre-charge at the last servicing. This may result in under inflation or non-inflation when the raft is put into use.

## C. PERSONAL FLOTATION DEVICES (PFDS)

### 1. Introduction

Life preservers, buoyant vests, cushions, and other personal flotation devices PFDs (Type I, II, III, IV, and V) are manufactured in accordance with:

| PFD TYPE | CFR APPROVAL CITATION |
|---|---|
| Type I | 46 CFR 160.002, 160.005, 160.055 |
| Type II | 46 CFR 160.047, 160.052, 160.060 |
| Type III | 46 CFR 160.064 |
| Type IV | 46 CFR 160.048, 160.049, 160.050 |
| Type V | 46 CFR 160.053, 160.077 |

There are some exceptions to type designations. These specifications place an explicit obligation on a manufacturer to inspect all PFDs. Such inspections are intended to maintain the high quality of such products.

---

2. **Life Preservers and Ring Buoys**

a. Type I devices. As of 1 September 1983, the Coast Guard discontinued regular factory inspections of these devices. Regular inspections are conducted by independent testing laboratories such as Underwriters Laboratories, Inc. (UL) and Pittsburgh Testing, Inc.

(1) The laboratory inspectors who perform this task are responsible for ensuring that the device meets all applicable specifications and approved plans, and that the manufacturer is performing sufficient tests and has an adequate quality control program.

(2) It is the laboratory inspector's responsibility to carry out the procedures in 46 CFR Subchapter Q and the "Guide for Independent Organization Inspection of Type I and Type V PFD's Under Subparts 160.002 and 160.055." This guide was prepared by Commandant (CG-CVC) and first issued on 5 August 1983. These procedures help ensure that a manufacturer's devices meet the applicable requirements before they are accepted and marked.

b. Type IV devices. For Type IV ring buoys approved under 46 CFR 160.050, inspections are also performed by independent laboratories as of 1 September 1983. The laboratory inspector is responsible for conducting the procedures required by Subchapter Q.

c. Coast Guard oversight. Unannounced Coast Guard inspections should be made at the place of manufacture to ensure that both the manufacturer's quality control and testing laboratory's inspection program are adequate.

(1) Such unannounced inspections must be conducted whenever a new approval is granted, and at least quarterly. Additional inspections should be conducted when problems have been discovered during the previous inspection or when the OCMI is notified of problems in the field.

(2) When discrepancies are found, immediate action must be taken to correct them. A report should be submitted to Commandant (CG-CVC) noting discrepancies found, corrective actions taken, and recommendations for further action, as

appropriate. Communication between the OCMI and the local laboratory inspector(s) will help ensure compliance by the manufacturers.

## FIGURE C3-1: IMO RESOLUTION A.693(17) ADOPTED ON 06 NOVEMBER 1991 ANNEX - RECOMMENDATION ON THE CONDITIONS FOR THE APPROVAL OF SERVICING STATIONS FOR INFLATABLE LIFERAFTS

1. Administrations should ensure that periodic survey of inflatable life rafts is performed at servicing stations that have demonstrated competence to service and re-pack rafts, maintain an adequate facility and use only properly trained personnel. Servicing stations, which should have demonstrated this capability for inflatable life rafts of each manufacturer whose rafts they service, should comply with the following:

    a. Servicing of inflatable life rafts should be carried out in fully enclosed spaces only. There should be ample room for the number of inflatable life rafts expected to be serviced at any one time; the ceiling should be sufficiently high to overturn, when inflated, the largest life raft to be serviced.

    b. The floor surface should be provided with an easily cleaned coating, sufficiently smooth to ensure that no damage will occur to the life raft fabric.

    c. The servicing space should be well lit provided that direct rays of sunlight do not enter the space.

    d. The temperature and, when necessary, the relative humidity in the servicing space should be sufficiently controlled to ensure that servicing can be effectively carried out.

    e. The servicing space should be efficiently ventilated, but be free from draughts.

    f. Separate areas or rooms should be provided for:

        1. Life rafts awaiting servicing, repair or delivery.

        2. The repair of glass fibre containers and painting $CO^2$ cylinders.

        3. Materials or spare parts.

        4. Administrative purposes.

    g. Means should be provided in the life raft storage space to ensure that life rafts in containers or valises are not stored in more than two tiers or subjected to excessive loads.

h. Spare and obsolete pyrotechnics should be stored in an approved, safe and secure magazine well away from the servicing and stowage spaces.

i. Smoking should not be allowed in the servicing and packing areas.

j. Sufficient tools should be available for the servicing of life rafts and release gear in accordance with the requirements of the manufacturer, including.

1. Manometers or pressure gauges and thermometers which can be easily read with sufficient accuracy.

2. Dual purpose air pump(s) for inflating and deflating life rafts, together with the necessary high pressure hoses and adaptors.

3. A suitable pair of scales for weighing $CO^2$ cylinders with sufficient accuracy.

4. Sufficient gas for blowing through the inlet system of the life rafts;

k. Procedures and arrangements should be made to ensure that a gas cylinder is properly filled and gas-tight before fitting to a life raft.

l. Sufficient materials and accessories should be available for repairing life rafts together with replacements of the emergency equipment; when servicing davit-launched life rafts adequate means should be provided for overload testing of such life rafts.

m. Servicing and repair work should only be carried out by qualified persons who have been adequately trained to the satisfaction of the Administration. The training procedure should ensure that servicing personnel are made aware of changes and new techniques.

n. Arrangements should be made with the manufacturer to make available.

1. Changes to servicing manuals, servicing bulletins and instructions.

2. Proper materials and replacement parts.

3. Bulletins or instructions from the Administration.

d. Factory inspections. Inspectors making factory visits must ensure that the PFDs produced comply with the specifications for materials, construction, buoyancy, and workmanship. The independent inspection organization guides referenced above should be followed. In all cases, the inspector must do the following:

1. Examine the manufacturer's records of production lot buoyancy tests.

2. Examine all materials used in PFD construction. The manufacturer must show compliance through material affidavits, certified test reports, or tests made in the presence of the inspector.

3. Examine the component parts and finished items for compliance with applicable drawings, product description, etc.

4. Examine the markings for proper wording, lot numbers, approval numbers, etc., and test the marking for waterproofness and legibility.

5. Test the strength and slippage of a body strap assembly. The test must be run at the load specified in the appropriate subpart and must last for 10 minutes, in which time no more than 3 inches of slippage is permitted (1 inch for Type I devices).

6. Test the buoyancy of pad inserts. If kapok-filled pad inserts fail the buoyancy test, the buoyancy test for processed kapok under 46 CFR 164.003 must also be made.

7. Test the volume displacement of vinyl-covered pad inserts.

8. Test the seam strength of heat sealed, vinyl-covered pad inserts.

9. Check the manufacturer's test equipment for calibration within the previous 6 months.

10. Compare test results with the records of manufacturer tests for correlation.

---

### 3. Work Vests

These devices are manufactured in accordance with the requirements of 46 CFR 160.053, which does not require regular factory inspections by the Coast Guard. The OCMI should, however, conduct unannounced inspections at least quarterly, as described above, for manufacturers of work vests in his or her zone.

### 4. Buoyant Vests, Cushions, and Marine Buoyant Devices

For Type II, III, and IV cushions and some special Type V's, factory inspections are conducted by a recognized laboratory such as UL. However, 46 CFR Subchapter Q specifications provide that unannounced Coast Guard inspections may be made at the place of manufacture at any time. Further, it is the Coast Guard's responsibility to ensure that the testing laboratory's inspection program is adequate. Through at least annual unannounced inspections, OCMIs must ensure that adequate quality control exists at PFD manufacturers' facilities. When discrepancies are found, immediate action must be taken to correct them. A report should be submitted to Commandant (CG-CVC) noting the discrepancies found, corrective actions taken, and recommendations for further action, as appropriate.

## D. IDENTIFICATION AND CERTIFICATION OF ENGINEERING MATERIALS

Under 46 CFR 50.25-1, certain products (e.g., plating, stay bolts, and valves) must be certified by the manufacturer. 46 CFR Table 50.25-1(a) outlines identification and certification requirements for engineering materials. As outlined in 46 CFR 50.15-5 and 50.15-15, certain American Society of Marine Engineers (ASME) and American Society for Testing Materials (ASTM) specifications are adopted for Coast Guard use. Those products listed in 46 CFR Table 50.25-1(a) should be stamped in accordance with the applicable specifications and accompanied by the manufacturer's certification. They may, however, be accepted without such certification, as indicated in 46 CFR 50.25-5. In all cases, the inspector must be satisfied that material presented by the fabricator or repair facility matches that identified in the mill or manufacturer's certificate.

## E. BOILERS AND UNFIRED PRESSURE VESSELS

### 1. Pressure Vessel Markings

Certain ASME certified Pressure Vessels (PVs) are accepted by the Coast Guard without Coast Guard shop inspection. However, stamping with the Coast Guard symbol in accordance with 46 CFR 50.10-25, 54.10-3, and 54.10-20 is required for all PVs that meet 46 CFR 54.01-5(c)(3), other than those excepted by 46 CFR.54.01-5(c)(4) and 46 CFR 54.01-15(a)(1), (2), (3), and (5). No Sector Office identification letters or serial numbers are required for PVs unless the Coast Guard conducts the shop inspections. The manufacturer's name and serial number provide sufficient identification for these units.

### 2. Data Reports

Since the Coast Guard requirements applicable to PVs found in 46 CFR Table 54.01-5(b) are in excess of the minimum requirements of the ASME Code, it must not be assumed that ASME authorized-inspectors will assure that they have been met. Accordingly, to ensure these additional requirements are met, Marine Inspectors must review the manufacturer's Data Reports. The Coast Guard symbol stamped on the PV indicates that a Marine Inspector reviewed the Data Reports and that the PV meets Coast Guard regulations.

### 3. Shop Inspections

Complete marking with the Coast Guard symbol and serial number is required for all PVs receiving Coast Guard shop inspection whether or not an ASME stamp is applied. This marking will be applied by the Marine Inspector performing the shop inspection. When conducting a shop inspection of a PV, the Coast Guard Marine Inspector will also sign the Data Reports to indicate compliance with Coast Guard regulations.

**NOTE:** See MSM Volume II, COMDTINST M16000.7A (series), Chapter A4 for additional information on boiler plan submittal.

## F. MARINE SANITATION DEVICES (MSDS)

PV components of these devices are generally exempt from shop inspection and plan approval requirements via 46 CFR 54.01-15(a)(1). Though not generally inspected as PVs, these units are subject to the requirements of 33 CFR Part 159.

## G. OILY-WATER SEPARATORS

Oily-water separators are nonstandard fluid conditioner fittings. As such, they are not subject to the 46 CFR 56.15-1(e) requirements for shop inspection and stamping Though not inspected as PVs, such units are subject to the requirements of 46 CFR 162.050.

## H. LIFERAFT INFLATION SYSTEMS

1. Servicing of Approved Inflatable Liferafts

Approved inflatable liferafts must have their inflation systems tested for compliance with 46 CFR 160.051-5(c)(4) and (e)(11) (see NVIC 2-75). These regulations require inflation systems to meet time and temperature range limitations.

The method presently used for compliance is pre-charging the Carbon Dioxide ($CO^2$) inflation cylinder with nitrogen gas to an approximate 10-percent volume. The nitrogen is relatively unaffected by external temperature changes, and acts as a catalyst to release the $CO^2$. Coast Guard approved service facilities must follow the manufacturer's service procedures to pre-charge cylinders. The use of nitrogen to meet this requirement is the industry's standard technique; other methods may be used upon Coast Guard acceptance.

**2. Servicing of Non-Approved Liferafts**

Uninspected vessels may be equipped with non-approved rafts or rafts that are not serviced at approved facilities. These rafts may not have received a temperature-compensation pre-charge at the last servicing. This may result in under inflation or non-inflation when the raft is put into use.

