# CHAPTER 1: INSPECTION OF VESSELS FOR CERTIFICATION

## A. INTRODUCTION

This part of the manual provides guidance with regard to inspections leading to the issuance of a Certificate of Inspection (COI). Information concerning miscellaneous decisions and interpretations as a result of inquiries is also included. This guidance is amplified by additional information in other parts of this manual, which are cross-referenced. The responsibilities of the officer in charge, marine inspection (OCMI) and inspection personnel are discussed in volume I of this manual.

## B. CERTIFICATION OF VESSELS

### 1. General Provisions

46 U.S.C. Chapter 33 requires that certain vessels possess a Certificate of Inspection (COI). Issuance of this certificate is dependent upon the satisfactory completion of an inspection for certification[1]. Retention of the COI depends upon the continued maintenance of the vessel in a safe operating condition. The Officer-in-Charge, Marine Inspection (OCMI) is authorized to issue permanent COIs generated by the Marine Safety Information System (MSIS) (see chapter 3 of this volume), or Temporary COIs (Form CG-854) pending issuance of the permanent form, when satisfied that the vessel in question complies with all applicable statutes and regulations and can be operated safely without endangering life or property.

[1]**NOTE:** The initial COI may be completed before issuance of the Certification of Document (COD). The COI should be issued, provided the National Vessel Documentation Center (NVCD) has received the application for documentation. Contact the NVCD about vessel documentation questions.

Government Owned Vessels

a. Government owned vessels may be subject to maritime and environmental safety laws. Check the "applicability" sections of the applicable CFR subchapter to determine if a regulation applies to government vessels.

Jones Act Requirements

b. Jones Act Requirements for Coastwise U.S. Trade: Vessels engaged in coastwise or Great Lakes trade must be built in the United States. For vessel to be considered a U.S. built vessel it must have been constructed totally within the United States. This includes fabricated[2] structural vessel components. There is no allowance for fabrication of even a small portion of major components outside of the United States.

[2]**NOTE:** Construction materials that are otherwise processed per detailed instructions so as to permit simplified assembly with nominal preparation will normally be considered fabricated.

### 2. Periods of Validity

Introduction

a. Introduction. The periods of validity for a COI vary by vessel type and are specified within the applicable regulations. In general, they are:

(1) **1 year** for passenger, small passenger vessels more than 65 feet in length, Nautical School Ships, and nuclear powered vessels;

(2) **2 years** for cargo, tank, oceanographic research, and miscellaneous vessels; and

(3) **3 years** for small passenger vessels not more than 65 feet in length.

Certificates are normally issued for the maximum period specified in the applicable regulations. A vessel is certificated on its ability to meet the minimum safety standards set forth in the regulations. Under existing law, any vessel meeting these standards is entitled to a full-term certificate. A vessel unable to meet the minimum standards shall be required to correct its deficiencies prior to certification or, if the deficiencies are minor and do not make operation of the vessel unsafe, be granted reasonable time in which to make the necessary corrections. An owner may surrender the COI and apply for inspection for recertification at any time prior to the expiration date. The conditions under which certain vessels on foreign voyages may return to the U.S. with expired certificates are discussed in paragraph B1.C.7 below.

Vessels with Expired COI

A vessel for which the COI has lapsed, regardless of circumstances or reasons, may be required to undergo inspection for certification as a "new vessel" if the owner/operator desires to place the vessel back into certificated service. A determination as to the type and extent of inspection requirements appropriate will be made by the cognizant OCMI after having given due consideration to the

Grandfathering

circumstances giving rise to the vessel's out-of-service period. Environmental conditions such as fresh water, saltwater or drydock lay-up as well as any structural modifications made to the vessel will be critically evaluated. The OCMI may, at his discretion, require a formerly certificated vessel to be inspected as a new vessel regardless of its former status as a certificated vessel. Such vessels would no longer be afforded exemption from regulatory requirements that may have been derived under "grandfather" provisions provided by law, regulation, or policy. A vessel that was once certificated does not qualify indefinitely as an "existing" vessel, especially when it has been structurally modified and/or out of service for an extended period. A vessel whose COI has lapsed will be required to meet those inspection for certification requirements determined to be appropriate by the issuing authority—the OCMI.