# CHAPTER 4: INSPECTION OF STEERING SYSTEMS

## A. INTRODUCTION

Proper and reliable operation of a vessel's steering gear is vital to the safety of the ship, its personnel, and the marine environment. The inspection of steering systems must be thoroughly and intelligently performed. Prior to any testing, the inspector should become familiar with the equipment and its operation. A review of the manufacturer's instruction manual may be necessary. The inspector should then carefully inspect and witness the testing of all equipment, controls, and alarms, remaining alert for signs of equipment failure, improper operation, defective equipment, or potentially hazardous conditions. The chief engineer and master should be interviewed concerning overall operation and reliability of the steering system. Attention should be given to steering operations and tests during review of the official logbook. A thorough knowledge of steering gear standards and their development is important to assess where to place inspection emphasis. For this reason, information on standards development, a list of references, and some vessel casualty and steering regulation history, are included in this section.

## B. INSPECTION PROCEDURES

### 1. General

Prior to conducting operational tests of the steering system, the Marine Inspector should inspect it as described below. The general objective is to closely examine all electrical, mechanical, and hydraulic connections and linkages of the main and auxiliary steering systems. The inspector should do the following:

a. Sound the mounting bolts of all equipment.

b. Check all piping systems and attachments, equipment-securing brackets, protective guards, wire runs and cages, and other items prone to corrosion or vibration fatigue.

c. Inspect control linkages, linkage pins, and ram guides for wear.

d. Identify and closely examine feedback devices, differential units, or other components that may represent potential single-point failures (i.e., the weakest link). Refer to the steering system design philosophy and requirements in F of this chapter to help identify sections not required to be duplicated.

e. Ensure that all vital connections, pins, couplings, and control linkages have securing devices, such as cotter pins or double-nut locking arrangements, to prevent loosening from heavy vibration. Hydraulic transfer valves, such as a six-way valve, should lock

in each position. Padlocks or other securing arrangements needing special keys or tools are not authorized.

f. Check emergency steering procedures and steering transfer diagrams for clarity and proper labeling of valves.

g. Check that the steering procedures and steering transfer diagrams accurately reflect actual conditions in the steering gear room and wheelhouse, respectively. Wheelhouse procedures should accurately reflect equipment/control actions required to change over to alternative or emergency steering).

h. Inspect carrier bearing or equivalent and rudder stock packing.

i. Inspect steering gear room for watertight integrity, cargo stowage, fire hazards, ventilation, missile hazards, or other hazardous conditions.

---

**2. Electrical Equipment**

With all power sources secured at the main and emergency distribution switchboards, the inspector should inspect all steering motor starters and switchgear in accordance with the appropriate provisions of 46 CFR 110.30 and Part 111. The inspector should be particularly alert for loose wiring connections, loose equipment mounting screws, frayed or broken control wiring (especially in way of door hinges), and dirt or debris. Mechanical operation of start/stop and transfer switches should be free and smooth. All switches and circuit breakers should be exercised during the inspection. Electrical securing devices such as lugs, strain relief crimp connections, edge connectors, and terminal boards are prone to vibration and corrosion problems and should be closely examined. All connections, insulators, and switching devices should be secure and clean to prevent arcing or insulation breakdown. Excess spare fuses may indicate past problems with overloaded circuits.

---

**3. Pumps and Motors**

The inspector should hand-rotate each motor and pump assembly and stay alert for unusual noise, binding, or a feeling of roughness during rotation. The inspector should examine couplings for excessive play and evidence of grease slinging. Grease on the overhead near a coupling may be a sign of coupling wear or excessive lubrication. The inspector should check motor ventilation openings for cleanliness.

---

**4. Hydraulics**

The inspector must carefully check all hydraulic hoses and connections. The inspector must check hydraulic oil for proper level, alarms, cleanliness, and signs of emulsion. On dual-power systems, interconnections or fittings that may fail and cause both systems to lose oil should be checked and noted. The inspector should be alert for signs of oil leakage or evidence of cleanup that occurred just prior to inspection. Evidence of metal in strainers or filters may indicate imminent failure.

---

### 5. Control Linkages

Mechanical linkages between the rudder differential and pumps are not subjected to high loads, so strength is not a problem. However, repeated bi-directional movements, combined with vibration, can cause loosening of connections. All of these connections are generally in the open and readily visible for inspection. Because these linkages are critical to the operation of the steering system, inspectors should be particularly careful during control linkage examinations. The ship's crew should also inspect all connections on a routine basis.

---

### 6. Differential Control Units

The function of the differential unit is to compare the helm order with the rudder position and produce an output to control the hydraulic pump. Because of the vital nature of this system, which is composed of many moving parts and connections, emphasis should be placed on this unit during an inspection.

---

### 7. Relief Valves

Relief valves are used to limit hydraulic pressures under severe loading conditions, such as those encountered during heavy weather. Vessels employ two basic types of relief valves, a balanced piston or a check-valve or spring-loaded type. The balanced piston is used for high pressures. Check-valve types are used for applications such as filter bypasses, in which lower differential pressures are expected. These valves are not subjected to frequent cycling under normal service, and a common problem is freezing of the piston in the closed position. Preventive maintenance should include proper hydraulic filtration and periodic valve cycling. The manufacturer's data book should be consulted for recommended relief valve testing and setting.

---

### 8. Piping and Fittings

The inspector should examine hydraulic pipes and fittings for condition, proper support, and alignment. Fittings should be closely examined for leaks and evidence of overtightening. Socket welded fittings are generally preferred in areas of high vibration. High-pressure piping is generally made from Schedule 80 seamless carbon steel and should be adequately supported. Tubing applications should be limited to minor services where exposure to rough handling is not a problem. Hoses with abrasions, kinks, twists, or soft spots should be replaced.

---

**9. Securing Devices**

Securing devices that are most seriously affected by vibration are keys, set screws, and pins. Rollpins, grooved straight pins, or similar securing devices should be used in heavy vibration areas. Lockwire may be used in lighter duty areas.

a. Rollpins provide good resistance to loosening from vibration because the rollpin is pressed into place and exerts a spring force to keep it in. Rollpins are often used to attach a gear to a shaft when strength is not a problem.

b. Keys provide more strength than rollpins and are excellent for transmitting torque. Keys are held in place by friction and should not be relied on for maintaining axial position. Vibration can back keys out even when they have been tightly fitted.

c. Woodruff keys are not as satisfactory as straight pins although they offer more resistance to tipping. These keys require a tight fit to the hub, which makes them more prone to backing out than straight pins.

d. Set screws may be used as a type of key and retainer. This arrangement may not hold up well to reverse loadings. Set screws are also used to better hold key arrangements.

   (1) To better secure set screws, staking is often used for light loads.

   (2) Staking must be done when the piece is assembled.

   (3) Minor repairs to parts utilizing staked set screws may result in a missing or improper stake and subsequent failure of the securing device.

e. Cotter pins provide a means of further retaining a bolt, pin, or other securing device. The pins must be properly bent (180 degrees) and secured to prevent failure or backing out.

f. Tapered pins of any kind are generally not accepted in steering systems.

g. Nuts are prone to backing off during vibration and should be used with additional retaining devices such as special lock washers, keys, pins, or double-nut arrangements.

## C. OPERATIONAL TESTS

### 1. General Tests

The objective of operationally testing the steering system is to thoroughly test all steering systems in all modes of operation from all control locations. This is best accomplished with one inspector on the bridge and another in the steering gear room. The inspectors must do the following:

a. Verify that the system operates to design and regulation requirements.

b. Ensure that operating instructions are properly posted and accurate. Steering system controls and changeover procedures may be distinctive for the wheelhouse and steering gear room.

c. Be alert for vibration, oil leakage, abnormal hydraulic pressures, and unusual noise during operation of the steering apparatus. "Hunting" and erratic or jerky movements of the rudder, follow-up system, or synchro-repeater system may indicate control or feedback problems.

d. Check for normal operation under load, with special attention to overheating of the operating motor and pump assembly, if underway.

e. Test all alternate systems, alarms and indicators under simulated casualty conditions such as tripping the main steering power breaker.

### 2. Pumps, Motors, and Controls

The inspectors must do the following:

a. Energize the steering pumps and motors and test the operation of each motor and pump assembly, using both port and starboard control cables.

b. Operate each motor and pump assembly from the bridge, the alternative control station, and the steering gear room through the full range of rudder travel.

c. Operate each motor and pump assembly on the normal, alternate, and emergency power supplies, checking for the proper operation of the manual feeder transfer switch and automatic bus transfers during this procedure.

---

### 3. Auxiliary Steering

Auxiliary steering arrangements should be thoroughly tested by simulating a main steering or power failure. Steering control and power should be readily switched to the auxiliary system.

---

### 4. Rudder Angle Indicators/ Feedback

The inspectors must verify that the rudder angle repeaters on the bridge, alternative control station, and steering gear room are in alignment with each other and with the mechanical rudder angle indicator. Visibility from the steering station and night lights should also be checked.

---

### 5. Alarms and Indicators

The inspectors should verify that all required indicating lights, alarms, and emergency lighting in the pilothouse, machinery space, and in the steering gear room operate properly. See I of this chapter for more information.

---

### 6. Communications

The inspectors should test for proper operation of all voice communication systems between the bridge, alternative control, and steering gear room.

---

### 7. Regulatory Compliance

Particular attention to detail is required during inspection of new installations, modifications, and major repairs to verify compliance with all steering gear standards and regulations. See F and G of this chapter for more information. Some compliance tests, such as overloads or maximum design limits, may not be feasible or safe. Early communications between the Officer in Charge, Marine Inspection (OCMI), vessel owner, equipment manufacturer, and contractor, concerning testing requirements and alternatives are encouraged.

## D. INSPECTION RECORDS

At the completion of a steering gear inspection, a detailed description of the tests and inspections performed should be included in the appropriate MISLE activity. If the inspection was split between hull and machinery inspectors, the hull inspector should summarize the entire inspection. The following are examples.

### 1. All Vessels Except Small Passenger Vessels

All accessible electrical, mechanical, and hydraulic connections and linkages in the steering gear room were examined by the boiler inspector and found satisfactory. Tested the main and auxiliary steering systems and associated alarms in all modes of operation from all control locations. Checked rudder angle indicators. All inspections and tests satisfactory. Interview of the chief engineer and master and review of the vessel's logbook indicate past reliable operation of all steering systems.

### 2. Small Passenger Vessels

For rod-to-gear and chain assembly systems, examined the entire system while exercising the helm. All couplings, sprockets, and chains should be aligned, well lubricated, and operate freely. Securing devices and connections should be well maintained. Rudder post, packing. and tillers should be examined for excessive wear and leakage. Operational tests of the bridge and flying bridge steering stations should be conducted. The emergency tiller should be readily accessible and operationally tested during the inspection.

## E. CONSIDERATIONS FOR SPECIFIC STEERING SYSTEMS

### 1. Ram Systems

These generally consist of single or paired double-acting hydraulic rams, connected to the tiller by a link or Rapson Slide mechanism.

a. Link systems use connecting rods or linkages from the ram to the rudder post. They are common in dual-rudder arrangements and installations with less space surrounding the rudder post.

b. The Rapson Slide unit is a common ram arrangement consisting of a block, sleeve or trunnion block pivoted on a ram that is guided by a cross-head or yoke fitted to the rudder stock. An advantage of this arrangement is that as the rudder angle increases, the ram's mechanical advantage increases.

---

### 2. Rotary Vane Systems

A rotary vane-type system consists of a vane actuator connected directly to the rudder stock. The power and control of a rotary vane-type steering gear is similar to hydraulic ram systems, but this system operates at lower pressures and has fewer moving parts than a ram system. Rotary-vane systems have proven to be as reliable as ram systems. Single actuator systems may be considered equivalent to the required dual apparatus with many of the same provisions as hydraulic rams. Preventive maintenance and routine inspections of the hydraulic system and strainers are especially important to rotary vane systems. On one notable occasion, a serious failure was prevented when metallic slag was found in the hydraulic system strainers. In this incident, sheared vane bolts had scored the pump cylinder walls. Investigation revealed that the bolts had sheared due to stresses at a notch created by tapered bolt heads fitted into unchambered bolt sockets.

---

### 3. Orbitrol Systems

Orbitrol steering systems are a type of hydraulic helm unit that may be found on Offshore Supply Vessels (OSVs) and small passenger vessels. This system has been accepted for cargo vessels of less than 500 GT, under certain conditions, if the vessel is capable of steering with its screws. Deck winch motors may also run off the Orbitrol system, if specifically approved, on vessels of less than 100 GT. All of an Orbitrol system’s auxiliary hydraulic motors should be running simultaneously when the system is undergoing testing.

---

### 4. Systems Aboard Small Passenger Vessels

Problems with small passenger vessel steering systems are frequently caused by a lack of maintenance, corrosion, or the loss of fasteners due to wear and vibration. The inspector should inspect the entire steering system visually, from behind the operator's console to the rudder post. The system should be exercised during the inspection to ensure that all pulleys, sprockets, cables, guides, etc., are free, well lubricated, and properly aligned. All linkages, pins, and fasteners should have locking devices. Steering system components that are not easily accessible may present potential failure points and should be carefully evaluated. The removal of protective guards, coverings, or other interferences may be necessary to inspect the system completely.

### 5. Auxiliary Steering Systems

Auxiliary steering and communication systems should be tested as outlined on posted directions. The inspector should check all labels and markings for compliance with the posted instructions. A deck winch to block and tackle arrangement need not be physically exercised, but all required equipment should be inventoried and examined. Trick wheel arrangements are easily tested and should be fully exercised. Hand pumps should be tested in both directions but need not be run through the entire rudder range. Auxiliary hand tiller arrangements should be checked for easy access, fit, and capacity.

### 6. Integrated Steering/ Propulsion Systems

Such systems maneuver a vessel solely by changes to propulsion settings and do not use a rudder. Two examples are cycloidal propellers (a Voith system), and the Z-drive/Z-peller. Such systems provide a full, 360-degree propulsion thrust output, which is especially advantageous on dredges, ferries, and towboats. The same essential design philosophy and inspection criteria apply to these systems as to other steering systems. The inspector should consult the manufacturer's data book and plan approval letters to become familiar with the system.

## F. STEERING GEAR STANDARDS AND DESIGN PHILOSOPHY

### 1. Coast Guard Regulations

For vessels built after 1 June 1982, the Coast Guard's standards apply a philosophy of duplication and separation to steering gear design standards so that, in the event of a casualty, a backup unit or operating position is available. The list below summarizes the duplication requirements in 46 CFR Subchapters F and J.

a. Steering apparatus. The Coast Guard requires a vessel to have a main and auxiliary steering gear. However, a more common arrangement on larger vessels uses a dual-power system that has been accepted as equivalent to the separate auxiliary steering gear.

b. Acceptable substitutions. Dual-powered hydraulic systems are an acceptable substitute for the auxiliary steering gear requirement, provided each power unit meets the capacity of the main steering gear. A dual-power hydraulic steering system is comprised of the following:

(1) Two cylinders or actuator chambers.

(2) Two independent pumps with independent piping to the cylinders.

(3) Cross-connects may be provided, in which case valving must be provided to allow any pump/cylinder combination.

(4) Separate power leads to the pump prime movers for the source of power. Separate feeder circuits are required for electrohydraulic steering gears.

(5) Each independent steering power unit has the required power to meet the rudder movement requirements of 46 CFR 58.25-10 (a).

(6) An independent control system for each hydraulic power unit.

(7) Two reservoirs, each of sufficient capacity. Cascade overflow types are acceptable, provided each half has sufficient capacity.

c. Steering station. Two stations are required for controlling the main steering gear: one in the pilothouse and the other on the after weather deck, unless duplicate controls are provided to the pilothouse. Generally, duplicate controls are provided and the alternative steering station is in the steering gear room.

(1) Steering gear control systems. A steering control system is defined as all equipment by which helm orders are transmitted from the bridge to the steering gear power units. The 1 June 1982 revision of Subchapter I has expanded this definition to include transmitters, receivers, feedback devices, differential units, hydraulic control pumps and all associated motors, cables, shafting, and piping for steering gear control.

(2) Separate and independent control systems. Two separate and independent control systems are required: one in the pilothouse, the other at the alternative steering station.

(a) Control systems external to the steering gear compartment must be duplicated.

(b) For vessels constructed prior to 31 May 1982, some essential control system elements, such as feedback devices and differential control units, may not be duplicated.

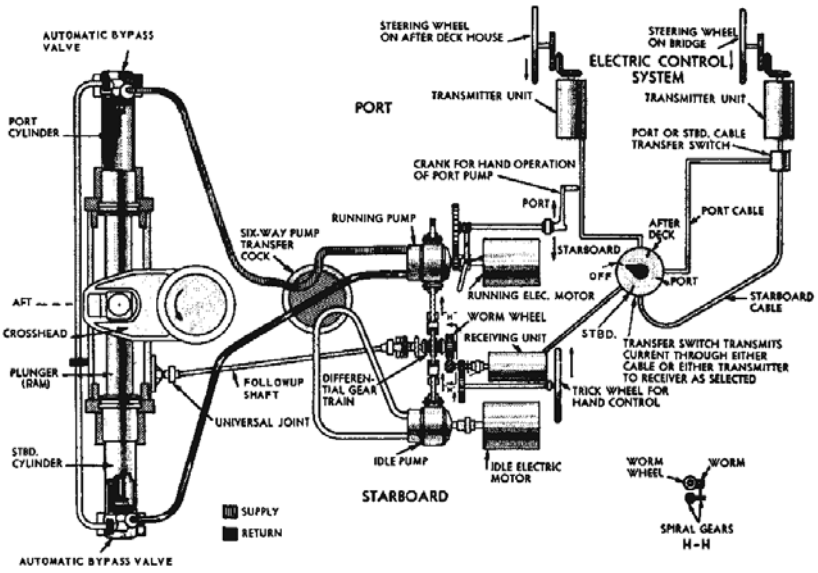
(3) Steering gear feeder circuits. One feeder circuit must be from the ship's service switchboard. The other circuit must generally be fed from the emergency or alternative power source. The circuits must be separated as widely as possible from one another.

---

## 2. International Standards

The international standards for steering gear are set forth in the International Convention for the Safety of Life at Sea (SOLAS). Historically, standards have been more specific and detailed for passenger ships than for cargo ships (including tankers). SOLAS 48 requirements in Chapter II, Part F, Regulation 56 only applied to passenger ships. SOLAS 60, Chapter II, Regulation 29 had some requirements for cargo vessels but continued to concentrate on passenger ships. The 1978 Protocol to the 1974 Convention removed the distinction between passenger and cargo ships and placed additional steering gear requirements on tankers.

The first amendments to SOLAS 74/78 have further improved steering standards for all vessels. However, the problems of common systems still exist and should be recognized during vessel inspections.




Single-ram electrohydraulic steering gear.

## G. STANDARDS AND REFERENCES

### 1. 46 CFR Subchapter F Marine Engineering

Marine engineering requirements have not appreciably changed since 1963, when the concept of a steering station located on the after weather deck was permitted to be replaced by an alternative steering station with duplicated pilothouse controls. These requirements can be found at the citations in the table below.

| SYSTEM COMPONENT | CFR CITATION |
|---|---|
| Piping | 46 CFR Part 56 |
| Steering gear requirements | 46 CFR 58.25 |
| Special steering apparatus (such as cycloidal propellers) | 46 CFR 58.25-65 |
| Steering gear periodic tests | 46 CFR 61.20-1 |
| Fluid control testing | 46 CFR 61.20-3 |

### 2. 46 CFR, Subchapter H Passenger Vessels

| SUBJECT | CFR CITATION |
|---|---|
| Steering gear installation details | 46 CFR 77.03 |
| Steering gear examination, testing, and logging by ship's officers | 46 CFR 78.17-15 |
| Instructions for changing steering gear | 46 CFR 78.47-55 |

### 3. 46 CFR, Subchapter J Electrical Engineering

These regulations were substantially revised in 1982. The revision reflects many recommendations of the National Transportation Safety Board (NTSB), requirements of the Port and Tanker Safety Act (PTSA) and the first amendments to SOLAS 74:

| SYSTEM COMPONENT | CFR CITATION |
|---|---|
| Emergency lighting in steering gear room | 46 CFR 112.15-1 |
| Emergency power source for steering | 46 CFR 112.15-5 |
| Communication requirements for steering gear room | 46 CFR 113.30 |
| Rudder angle indicator systems | 46 CFR 113.40 |
| Steering failure alarm systems | 46 CFR 113.43 |

### 4. 46 CFR, Subchapter T (Small Passenger Vessels (Less than 100 GT))

Steering gear requirements for T-Boats or Small Passenger Vessels may be found at the following references:

| | SUBJECT | CFR CITATION |
|---|---|---|
| a. | Examination and testing of steering system by inspector | 46 CFR 176.814 |
| b. | Steering gear requirements | 46 CFR 182.600 |

### 5. Steering Gear, Foreign Tankers

The regulation cited in 33 CFR 164.25 contains the requirements from the PTSA. Enacted on 17 October 1978, the PTSA specifically prescribed new steering gear requirements of the 1978 Protocol to SOLAS 74 for both new and existing tankers. The requirements of the PTSA are applicable to U.S. tankers and foreign tankers trading in U.S. ports. These regulations, essentially the same as those adopted by the International Conference on Tanker Safety and Pollution Prevention (TSPP), apply to tankers of more than 10,000 GT. New tank vessels were required to meet additional standards after 1 June 1980. Additional requirements became effective 29 October 1984.

### 6. Navigation and Vessel Inspection Circular (NVIC) 1-81

NVIC 1- 81, "Guidance for Enforcement of the Requirements of the Port and Tanker Safety Act of 1978," provides a comparison of existing and new steering gear regulations.

### 7. International Standards

a. Safety of Life at Sea (SOLAS) 60 and 74. The 1960 and 1974 SOLAS Conventions reproduced the steering standards of SOLAS 60 verbatim because final agreement had not been reached on new standards, which were under consideration at the time.

b. International Conference on Tanker Safety and Pollution Prevention (TSPP). One of the important actions that the TSPP, held in London during 6-17 February 1978, recommended was improved steering gear standards for tankers. These were adopted in the 1978 Protocol to SOLAS 74.

c. SOLAS 74/78 and amendments. The 1978 Protocol to SOLAS 74 was ratified on 1 November 1980 and entered into force on 1 May 1981. Steering gear standards for tankers of more than 10,000 GT became effective for new vessels when the Protocol entered into force and allowed an additional 2 years for existing tank vessels to comply. Together with SOLAS 74, these standards are referred to as SOLAS 74/78, and were amended with an effective date of 1 September 1984.

| SUBJECT | SOLAS CITATION |
|---|---|
| Steering gear standards | Chapter II-1, Regulation 29 |
| Additional requirements for electric and electrohydraulic steering gears | Chapter II-1, Regulation 30 |
| Steering gear operation requirements | Chapter V, Regulation 19-1, Regulation 25 of the 2009 Consolidated Edition |
| Steering gear testing requirements | Chapter V, Regulation 19-2, Regulation 26 of the 2009 Consolidated Edition |

## H. REQUIRED LOGS AND TESTS FOR ALL VESSELS

### 1. Steering Gear Testing and Drills

Within 12 hours of departure, or at least 48 hours prior to entering U.S. waters, the ship's steering gear must be checked and tested by the crew. The test procedure must include, when applicable, operation of the following:

a. The main steering gear.
b. The auxiliary steering gear.
c. The remote steering gear control system.
d. The steering positions located on the navigating bridge.
e. The emergency power supply.
f. All rudder angle indicators in relation to the actual position of the rudder.
g. All steering gear control system power failure alarms (46 CFR 113.43).
h. The steering gear power failure alarms (46 CFR 113.43).