One-Year Certificates

b. Regulations permit the issuance of certificates to certain cargo, tank, and miscellaneous vessels for periods of less than 2 years. Examples are one-year certificates for the following:

(1) Vessels equipped with firetube main propulsion boilers, including riveted lap seam boilers;

(2) Vessels that, in the opinion of the OCMI, should be inspected on a one-year basis by reason of route (the Commandant's approval shall be obtained in these cases); and

(3) Nuclear powered vessels.

**3. Entries on COIs**

Number of Passengers Stated

a. Except for ferryboats, the OCMI is responsible for determining the number of passengers that a vessel has accommodations for and can carry with prudence and safety, as provided for in 46 U.S.C. 3501. That number shall be stated on the COI. The OCMI shall not permit the number of passengers allowed to exceed that permitted by law or regulation, or specified in the vessel's stability letter. See chapter 10 of this volume concerning the number of passengers permitted to be carried aboard an excursion vessel.

Maximum Number of Passengers on Ferry Vessels

b. See Title 46 U.S.C. 451, Notes of Decisions, for guidance on how to compute and list the number of passengers and crew on the COI for Ferry Vessels. 46 USC 451 notes state that …"respecting the number of passengers that may lawfully be carried by a passenger steamer, (46 USC 452 and 453) have no application to a ferryboat, though temporarily employed as an excursion boat." Essentially, ferry vessels are not considered passenger vessels by 46 USC 451, and are considered to be cargo vessels. Accordingly, the number of passengers and crew authorized on a ferry vessel is not to be listed on the COI. However, many Ferry Vessels are a combination of both cargo and passenger vessels. As such, when the OCMI and the owner of a ferry vessel agree on the number of passengers that can be carried safely, and when the owner of the ferry desires it, the maximum number of passengers permitted may be entered on the COI.[2]

c. Tankships Carrying Grain Cargo. No amendment of the COI is necessary for a tankship to carry grain cargo. The Federal Grain Inspection Service provides inspectors to oversee loading of vessels with grain.

[2]**NOTE:** When stability is a factor in limiting the maximum number of persons that can be carried with safety on any ferry vessel, the total number of persons permitted aboard shall be stated in the stability letter.

**4. Temporary COIs**

A Temporary COI, Form CG-854, provides evidence of the satisfactory completion of an inspection for certification (see 46 U.S.C. 3309). It stands in lieu of a COI and, until replaced by a COI, has all the force and effect of the permanent certificate. The temporary certificate is intended for use when the immediate issuance of a COI is not possible at the completion of an inspection. It is not the Commandant's intention that a COI should be withheld pending correction of minor deficiencies after a temporary certificate has been issued. Further, when the permanent COI can be issued in time to meet the vessel's needs, no temporary certificate should be issued.

**5. Seasonal Restrictions**

Seasonal limitations are intended to ensure the overall seaworthiness of the vessel and the safety of the passengers carried under differing operational conditions, without completely halting the operation of the vessel during any specific period of time. COI statements of seasonal restrictions shall be as descriptive as possible, showing limitations on vessel routes, the scope of passenger carrying authorizations, and the like.

**6. Certificates Expiring At Sea**

Extensions Not Granted

a. There are no statutory provisions that allow for the extension of a COI. Accordingly, requests for extensions of certificates shall be denied.

Expirations of COIs During Foreign Voyages

b. Under 46 U.S.C. 3314, a vessel may complete a foreign voyage to a port of the U.S. within 30 days of the expiration of its COI without incurring penalties for operating without a valid certificate. The vessel owner/operator must apply for an inspection for certification at the first U.S. port of call. The inspection for certification shall be completed, and a new COI issued, or a Permit to Proceed shall be issued, provided an inspection for certification has been conducted to the point that the OCMI considers the vessel safe to proceed on the voyage (See Section A, Chapter 6 of this volume).