**NOTE: These checks and tests must include the following:**

1. The full movement of the rudder according to the required capabilities of the steering gear.

2. A visual inspection of the steering gear and its connecting linkage.

3. Operation of the means of communication between the navigating bridge and the steering gear compartment.

---

### 2. Emergency Steering Drills

Emergency steering drills must take place at least once every 3 months to practice emergency steering procedures. These drills must include testing of direct control from the steering gear room, communications, and operation of any alternate power supplies. All officers concerned with the operation or maintenance of steering gear must be familiar with the operation of the steering systems fitted on the ship and with the procedures for changing from one system to another. For more information, see SOLAS 74/78.

---

### 3. Logging of Steering Gear Tests

All tests and inspections must be recorded in the Official Logbook. For these requirements, see 33 CFR Part 164 and SOLAS 74/78, Chapter V, Regulation 19-2.

## I. Summary of Requirements for Steering Gear Alarms and Indicators

### FIGURE C4-1: Major Events Contributing to Improved Steering Gear Standards.

| Date | Event |
|---|---|
| 1963 | 46 CFR Subchapter F is revised. |
| October 1971 | Seventh Intergovernmental Maritime Consultative Organization (IMCO) Conference. |
| 2 June 1973 | S/S SEAWITCH loses steering control due to the loss of a keeper pin in a shaft coupling to the differential mechanism and collides with the S/S ESSO BRUSSELS: 16 fatalities, $23 million in damage. |
| 6 May 1976 | CG proposes rule to require manning of steering gear room in certain waters; proposal withdrawn on 31 Jan 1977 in favor of redundant system controls. |
| 1976-1977 | "Winter of the Tankers" (ARGO MERCHANT, SANSINENA, ELSA ESSBERGER). A series of disasters involving U.S. and foreign tank vessels prompts President Carter to propose tanker safety and pollution prevention initiatives, including emergency steering requirements. |
| 24 February 1977 | S/S MARINE FLORIDIAN rams Benjamin Harrison Bridge in Virginia when steering power is lost due to a manual transfer switch jarring open. |
| November 1977 | Ninth IMCO Assembly recommends improved steering gear standards. |
| 28 July 1977 | M/V SITALA collides with moored barges near New Orleans due to loss of steering hydraulic fluid caused by leaking fittings in a single reservoir system. |
| 6 February 1978 | IMCO sponsors International Conference on Tanker Safety and Pollution (TSPP), which accepts improved steering gear standards for SOLAS 74. |
| 16 March 1978 | Very large crude carrier AMOCO CADIZ grounds off Portsall, France, following severe damage to the steering gear, after the loss of hydraulic fluid from a flange failure allows the rudder to swing free in heavy seas: millions of dollars in environmental damages, cleanup costs exceed $2 billion. |
| 17 October 1978 | Enactment of the Port and Tanker Safety Act (PTSA). |
| 30 August 1979 | M/V INCA CAPAC YUPANQUI collides with a moored butane barge after 0.8 ampere fuse opens on the vessel's only steering control system: 12 dead, $10.5 million in damage. |
| 25 May 1980 | 1974 SOLAS Convention enters into force. |
| 1 May 1981 | The 1978 Protocol to SOLAS 74 comes in force. |
| 8 April 1982 | CG revises 46 CFR Subchapter J, Electrical Engineering Regulations, and incorporates improved steering standards. |

| | |
|---|---|
| 22 May 1982 | IMCO becomes the International Maritime Organization (IMO). |
| 1 June 1982 | Effective date of revised 46 CFR Subchapter J for vessels contracted for after 1 May 1978. |
| 1 October 1984 | First set of amendments to SOLAS 74 effective this date. |
| 29 October 1984 | Final rule for 33 CFR Part 164, which incorporates provisions of 1978 TSPP Conference (Regulations 19-1 and 19-2 of SOLAS). |

# CHAPTER 5: INSPECTION OF INERT GAS SYSTEMS

## A. INTRODUCTION

### 1. Background

Fire and explosion are among the greatest threats to a mariner. On a tankship carrying crude oil, refined petroleum, or chemicals, fire and explosion are even greater threats. A properly designed, installed, operated, and maintained Inert Gas System (IGS) will prevent fire and explosion in an intact ship tank. Combustion is impossible without oxygen. If there is some way to keep the oxygen below about 8 percent, the ship will be free of danger from explosions in intact tanks. Typically, this is accomplished by the addition to the tank atmosphere of a gas that has less oxygen (often 5 percent or less) than air, which has an oxygen concentration of 21 percent. This is what an IGS accomplishes. Of course, when a tank is opened, as in a collision, oxygen can enter the tank regardless of the IGS.

Since the late 1970's, inerting has been required for most U.S. and foreign tankships. 46 CFR 32-53 provides the requirements for vessels required to have an operable IGS.While in U.S. waters, foreign tankships of the same size must have IGSs in operation. Integrated Tug-Barge (ITB) combinations that operate only in a combined mode are subject to the tankship rules for IGSs.

**NOTE:** For chemical tankers and gas carriers, the applicability of equivalent inerting requirements, as allowed by Safety of Life at Sea (SOLAS) Regulation II-2, 4-5.5, were adopted in 1985 through the International Maritime Organization (IMO) Assembly Resolution.

### 2. References

There are several good sources of information about IGS in addition to the main regulations for IGS, 46 CFR Subpart 32.53 and Regulation II-2, 4-5.5 of SOLAS.

Commandant's International Technical Series (CITS) Volume VII (USCG CITS-80-1-1), "Regulations and Guidelines for Inert Gas Systems," contains the SOLAS requirements, the IMO Guidelines For Inert Gas Systems, and the National Academy of Sciences National Materials Advisory Board Study on Material Aspects of Inert Gas Systems.

Another excellent resource on IGS is the International Maritime Organization’s MSC/Circ.387 (Revised Guidelines for Inert Gas Systems.

3. Federal Initiatives

A series of tankship accidents in the mid-1970's led to the International Conference on Tanker Safety and Pollution Prevention (TSPP) of 1978 and the passage of the Port and Tanker Safety Act of 1978 (PTSA). A major result of these initiatives is that most U.S. and foreign tank vessels are required to have IGSs in operation while they are in U.S. waters.

The Coast Guard's IGS regulations are contained in 46 CFR Subpart 32.53 (Inert Gas Systems); international rules are contained in Regulation II-2, 4-5.5. (Inert Gas Systems) of SOLAS 74.

The first set of amendments to SOLAS 74 were adopted and came into force on 1 September 1984; under them, a ship must satisfy applicable requirements to receive a SOLAS Safety Certificate. The second set of amendments to SOLAS 74 come into effect on 1 July 1986; they have only a minor effect on the IGS requirements.

## B. SYSTEM CONCEPTS

### 1. Reasons for Inerting Systems

The fire triangle is the basis of fire prevention techniques on tankships. It would not be practical to remove the fuel, which, in this regard, is the vapor generated by the cargo. Unless the cargo is Grade E and carried at a temperature at least 5° C below its flash point (in which case there are no inert gas requirements), the cargo is volatile enough to produce a flammable vapor-air mixture above the fuel.

A flammable atmosphere can be expected after the cargo is offloaded, unless the tank is gas-freed and cleaned of all residue and clingage on its surfaces. If all ignition sources could be eliminated, so would all chances for a fire. However, conditions such as lightning and electrostatic fields generated during tank washing and heavy seas in partially ballasted tanks will always be present as ignition sources. Hence, there is really no practical alternative to inerting cargo tanks.

### 2. Means of Inerting Cargo Tanks

a. Introduction. The following general description of an IGS includes components that may vary, depending upon the manufacturer. There are several ways to inert a tank.

(1) The simplest way to inert a tank would be to add a pure, nonflammable gas, such as nitrogen or carbon dioxide, to the tank atmosphere. Unfortunately, these pure

gases tend to be expensive, the costs of their storage aboard ship tend to be high, and re-supply in some ports is difficult.

(2) Most inerted tanks use the gases from a fuel burner, from the ship's propulsion equipment (flue gas), or from a unit dedicated to producing inerting gas (an Inert Gas Generator (IGG)).

b. Use of combustion gases. Use of combustion gases as the inerting medium is advantageous due to their availability and low cost, if sufficient fuel and properly adjusted and operated equipment are available.

(1) The disadvantage of this method is that the raw combustion gases are impure and must be treated before use in the cargo tanks. This is especially important for product carriers, in which cargo purity is critical and some cargoes may react with impurities in the inert gases.

(2) Each IGS has several components intended to remove these impurities. For example, sulfur in the fuel appears in the inert gas in the form of sulfur oxides, sulfurous acid, and sulfuric acid. If not removed, these will attack the metal of the tank and gradually destroy it.

(3) Passing the inert gas through a water-filled device called a scrubber removes most of these acids (see C.2 of this Chapter).

c. Gas distribution. When the inert gas is clean, cool, and water-free, it is pressurized and sent to the various cargo tanks through a distribution system.

(1) The distribution system contains backflow prevention devices, control valves, alarms, and automatic shutdowns. These can alert personnel to a malfunction and, when necessary, shut down the system before a dangerous condition develops in the tanks. Such conditions involve the oxygen concentration, the temperature and pressure of the inert gas, the water flow to and water level within the scrubber, and the backflow prevention devices (water seals).

(2) Because IGSs are complex and subject to malfunction, it is important for ships' crews to inspect and maintain them in good working order. The Coast Guard's inspections verify that they are properly maintained and operable.

---

**3. Operation of the System**

# CHAPTER 5: INSPECTION OF INERT GAS SYSTEMS

a. Introduction. The purpose of an IGS is to keep the oxygen content of the vapor space below the level needed for combustion. For crude carriers, the oxygen content of the inert gas delivered to the cargo tanks should be no more than 5 percent.

**NOTE:** This figure may be lower for certain chemicals carried in product carriers.

b. Operation. 46 CFR Subpart 32.53 identifies which product/crude oil tankships must be equipped with an IGS. (See B.4 of this chapter for discussion of "Inerting Requirements for Chemical Tankers and Gas Carriers.")

(1) For inerting purposes, oil cargoes are those cargoes identified as pollution category I in 46 CFR Table 30.25-1. These cargoes may be different from what is considered to be oil for the application of Oil Pollution Act of 1990 requirements.

(2) Generally, vessels required to have an installed IGS must maintain an inert atmosphere in the tanks whenever they are not gas free.

(3) When an IGS-equipped tanker is carrying a cargo that is not required to be inerted and the tank, piping, and venting conditions are functionally equivalent to a non-IGS tanker, the system may be secured.

(4) Table C5-1 summarizes the tanker categories that are required to have an installed IGS and the conditions whereby the system may be secured. On tankers that are required to maintain an inert tank atmosphere, it is not necessary for the IGS to be operated continuously. Once a tank is inerted and the tank openings closed and sealed, inert gas will leak out of the tank at such a small rate that the IGS may only need to be operated intermittently to maintain the inert tank atmosphere.

c. Requirements during transfer and tank cleaning operations. Offloading cargo is one of the few conditions under which the IGS must be in continuous operation.

(1) As the cargo is pumped out, inert gas must be introduced at an equal or greater volume rate, with excess inert gas flow vented to the atmosphere; if this is not done, air will enter the tank.

(2) Loading usually requires no additional inert gas if the tank is already inerted; the incoming cargo will displace the inert gas in the tank, which is then vented.

(3) Similarly, tank cleaning with fixed washing machines should not let inert gas escape. Cleaning with portable machines, if done with proper temporary seals around the machines, should release only a small amount of inert gas (requiring the IGS to operate for a short period to replace the gas that escapes).

(4) To gas-free an empty, clean tank, the IGS can be used to purge the tank free of hazardous vapors. Before loading a flammable cargo into a gas-free tank, the tank should be filled with an inert gas.

---

## 4. Inerting Requirements for Chemical Tankers and Gas Carriers

In considering the application of IGS requirements to chemical tankers, it was argued that this type of tanker should be given special consideration. This is primarily because both the inert gas from shipboard IGS and impurities in the inert gas can contaminate chemical cargoes. For example, the carbon dioxide produced as an inerting agent can drive certain cargoes off specification. Additionally, there are other chemical cargoes that are shipped with inhibitors that react with the oxygen in the tank to prevent the cargo from undergoing unwanted reactions. Therefore, the displacement of oxygen through inerting by any means (bottled nitrogen, IGG, flue gas systems, etc.) can cause breakdown of inhibitors used to prevent these reactions.

Since the implementation of the 1993 Amendments to SOLAS ’74, Regulation II-2/55.5 has allowed for substitute inerting requirements to be applied to chemical tankers and gas carriers in lieu of the requirements in Regulation II-2/60. These substitute requirements are contained in Res. A.473(XII), adopted on 19 November 1981. They apply to chemical tankers and gas carriers carrying petroleum products only.

The inert gas applicability requirements set out in Regulation II-2/55.5 are further modified by Res. A.566(14). In addition to the substitute requirements of Res. A.473(XII), Res. A.567(14), adopted on 20 November 1985. This extends the applicability of substitute inerting requirements to the carriage of all flammable cargoes onboard chemical tankers and gas carriers. Res. A.566(14) also prescribes the conditions under which no inerting is required.

a. Implementation. Res. A. 566(14) applies only to chemical tankers and gas carriers, which would otherwise be subject to the IGS requirements of 46 CFR Subpart 32.53 and SOLAS Regulation II-2/60 for tankers carrying crude oil and petroleum products.

(1) This category includes all new chemical tankers and gas carriers of 20,000 DWT or more as well as those existing vessels that are at least 40,000 DWT but less than 40,000 DWT if fitted with tank washing machines having an individual throughput of greater than 60 $m^3$ per hour.

(2) The dates distinguishing “new” from “existing” for the purpose of applying IGS requirements are contained in 46 U.S.C. 3701 and the 1978 protocol to SOLAS ’74.

b. Identification of cargo inert gas need. Next, each flammable cargo to be carried must be considered individually to determine the inerting requirements applicable to the tank in which the cargo is being carried. The flammable cargoes should be divided into the following three categories:

(1) Crude oil.

(2) Petroleum products.

(3) "Other than crude oil or petroleum products."

**NOTE:** Flammable cargoes "other than crude oil or petroleum products" are those listed in 46 CFR Part 153, Table 1; Chapters VI or VII of the BCH Code; or Chapters 17 or 18 of the IBC Code. The cargoes listed in 46 CFR Part 153, Table 1, closely parallel those listed in Chapter VI of the BCH Code and Chapter 17 of the IBC Code. There is no listing in U.S. regulations parallel to Chapter VII and 18 are identical); however, many of those cargoes are listed in 46 CFR 30.25-1.

d. For chemical tankers and gas carriers carrying flammable cargoes "other than crude oil or petroleum products," there are no inerting requirements, provided that the vessel was constructed before 1 July 1986. If the vessel was constructed on or after 1 July 1986, no inerting is required provided the following conditions are met:

(1) The individual tank(s) involved do not have a capacity exceeding 3,000 $m^3$.

(2) The individual nozzle capacities of the tank washing machines do not exceed 17.5 $m^3$/hr.

(3) The total throughput for all the machines in use in a tank does not exceed 110 $m^3$/hr.

e. For all chemical tankers carrying flammable crude oil or petroleum products, the IGS requirements of IMO Res. A.567(14) apply.

(1) If a chemical tanker was constructed before 1 July 1986, the IGS requirements of IMO Res. A.473(XII) may be substituted for those in IMO Res. A.567(14).

(2) The same requirements as included in this paragraph for chemical tankers or an equivalent should be applied to gas carriers carrying flammable crude oil or petroleum products.

d. There may be instances when a flammable cargo that is not crude oil or a petroleum product also is not listed in 46 CFR Part 153, the BCH Code, or the IBC Code. This is

most likely to occur when a new chemical is marketed and first transported. In situations such as this or any other time there is uncertainty regarding the inerting requirements for a particular cargo carried on board a chemical tanker or gas carrier, Commandant (CG-CVC) should be consulted.

## TABLE C5-1: INSTALLATION AND OPERATION REQUIREMENTS FOR IGSS [1,2]

| VESSEL TYPE | INSTALLATION REQUIRED? | OPERATION REQUIRED? |
|---|---|---|
| **Crude Oil Tankships** | | |
| Existing ships[3,4] All cargo grades | Yes for ships 20,000 DWT & over | Yes for ships 20,000 DWT & over |
| New ships All cargo grades | Yes for ships | Yes for ships |
| **Product Tankships** | | |
| Existing ships[3] Grades A-D | Yes for ships 40,000 DWT & over | Yes for ships |
| 40,000 DWT & over Grade E5 Design limited | No | No |
| Operationally limited: No volatile residues from previous voyages[6,7,9] | Yes for ships 40,000 DWT & over | No |
| Volatile residues from previous voyages | Yes for ships 40,000 DWT & over | Yes for ships 40,000 DWT & over |
| Any grade with high capacity washing machines (exceeding 60 cubic meters/hour) | Yes for ships 20,000 DWT & over | Yes for ships 20,000 DWT & over |
| **New Ships** | | |
| Grades A-D | Yes for ships 20,000 DWT & over | Yes for ships 20,000 DWT & over |
| Grade E5 | | |
| Design limited | No | No |
| Operationally limited: | | |
| No volatile residues from previous voyages[6,7,9] | Yes for ships 20,000 DWT & over | No |
| Volatile residues from previous voyages | Yes for ships 20,000 DWT & over | Yes for ships 20,000 DWT & over |
| **Crude Oil/Product Tankships[8:] Existing Ships[3,4]** | | |
| Grades A-E crude oil | Yes for ships 20,000 DWT & over | Yes for ships 20,000 DWT & over |
| Grades A-D product[6,7] | Yes for ships 20,000 DWT & over | Yes for ships 40,000 DWT & over |
| Grade E5 product | | |
| Design limited | No | No |
| Operationally limited: | | |
| No volatile residues from previous voyages[6,7,9] | Yes for ships 20,000 DWT & over | No |

| | | |
|---|---|---|
| Volatile residues from previous voyages | Yes for ships 20,000 DWT & over | Yes for ships 40,000 DWT & over |
| Any grade with high capacity washing machines (exceeding 60 cubic meters/hour) | Yes for ships 20,000 DWT & over | Yes for ships 20,000 DWT & over |
| **Crude Oil/Product Tankships[8]: New Ships** | | |
| Grades A-E crude oil | Yes for ships 20,000 DWT & over | Yes for ships 20,000 DWT & over |
| Grades A-D product | Yes for ships 20,000 DWT & over | Yes for ships 20,000 DWT & over |
| Grade E5 product | | |
| Design limited | N/A | N/A |
| Operationally limited: | | |
| No volatile residues from previous voyages[6,7,9] | Yes for ships 20,000 DWT & over | No |
| Volatile residues from previous voyages | Yes for ships 20,000 DWT & over | Yes for ships 20,000 DWT & over |

**NOTES:**

1. This table is based on the requirements of 46 CFR Subpart 32.53.

2. The requirements for U.S. flag ships (operating worldwide) and foreign flag ships (operating in U.S. ports) are the same except as noted in footnote 8.

3. "New" and "Existing" tankers are defined in 46 U.S.C. 3701 (Contract date after June 1, 1979; in the absence of a contract date, keel laying date after January 1, 1980; delivery after June 1, 1982.).

4. The U.S. and SOLAS regulations provide for inert gas exemptions for existing crude and crude/product carriers in the range 20,000 to 40,000 DWT. However, the United States has not granted any exemptions to date for either U.S. or foreign flag tankships, and the United States does not recognize inert gas exemptions granted by foreign Administrations.

5. This entry applies to a Grade E cargo that is carried at a temperature lower than 5 degrees C below its closed cup flashpoint. If it is heated to within 5 degrees C of its closed cup flashpoint, it is treated as if it were a Grade A - D cargo for the purposes of the IGS. Differentiation is made between tankers that are limited to carriage of Grade E cargoes by design and those that are capable of carrying more volatile cargoes but are only engaged in Grade E trade (i.e., operationally limited). The intent is to ensure that tankers that are operationally limited to Grade E cargoes are

functionally equivalent to tankers that are limited by design to Grade E. See footnotes 6, 7, and 9.

6. Note that where an IGS is installed but not operated, the inert gas main stop valve must be closed and the inert gas blowers and IGG, if any, secured.

7. In some venting system designs, when the IGS is not operating, the inert gas main can serve as a path for fire and explosion to travel from one tank to another. Therefore, if the tank venting system incorporates the inert gas main and the tanks cannot be isolated from the inert gas main without risking over or under pressurizing the tanks, the IGS must operate at all times.

8. Foreign flag crude/product tankships from 20,000 to 40,000 DWT that have received inert gas exemptions from their Administration and that do not have inert gas systems installed may not carry crude oil in U.S. ports. However, they may carry product in U.S. ports.

9. A tank is considered to be free of volatile residues from previous cargoes when it has been cleaned and gas freed (safe for hot work) prior to loading the Grade E cargo. If the vessel shifts from the carriage of Grade D or higher cargoes to the carriage of Grade E cargoes without gas freeing, the first Grade E cargo must be treated as though it contained volatile residues. Subsequent Grade E cargoes need not be inerted provided the requirements of footnote 5 are met.

---

**4. Problems of Reactive Products**

There is one significant potential problem introduced by the IGS: the creation of pyrophoric iron sulfide. This solid chemical is formed at a very slow rate (building up over a period of months or years) by the reaction of the iron in the cargo tank surface with the sulfur compounds in the cargo. Iron sulfides react spontaneously and very rapidly with oxygen in the air, giving off heat.

In an uninerted tank, this is not a problem. Each time that the tank is emptied (usually every few weeks), the iron sulfides react with the oxygen before much of a deposit has formed; thus, there is no opportunity for a buildup. If the tank is inerted, however, the tank surfaces may not be exposed to air for as long as 2 or more years and the iron sulfide may build up. When suddenly exposed to air, it will react, give off heat, and ignite any flammable vapors present. Although the IMO is examining this problem, no definitive solution has been found. A tankship should not be offloaded with an inoperative IGS because the process results in large amounts of oxygen entering the tank. In such cases, an external source of inerting gas should be used as a substitute for the inoperative system.

---

### 5. Basic Inspection Considerations

IGSs are complex, and the Marine Inspector should invest the time to learn what an IGS is, how it is designed, and how it can fail.
There are numerous IGS designs in use today. These involve different methods of producing inert gases, various ways to clean the gases themselves, and a vast number of combinations of types and arrangements of valves and piping.

The inert gas is either treated flue gas from the ship's boilers or combustion gases from a separate, dedicated IGG. The major difference between flue gases and products of an IGG is that the sulfur oxide, sulfurous acid, and sulfuric acid concentrations are considerably lower when a low sulfur fuel is burned in the IGG. Otherwise, the principles of unable to support combustion operation, components, and general design are similar.