Vessels Sailing <15 Days Prior To Expiration of COI

c. 46 U.S.C. 3314 prevents the grace period described above from being applied if the COI would expire within 15 days of the date of sailing from a U.S. port. A vessel would not violate this provision merely by sailing to a foreign port within 15 days of the expiration of the COI, as long as it can complete a round trip to that port in less than 15 days before the certificate expires. However, such a vessel would be in violation if it sailed within 15 days of the expiration date and failed to return before expiration of the certificate.

**7. Marking of Hailing Ports**

Under 46 CFR 67.123, a hailing port must be marked on some clearly visible exterior part of the stern of a documented vessel. The markings must be durable and made in clearly legible letters of the Latin alphabet or Arabic or Roman numerals of no less than 4 inches in height.

**8. U.S. Vessels Operating in Foreign Waters for Extended Periods**

Questions have been raised concerning the following proposed operation of a U.S. tank vessel: the vessel would be permanently anchored in Venezuelan territorial waters for the express purpose of storing crude oil to be subsequently transferred to vessels coming alongside. While the vessel is permanently anchored, the engineering plant would remain in a standby condition so that, in the event of emergency, the vessel could be moved to a place of safety. It would be manned by two licensed deck officers and two licensed engineers who would generally maintain the vessel, to supervise the transfer of cargo from its tanks to other vessels, and to move the vessel should it be necessary.

As a U.S. tank vessel, it would be subject to inspection and certification under 46 U.S.C. Chapter 33 and 46 CFR, Subchapter D. For the manning of such vessels, as stated in 46 CFR 31.15-1, the OCMI must specify on the COI the number of officers and crew that, in his or her judgment, would be necessary for its safe operation. The complement could be amended by endorsement on the certificate, as a result of changed conditions of employment. Under the regulations, special manning requirements may be set governing particular operating conditions of the vessel. However, such requirements must be within the statutory limitations relating to the manning of vessels (46 U.S.C. 8301). 46 U.S.C. 3311 states that a vessel subject to inspection may not be operated legally without a valid COI. Therefore, as long as it is operated, the vessel could not be exempted from inspections by "permanent" anchoring in Venezuelan waters and would be subject to periodic inspections for certification.

**9. Vessels Constructed for Sale to Foreign Interests**

When inspection is requested for a vessel being built for sale to foreign interests, the OCMI shall inquire whether the vessel is intended to operate under the U.S. flag. If the reply is affirmative, inspection should be undertaken upon application by a citizen legally entitled to have the vessel documented under U.S. law. If the reply is negative, inspection shall not be undertaken.

**10. Towing of Vessels Permanently Laid-Up, Dismantled, or Out-of-Commission**

Vessels are frequently towed for purposes of permanent removal from navigation or scrapping as these vessels reach the end of their useful lives. It has been generally determined that such vessels making a one-way voyage under tow, without crew, cargo, or passengers and not holding documents as a merchant vessel, are not subject to inspection and certification requirements as they are "laid up, dismantled, or out of commission" as envisioned in 46 U.S.C. 3302(e) and 46 CFR 90.05-1(a)(3). In accordance with this determination, when the OCMI is satisfied by documentary evidence or other means that certain conditions are met, such vessels do not require a COI. These conditions may include some or all of the following:

- Is not currently documented by the Coast Guard;
- Will carry no passengers or cargo;

- Will be towed and unmanned;
- Is making a one-way voyage for purposes of scrapping or permanent removal from navigation;
- Is not intended to be used in commerce during the voyage; and
- Will pose no threat to life, property, or the environment while in U.S. waters.