Prior to inspecting an installed IGS, the inspector must become familiar with the particular system he or she will inspect, including a review of the manufacturer's instruction manual and the ship's operation and maintenance manual. The latter must provide specific outline plans, instructions, and safety precautions for the particular vessel.

**SAFETY NOTE:** Above all, the inspector must be careful: if a tank atmosphere has been inerted by an IGS, it will not support life, either. A person who enters an inerted space without adequate breathing apparatus will die within a few minutes.

No person must enter a tank unless it has been certified gas free by a Marine Chemist.

## C. TYPICAL SYSTEM COMPONENTS FROM THE GAS SOURCE TO THE TANK

### 1. Boiler Uptake Valves (Flue Gas Isolating Valves, IGG Isolating Valves)

These valves are located near the main boiler uptake to isolate the IGS scrubber from the boiler uptake. Alternatively, if a dedicated IGG is used, this valve will be located near the IGG; it is closed when the IGS system is not operating. Associated with each boiler uptake valve is a steam soot-blowing system. A spectacle blank is also fitted between the boiler uptake valve and the IGS scrubber to ensure complete isolation of the IGS plant and cargo. This is very important to ensure that inert gas is not introduced into the system during maintenance.

### 2. IGS Scrubber (Scrubbing Tower, Absorption Tower, and Gas Washer)

The raw inert gases are hot and contain soot, sulfur oxides, sulfurous acid, and sulfuric acid; all of these can be harmful to the cargo and the cargo tanks. The scrubber cools the gases and removes the contaminants by bubbling the gases through large quantities of seawater (there must be two sources of water for the scrubber). The gases are then sprayed with additional quantities of water, or rise through a packed bed of ceramic forms, plastic shapes, or metal trays through which seawater falls, increasing the efficiency of the water in cleaning the inert gas.

If the scrubber is provided with a heater to prevent the water from freezing, an automatic control system is installed to prevent its overheating. The scrubber also acts as an automatic safety device by preventing a backflow of gas to the boiler uptake or the IGG (see Figure C5-1).

---

### 3. Demister Units

The gas from the scrubber has significant amounts of moisture, both from the burning process and from bubbling through the seawater in the scrubber. The demister is located close to the scrubber to remove entrained water from the IGS gas stream. If this water is not removed, it increases the corrosion rate in the system's piping, valves, and cargo tanks. Water may also contaminate the cargo. The demister may consist of "pads" or "mattresses" of woven polypropylene or fiberglass, or centrifuge separation (cyclone dryers). There are many designs, which vary considerably.

---

### 4. IGS Blowers (Fan Units)

Two or more independent blowers are located near the demister to draw the inert gas through the scrubber and the demister and deliver it to the IGS distribution system at the required pressure.

Since the greatest need for inert gas is during offloading, the blower capacity is set at 125 percent of the maximum rated capacity of the cargo pumps. This provides a margin of safety to ensure that no air enters the cargo tanks. This capacity may be provided by two blowers of equal size, or by one large and one small blower. Separate inlet and discharge valves are fitted to each blower unit. On most plants, the valves are hand-operated, but on some the discharge valves are combined with the main and auxiliary pressure regulating valves.

---

### 5. Pressure Regulating Valve (Gas Regulating Valve, IGS Control Valve, Main Valve)

The pressure-regulating valve is used to adjust the pressure between the IGS and the cargo tanks. An overpressurized cargo tank can rupture if the pressure in the IGS value is too high. It is also important to prevent backflow from the cargo tanks, which could lead to inert or cargo gases entering the machinery spaces. A fire or explosion could occur if cargo gases mix with air and enter the boilers, the engines, or the IGG.

The pressure-regulating valve is installed to regulate the flow of inert gas to the IGS deck main, maintain the IGS pressure, and prevent gas backflow when the IGS malfunctions or is shut down. The value position may be controlled either manually or automatically. For automatic control, the IGS pressure is used to set the valve in a pneumatic, hydraulic, or electric feedback control to maintain a constant pressure regardless of the rate of cargo discharge.

**NOTE:** Electrical equipment in a hazardous location must be suitable, i.e., explosion-proof, intrinsically safe, or purged and pressurized.

---

6. Deck Water Seal

   a. Usually located on the main deck, the deck water seal is the primary safeguard to automatically prevent a reverse flow of cargo gas from a tank to the boilers, the engines, or the IGG.

      (1) The deck water seal offers a positive break in the system by means of a water trap. This permits inert gas to be delivered to the main deck while preventing gas backflow, even when the IGS is shut down.

      (2) Chapter 15 of the International Code for Fire Safety Systems (FSS Code) requires two independent water supplies for the deck water seal. When the IGS is operating, the scrubber pump supply is used; the second supply, normally the salt water service pump, is used when the IGS is not operating. Each pump must be capable of operation at all times.

      (3) There should be provisions in place to prevent the water in the seal from freezing and an automatic control system that prevents overheating of the seal.

      (4) Although it is not required, a demister is usually fitted to separate any remaining water and solids from the inerted gas. There is always a water layer through which the inert gas bubbles (see Figures C5-2 through C5-4).

   b. Type requirements. There are three general types of deck water seals: wet, semidry, and dry.

(1) The wet seal is described in Figure C5-3. It is deemed the most reliable seal and is the only type generally approved for use on U.S. vessels.

(2) The semidry seal operates dry after the inert gas flow displaces the water. Venturi action returns the water when a gas block is needed, as described in Figure C5-4. This type of seal may be approved for U.S. vessels on a case-by-case basis, if the unit is quick-acting, has no moving parts, and has no sensors that are subject to failure.

(3) The dry seal operates normally dry and is filled with water when the inert gas plant is shut down or when tank pressure exceeds the inert gas pressure. This system requires more operating parts, reacts more slowly than and is not deemed as reliable as the wet type. Dry seals are not approved for use on U.S. vessels. See Figure C5-4 for a more complete description.

(4) A double block-and-bleed arrangement is not common but may be used on some foreign vessels in place of the water seal. This involves two closely spaced valves to stop the inert gas flow (the "double block") plus a means to release (or "bleed") any gas trapped between the valves. This automatic device is not permitted on U.S. ships as a substitute for the required water seal.

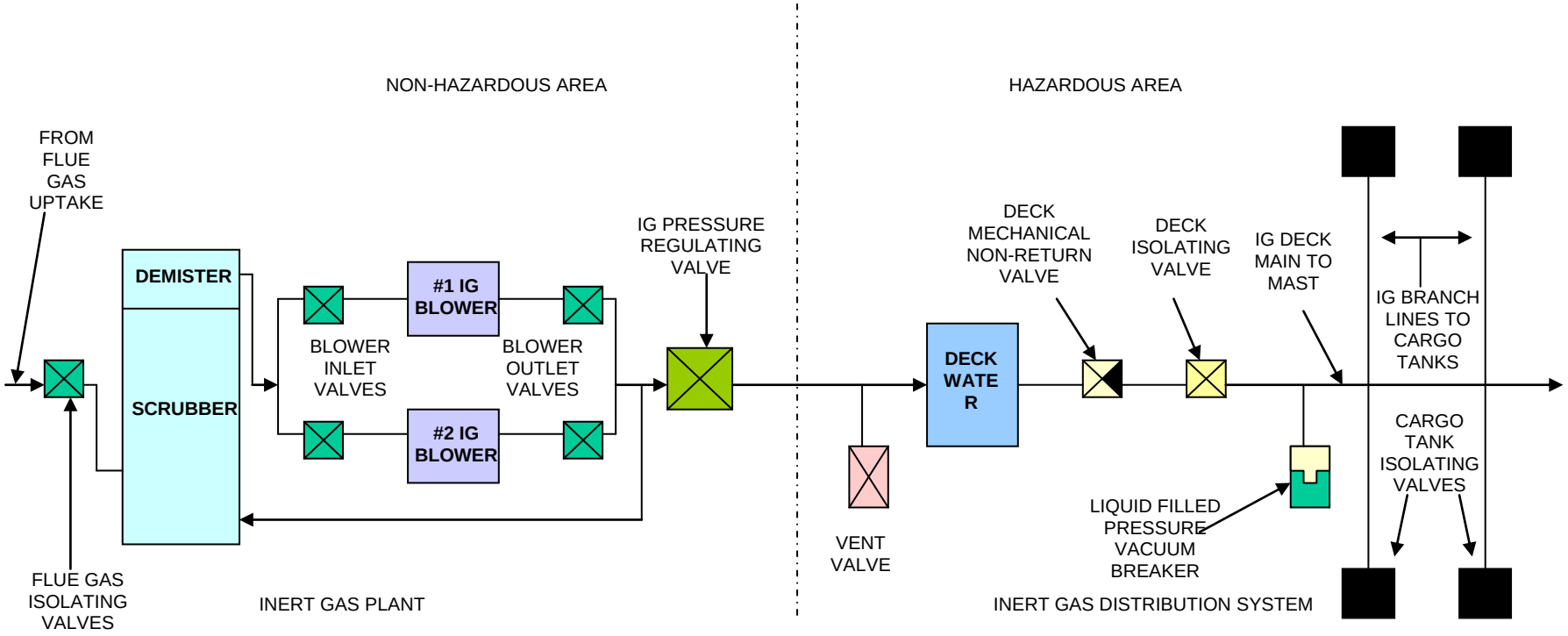
---

### 7. Deck Mechanical Non-Return Valve

In addition to the deck water seal, FSS Code 15/2.3.1.4.3 requires a second non-return device with a positive means of closure be fitted in the inert gas supply main. Review the FSS Code for further guidance.

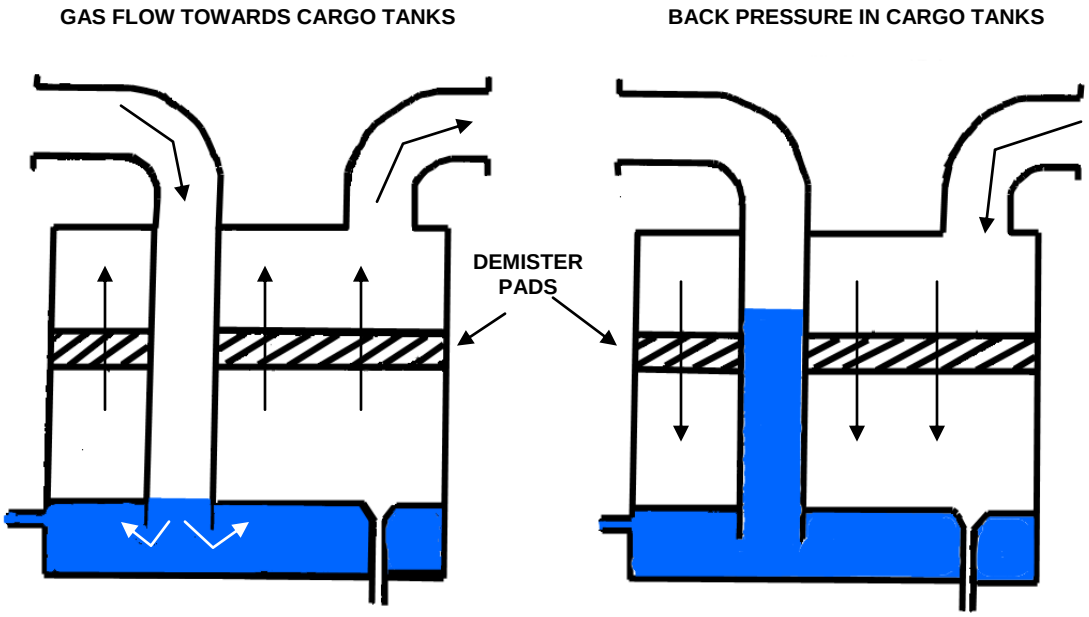
---

## FIGURE C5-2: TYPICAL IG SYSTEM COMPONENTS



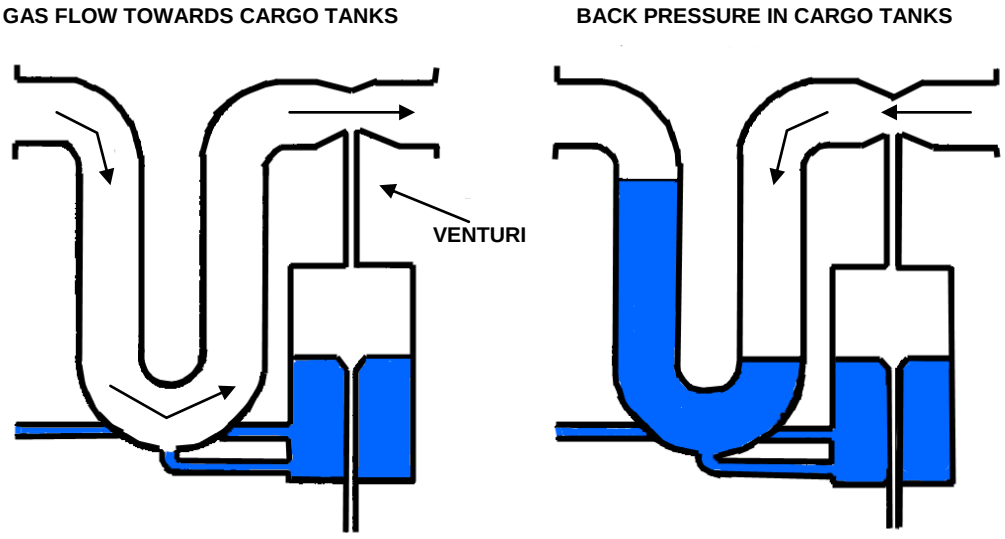

TYPICAL ARRANGEMENT FOR AN INERT GAS SYSTEM

**FIGURE C5-3: DECK WATER SEAL — WET TYPE**



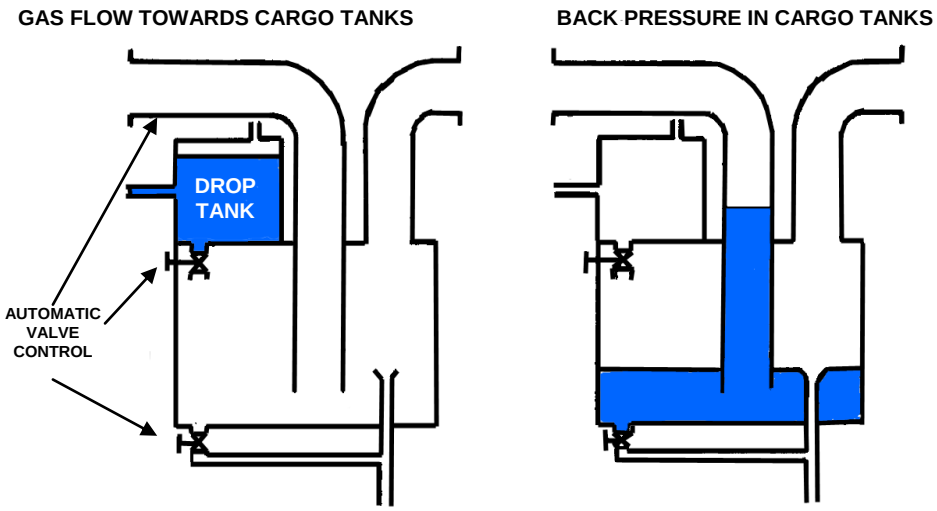

DECK WATER SEAL — WET TYPE

**FIGURE C5-4: DECK WATER SEAL — SEMI-DRY TYPE**




DECK WATER SEAL — SEMI-DRY TYPE

## FIGURE C5-5: DECK WATER SEAL—DRY TYPE




DECK WATER SEAL — DRY TYPE

In the dry type seal, the water is drained from the seal when the IG plant is in operation (gas flowing to the tanks), and filled with water when the IG plant is either shut down, or the tank pressure exceeds the IG blower discharge pressure. Filling and drainage are performed by automatically operated valves controlled by the levels in the water seal and the drop tank, and by the operating state of the blowers.

U.S. vessels must be equipped with seals that are completely passive in operation so that failure of sensors, control systems, or moving parts cannot cause failure to establish a seal. Active seals, such as the dry seal shown above, are not acceptable. For the relevant regulations, see 46 CFR 32.53-10.

### 8. Deck Isolating Valve (Main Isolating Valve)

This valve is used to isolate the inert gas plant from the deck distribution subsystem and the cargo tanks; it therefore constitutes the "first" barrier to any reverse flow of cargo tank gas when the IGS is started, tested, or secured. A second valve is necessary unless the deck mechanical non-return valve has a positive means of closure.

---

### 9. Deck Distribution System

This subsystem consists of a single inert gas main running the entire length of the cargo deck, starting at the deck isolating valve aft and ending at the vent valve forward. One or more pressure/vacuum devices are fitted to the inert gas main to prevent the cargo tanks from being over or under-pressurized. The inert gas main contains a means for receiving an outside source of inert gas when the IGS is not functioning. From the inert gas main, individual branch lines run to the cargo tanks. Stop valves or equivalent closures are fitted at each branch line so that each cargo tank can be isolated from the IGS.

If there is a connection between the inert gas main and the cargo piping system, there must be valves or similar closures to isolate the systems from one another.

---

### 10. Typical Gas Venting Arrangements

a. Venting system. Each tank vessel has a venting system that is capable of venting vapors displaced from the cargo tanks during loading and ballasting. There are also Pressure/Vacuum (P/V) valves to protect the cargo tanks from overpressure or vacuum resulting from thermal variation when the cargo tanks are isolated from the inert gas mains. Some of the possible arrangements are--

(1) A single common venting system using the IGS deck main and branch lines from each tank and venting to the atmosphere through one or more mast risers or high-velocity vents. Precautions must be taken to prevent an arrangement by which tank vents can be blocked off;

(2) A common venting system using a separate vent main and vent lines from each tank, with the system venting to the atmosphere through one or more mast risers or high-velocity vents; or

(3) Individual vents on each tank using either standpipes (vent stacks) or high-velocity vents.

b. High level alarms. Tank high level alarms have been accepted in lieu of equal area venting required by 46 CFR 56.50-85(a)(7). However, precautions are necessary to prevent tank over pressurization during cargo or ballast loading. The oil transfer procedures, Crude Oil Washing (COW) procedures, equipment manual, and ballasting instructions should include requirements for testing high level alarms and the proper positioning of valves for each type of operation.

### 11. System Documentation

Each tank vessel is required by FSS Code to have an operating and maintenance manual. There are devices located downstream of the blowers to indicate the oxygen concentration and the IGS pressure and temperature, as well as a means of automatically recording this information. The records of oxygen concentration and IGS pressure should remain aboard the vessel for at least 2 years.

## D. GAS FLOW THROUGH THE IGS

### 1. Introduction

Inert gas is provided from the main or auxiliary propulsion uptake point or from the IGG, and flows through the flue gas isolating valve or IGG isolating valve to the IGS scrubber. Before entering the bottom of the scrubbing tower, the gas is cooled by bubbling through a water seal or by passing through a water spray (see Figure C5-2 for a diagram of a typical IGS arrangement).

### 2. Water Flow

a. In the scrubbing tower, the gas moves upward through a supply of downward-flowing seawater. To maximize the contact between the gas and the water, several water layers created by one or more of the following arrangements may be used:

(1) Spray nozzles.

(2) Trays of packed stones or plastic shapes.

(3) Perforated impingement plates.

(4) Venturi nozzles and slots.

b. Seawater is supplied to the scrubber by an independent, continuously rated scrubber pump. The saltwater service pump is normally piped into the system to provide a secondary or backup supply of seawater. The scrubber effluent ("wash" or "cooling water") is both warm and acidic, and special corrosion-resistant piping must be used to discharge it overboard. A vacuum breaker (U-bend) is necessary to prevent possible loss of water in the seal.

**NOTE:** The scrubber must have an adequate supply of saltwater for the prescribed gas flow. A low saltwater level means that the scrubber will not work as designed or not at all.

c. Fresh water flushing facilities are provided so that all acidic solutions and all salt water may be removed from the scrubber when the IGS is shut down.

---

3. Refinement of the IG Mixture and Flow Control

At the top of the scrubbing tower, water droplets are removed from the inert gas mixture by one or more demisters. The operating blower draws the gas from the scrubber/demister unit under vacuum and delivers it to the inert gas distribution at the required pressure and volume.

The total capacity of the blowers must be at least 125 percent of the maximum rated capacity of the cargo pumps. The blowers may be either steam turbine or electric powered. Steam inlet and return valves are manually operated, but both blowers can be controlled from the engine control room.

To prevent the blowers from overheating when there is no demand for inert gas in the cargo tanks and to allow gas concentration to be developed during startup, a recirculating line is fitted to return the blower discharge to the scrubber. Flow is controlled by recirculating or bypass valves, operated independently by gas flow demand, or in conjunction with the gas pressure regulating system.

---

**4. Alternate Blower Arrangements**

Some IGS blowers are used to gas free the cargo tanks in lieu of portable blowers or a separate fixed gas freeing blower system. In this arrangement, the installation is fitted to isolate the flue gas and substitute suction from the atmosphere.

As with the scrubber, fresh water flushing facilities are fitted to remove acidic residues in the blower casings. The fresh air then passes through the pressure regulating valve, the deck isolating valve, the IGS main, and the individual branch lines into the cargo tanks.

---

## E. INTERNAL INSPECTIONS OF IG SYSTEMS

### 1. Introduction

The Marine Inspector must appreciate the potential for introducing "dirty" or corrosive gas into the IGS by improper operating procedures or poor maintenance practices. This situation will create an environment for rapid system degradation or component failure.

The following policy is not intended to be applied during routine testing of the IGS on either a U.S. or foreign tanker during a COI, Annual, or PSC/COC exam. Internal inspections are anticipated by the operators of U.S. tankers during scheduled drydock exams.

### 2. Specific Inspection Guidelines

a. Scrubber. Where feasible, all access plates and internal components such as demister pads and scrubber trays must be removed. Soot and scale deposits must be removed prior to the inspection. The following areas and internal components should be given close attention:

(1) Internal coatings should be completely intact. Check for signs of chipping or cracking, particularly around internal fastenings.

(2) Gas inlet pipe in the scrubber water seal should be inspected for corrosion and holes or leaking flanges, especially above the water level, that would allow gas to bypass the seal and render it ineffective.

(3) The internal area at the bottom of the scrubber should be closely inspected for corrosion, especially in way of the effluent discharge line. The discharge line should be checked for clogging.

(4) Float switches, temperature sensors, Venturi slots, impingement plates, packed trays, and demisters (as applicable) should be inspected for damage, wastage, and corrosion.

(5) The water heater (used to prevent water freezing) and its control system should be in good condition.

(6) Fresh and saltwater inlet piping should be inspected for corrosion or wastage, and especially for holes or leaking flanges. Spray nozzles should be checked for clogging and intact condition.

b. Valves. Boiler uptake (or IGG) valves, blower inlet and discharge valves, recirculating valves, pressure regulating valves, deck mechanical non-return valves, deck isolating valves, and IGS isolating valves must be disassembled for inspection.

(1) Valve internals must be inspected for cleanliness, and for signs of corrosion or erosion.

(2) Careful attention should be given to "butterfly" mechanisms to ensure free, smooth operation, and proper seating.

(3) Check non-return valve seals. If accessible, either through inspection ports or disassembled components, the internal areas of the inert gas main and branch lines must be checked for excessive scale buildup or soot deposits, which could result in a critical gas pressure drop between the IGS blowers and the cargo tanks.

c. Deck water seal. This must be disassembled. Internal coatings must be inspected for intactness; housing and heating coils, for corrosion; gas inlet pipes, for corrosion, holes, or leaking flanges (especially above the water level) that would permit gas to bypass the seal; and drain lines, for clogging or corrosion.