**NOTE:** Such vessels do require a Load Line Exemption Certificate. See MSM, Volume IV, Chapter 6 for guidance.

b. The U.S. Customs Service has determined that although such vessels require clearance before being towed to a foreign port, verification by the OCMI to the effect that "(name of vessel), being towed on a one-way voyage for purposes of scrapping, etc., is not required to hold a COI" will suffice for clearance purposes.

Carriage of Scrap

d. Scrap metal carried for ballast in such vessels will not be classed as cargo to meet the requirements above, as long as the amount, location, and method of stowage of scrap is acceptable to the OCMI and does not exceed the tonnage of liquid ballast that would normally be employed. When the matter of what constitutes cargo is at issue, Commandant (G-MOC) should be consulted.

Requirements for Passage Through the St. Lawrence Seaway

e. Vessels subject to the Load Line Acts (46 App. U.S.C. 86 or 88) and the their own power for decommissioning in other than a U.S. port, require load line and inspection certificates before leaving a U.S. port. This policy is not intended to contravene or supersede requirements of the Canadian government with respect to passage through Canadian waters and clearance from Canadian ports. Owners of such vessels should contact the Director, Marine Regulations Branch, Department of Transport, Ottawa, Ontario, Canada, for further information in this regard. Owners of such vessels intending to transit the waters of other countries should contact officials of those countries. The issuance of an “International Load Line Exemption Certificate,” by the local OCMI may be required. For further information and guidance, see MSM Volume IV, Chapter 6, and for applicable regulations, see 46 CFR 42.03-30(b)(3).

**11. Vessels Operating in South-eastern Alaska**

46 CFR 2.01-80 states that the waters of southeastern Alaska, inside of the general trend of the shore from Cape Spencer, southeasterly to Cape Muzon, and thence easterly to Sitklan Island, shall be considered "lakes, bays, and sounds other than the Great Lakes" for administration of the vessel inspection laws and regulations. The waters between southeastern Alaska and Prince Rupert, BC via Chatham Sound likewise have been classed "lakes, bays, and sounds" for purposes of vessel inspection. The "Inside Passage" between southeastern Alaska and Puget Sound is considered "lakes, bays, and sounds" for inspection and licensing purposes only if certain conditions are met. Approval by Commandant (G-MOC) is required for vessels to operate between southeastern Alaska and the state of Washington under these considerations.

**12. Dual Certification for Passenger-Carrying Vessels and Sailing School Vessels**

Under existing regulations, a qualifying vessel may be operated in service part-time as a sailing school vessel and at other times as a passenger-carrying vessel (Subchapter T or H). 46 CFR 169.103(b)(5) states that the sailing school regulations are not applicable when a vessel is operating under the authority of a current valid COI as a passenger-carrying vessel. This regulation was written specifically to clarify the dual service situation. Although the regulations allow for dual certification, the OCMI may be reluctant to issue a certificate, let alone two, without conducting an inspection each time the operator physically alters the vessel as it shifts from one service to the other. General practice is to issue only one certificate at a time for the appropriate service, thus creating both an administrative and an inspection burden each time the vessel changes service. Alternatively, the OCMI may issue a single COI, under the conditions addressed below, to cover both services.

Single COI for Predominant Service

a. OCMI's may issue a single COI for the vessel's predominate service with an endorsement for the alternative service. Before issuing such a COI, the OCMI should be reasonably satisfied that the vessel is constructed, maintained, and outfitted in compliance with the applicable regulations regardless of which service the vessel is in at any given time. This requires the vessel to meet the more stringent requirements between 46 CFR 169 and either Subchapter T or H at all times. This procedure should enable the OCMI to avoid some degree of inspection each time the vessel shifts from one service to the other. With the vessel's material condition and outfitting fixed, operating conditions, manning, and possible total persons allowed may vary depending upon the applicable regulations and can be addressed accordingly in the endorsement for the alternative service. In cases where the OCMI finds it appropriate and practicable to permit outfitting to vary, such variance should also be addressed in the endorsement.