(1) The demister pads must be clean and free of soot and scale deposits.

(2) Check that the heater (used to prevent water freezing) and its control system are in good condition. Only the wet type of water seal is permitted; in this type there is always water present in the device and the inert gas flowing through the seal always bubbles through a layer of water.

(3) Semidry seals, in which water is not always present, are approved for U.S. vessels on a case-by-case basis.

(4) Dry water seals and the double block-and-bleed assemblies are not permitted aboard U.S. vessels.

d. Blowers. The inspection ports and access plates on all blowers must be opened. Blower impellers, bearings, and casings must be checked for corrosion or excessive buildup of deposits that may cause blade failure. If accessible, fresh water flushing spray nozzles must be checked for intactness or clogging; the blower drain piping, for corrosion or clogging.

e. P/V valves. P/V valves must be disassembled and inspected for corrosion and the choking of flame screens from soot, oil entrainment, and rust. The forward pressure release valve must be disassembled and the butterfly mechanism inspected for free, smooth operation and proper seating. If feasible, the liquid-filled, P/V breaker must be drained and inspected for sludge, sediment, or soot deposits that could render the component ineffective. High-velocity vent installations must be inspected for internal deposits or corrosion that may reduce venting capacity or prevent tight closure.

f. Flue gas uptakes. If accessible, the flue gas uptake should be inspected for clogging from soot deposits when the boilers, engines, or IGGs are secured. On systems with IGGs, the combustion chamber must be checked for soot, scale, or fuel deposits that could indicate improper combustion control or a distorted fuel spray pattern.

g. Calibration. Check the equipment used for the calibration of the fixed and portable gas concentration measurement devices.

## F. OPERATIONAL INSPECTIONS

### 1. Introduction

The following tests must be conducted on U.S. tankships during annual and COI exams and, on foreign tankships, at each PSC/COC examination.

On all vessels, these tests must be conducted prior to allowing COW in a U.S. port.

The scope of such tests must be sufficient to ensure that the IGS is operating within the manufacturer's design parameters and that the installed safeguards will operate as designed in the event of system malfunction.

The Marine Inspector must review the manufacturer instruction manual and the vessel's operating and maintenance manual, and must be alert to conditions that must be simulated. The inspector must not accept a manual that does not address specific safety precautions for the particular vessel.

### 2. Inspection Procedures

a. Externally inspect the condition of all piping and components, including scrubber, fans, valves, bellows expansion pieces, standpipes, and screens, for signs of corrosion and gas/effluent leakage.

b. Observe all IGS blowers in operation for proper operation and for excessive bearing noise or vibration. Ensure that the scrubber room ventilation system is operating.

c. Observe the operation of both the salt water scrubber pump and the pump used to provide an alternate salt water supply.

d. If the scrubber design uses a water seal, check for proper water level. Some foreign vessels are fitted with water sprays only, but U.S. vessels must have a wet type water seal.

e. Observe the deck water seal for automatic filling and check the water level with the local gauge, if possible. Check for the presence of water carryover (especially in the wet and semidry types) by opening the drain cocks on the IG main during operation. Check that the heater coil for cold weather operation is operational.

f. Check the operation of all remotely operated or automatically controlled valves, particularly the flue gas isolating valves. Check that there are functioning indicators showing whether the valves are open or shut.

g. If possible, check the level of the liquid in the P/V breaker.

h. Check to ensure that all salt water supply pressure gauges, oxygen and gas pressure recorders, and temperature and pressure gauges are fully operational. The fixed inline oxygen analyzing equipment will be calibrated during the operation of the IGS. Observe a calibration check of the equipment by a qualified member of the ship's crew. Spot-check several recordings made since the last inspection during normal system operation for compliance with oxygen and pressure level requirements.

i. Examine the blower drives, the seawater pumps, valves, and strainers for the scrubber and the water seal; the piping connections at the scrubber; water seals; and the shell plating.

j. Observe that all portable instruments are properly calibrated and operating as required by the manufacturer instruction manual. These may include an oxygen analyzer, a combustion gas indicator, and a hydrocarbon gas indicator. Sample points should be provided for the use of portable instruments for monitoring cargo tank atmospheres.

k. If an IGG is used, examine the automatic combustion control system, the combustion chamber and its mountings, the forced draft fan, and both fuel oil service pumps.

3. Operational Tests

   a. The operation of both audible and visual alarms should be observed in the cargo control room, the engine control room, and the pilothouse. The marine inspector must consult the manufacturer instruction manual and the ship's operation and maintenance manual for guidance in establishing proper test procedures. Simulation may be necessary for some tests. However, simulation tests of the alarm panel must not be accepted as evidence of satisfactory operation of the following alarm and safety shutdown systems:

      (1) High oxygen content of gas in IGS main; alarms activated at an 8 percent concentration.

      (2) Low gas pressure in IGS main downstream of all non-return devices; alarms activated at 100mm (4 inches) water gauge. An automatic shutdown of the cargo pumps may be fitted on some vessels. Also, high gas pressure in the IGS main downstream of all non-return devices.

      **(3)** IGS blower high discharge temperature alarm that will automatically shut down the IGS blowers and the gas regulating valve; alarms activated at 150°F (65.6°C) or less for U.S. vessels and at temperatures indicated in approved operation manual for foreign vessels.

      **(4) A low water level alarm fitted to the deck water seal.**

      (5) High gas pressure of the inert gas supply forward of the non-return devices.

      (6) IGS blower failure alarm and automatic shutdown of main or regulating valve.

      (7) Power supply failure for the automatic control system gas regulating valve and the indicating devices showing the proper quantity and quality of the inert gas supply.

      (8) Insufficient fuel oil supply to the IGG and the failure of the power supply to the IGG.

   b. Conduct backflow pressure test of water seal and non-return valve.

   c. Test interlocking of soot blowers. The IGS will automatically shut down if soot blowers are operated.

d. Test for automatic shutdown of the gas pressure regulating valve when the IGS blowers are secured.

e. Test the automatic combustion control features of the IGG (if used) in accordance with standard combustion test procedures for automatic auxiliary heating equipment (see 46 CFR Part 63).

f. Test IGS remote shutdown required by 46 CFR 111.103-9.

## G. SAFETY PRECAUTIONS

### 1. Introduction

The purpose of an IGS is to establish positive pressure in a cargo tank with an atmosphere that will not support combustion. If an atmosphere will not support a fire, it will not support life. Clearly, such an inerted, pressurized atmosphere is highly dangerous, producing unconsciousness and death in a short period. The following guidance is intended to make inspectors aware of the fundamental steps that must be taken to ensure IGS safety.

### 2. References

In addition to this chapter of the MSM, the inspector should consult the following sources:

a. 46 CFRSubchapter D, Part 32.53.

b. The American Bureau of Shipping (ABS) Rules for Building and Classing Steel Vessels, Appendix B, Regulation 10.

c. SOLAS 74/78, Chapter II-2, Regulation 4, and amendments.

d. The manufacturer instruction manual.

e. The vessel's operating and maintenance manual.

f. Commandant's International Technical Series (CITS), Volume VII (USCG CITS-80-1-1), "Regulations and Guidelines for Inert Gas Systems."

### 3. Requirements for an Escort

The Marine Inspector must always have a ship's officer or port engineer trained in the operation of the IGS along as an escort. The ship's officer or the port engineer will oversee all required tests and inspections.

---

### 4. Personal Caution

Always stand well clear of any ullage opening when the cover is being removed, even though the cargo tank pressure has been lowered to a safe level. Wear protective clothing and goggles when conducting internal inspections of the system.

Remember that the potentially corrosive nature of the dirt, scale, and soot associated with the internals of an IGS can irritate or damage your skin and eyes.

---

### 5. Requirements for Tank Entry

The Marine Inspector must not, under any circumstances, enter a cargo tank when the IGS is operating or when the tank or the adjacent tanks have been inerted, unless the following steps are taken:

a. The cargo tank must be certified "safe for workers" by a certified marine chemist.

b. Pressure on the remainder of the system must be lowered to 200mm (8 inches) water gauge to minimize the possibility of IGS leakage into the "gas-free" cargo space.

c. The IGS branch line control valve to that tank must be closed, with a person stationed at the ullage opening within clear view of the valve. This person should be wearing a self-contained, pressure-demand breathing apparatus, ready for immediate use, and should be provided with a rescue lifeline and a standby person positioned as noted above.

**NOTE:** If an isolation blank is fitted instead, it must be wired closed with the label "Personnel in cargo tank."

d. Drain lines (if fitted) from the IGS main to that cargo tank must be secured.

e. The relevant cargo line valve must be closed.

f. The cargo tank must be continually vented and regularly tested with the portable oxygen analyzer.

g. An approved self-contained, pressure-demand breathing apparatus must be worn for immediate use, if needed. It must be equipped with a belt-mounted, calibrated oxygen/combustion gas indicator in continuous operation.

---

### 6. Ventilation Requirements

If the IGS is secured and the IGS blowers are being used to purge and ventilate the cargo tanks, the branch valve must be left open.

In this case, ensure that the spectacle blank or valve downstream of the boiler uptake valve is in place and that a person is stationed at that blank.

---

### 7. Branch Line Inspections

Never inspect the flue gas bellows or scrubber unless all branch line spectacle blanks are in place (or branch line isolation valves are closed), the spectacle blank downstream of the boiler uptake valve is in place, isolation valves are closed, and the IGS has been purged and certified "safe for workers" by a marine chemist. If a boiler is operating, require a person to be stationed at the spectacle blank downstream of the boiler uptake valve.

---

### 8. Internal Inspections of Enclosed Spaces

When conducting internal inspections of pumprooms, cofferdams, permanent ballast tanks, and fuel oil tanks on tank vessels fitted with IGS, be aware that inert gas may have leaked into such tanks or compartments.

While inspecting the tank or compartment, the inspector must be equipped with an emergency escape breathing apparatus and a belt-mounted, calibrated oxygen/combustion gas indicator that is in continuous operation. Always test for sufficient (at least 19.5 percent) oxygen first, then test for vapors above 10 percent of the lower flammable limit.

**NOTE:** A combustion gas indicator will not give an accurate indication of the percentage of hydrocarbon gas in an oxygen-deficient atmosphere. A hydrocarbon gas content meter must be used to determine whether hydrocarbon vapors are present in an inerted tank or compartment.

## H. PRESSURIZATION OF IG SYSTEMS

### 1. General Requirements

The operational requirements in 46 CFR 32.53-5 require the master to ensure that the IGS is operated as necessary to maintain a positive pressure on the cargo tanks. This requires the tank to be sealed at all times except when the tank is either gas-free or carrying a cargo that cannot produce a flammable atmosphere.

For certain cargoes, the cargo purity is of critical importance; thus, the cargo tanks must be gas-freed and entered prior to loading. In such instances, standard gas-freeing procedures must be followed.

### 2. During Periods of Cargo Access

The high costs of crude oil and petroleum products can require cargo level measurement and cargo sampling before and after loading, and before and after the cargo is transferred. Cargo and ballasting operation must not be performed while manual measurement or cargo sampling is being conducted.

The following requirements apply:

a. A minimal number of small tank openings may be uncovered for as short a time as necessary to perform measurement or sampling.

   (1) If tanks are thus opened prior to cargo transfer, the tanks must be repressurized before beginning the transfer.

   (2) If tanks are thus opened after cargo transfer, the tanks must then be repressurized before beginning another transfer or the vessel leaves port.

b. Neither cargo transfer nor movement of the vessel must begin until all conditions have been checked and are in order.

c. During cargo transfer operations, the oxygen content and pressure of the inert gas in the IG main must be continuously recorded.

`