Period of Validity

b. Regardless of the predominate service under which the vessel will be certificated, there could be substantial use of the vessel in the alternative service for which the COI is endorsed. Consequently, the vessel must be certificated for a period that is consistent with the more stringent requirement, whether it be for the predominate service for which the certificate is issued or the lesser service for which the endorsement is added. The intervals for inspections, and drydock and tailshaft exams must also be based upon the more stringent of the regulatory requirements. An owner or operator must accept the application and maintenance of the more stringent requirements as a requisite to obtaining the benefits of a single COI, as opposed to trading COIs every time the vessel changes service and submitting to inspection as deemed necessary by the OCMI.

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**13. Inspection of U.S. Vessels in Foreign Countries**

The following offices have responsibility for foreign marine inspection:

a. MSO Puget Sound. Zone to include the western coast of Canada.

b. MSO San Diego. Zone to include the western coast of Mexico north of latitude 20 North.

c. MSO New Orleans. Zone to include South and Central America, the western coast of Mexico south of latitude 20 North, and all of the eastern coast of Mexico.

d. MSO Boston. Zone to include the eastern coast of Canada.

f. Far East ACTIVITIES: Asia and Diego Garcia.

e. ACTIIVITIES Europe, Europe, the Mediterranean Sea, the Red Sea, the Persian Gulf, the Arabian Sea, and all of Africa.

**NOTE:** For areas in question or new construction projects, Commandant (G-MOC) should be contacted.

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**14. Certification of Vessels Undergoing a Reflag and/or Major Conversion**

a. NVIC 10-81, CH-1, was developed to allow certain categories of existing foreign flag vessels to be brought under U.S. flag in a manner consistent with the principles and levels of safety in current Coast Guard regulations or, as in some cases, to Coast Guard standards in effect at the time of the vessel's construction. The NVIC makes reference to acceptance of vessels between 2-10 years old for reflag and conversion. Older vessels will not be precluded if they can be made to meet the SOLAS Method I-C Structural Fire Protection Requirements, as amended in 1981, in addition to all other requirements prescribed in the NVIC. In addition, NVIC 10-81 can be used as a guideline for existing vessels that undergo a major conversion, are brought under Coast Guard inspection, or wrecked vessels that are able to register under 46 U.S.C. 14.

b. Major Conversion Determinations. Determinations of major conversions are made by Commandant (G-MOC). It is important that vessel owners contemplating work which may constitute a major conversion contact Commandant (G-MOC) as soon as they have a general concept of the work to be performed so it can be reviewed. The Coast Guard bases major conversion determinations on 46 U.S.C. 2101(14a). This defines major conversion as a conversion that:

(1) Substantially changes the dimensions or carrying capacity of the vessel;

(2) Changes the type of the vessel;

(3) Substantially prolongs the life of the vessel; or

(4) Otherwise, so changes the vessel that it is essentially a new vessel.

Special Provisions for the Reflag of Vessels Participating in the Maritime Security Program (MSP)

c. Special Provisions for the Reflag of Vessels Participating in the Maritime Security Program (MSP):

(1) BACKGROUND: The Maritime Security Act of 1996 became law as an amendment to Title VI of the Merchant Marine Act of 1936. MSP is administered by the U.S. Maritime Administration (MARAD) Office of Sealift Support (MAR-630) and establishes a program for direct U.S. government payment to private vessel owners for the right to use designated U.S. Flag vessels to carry military cargo in time of war, national emergency or military contingency. These privately owned and operated commercial vessels will normally be employed in commercial operations unless called upon by MARAD for military operations. Foreign flag vessels may apply for MSP but must reflag to U.S. flag as a condition of participation. MSP vessels are not (and will not become even upon activation) public vessels as defined by 46 U.S.C. 2101 (24). These vessels will be U.S. documented vessels, subject to inspection and certification by the Coast Guard. Separate legislation contained in the Coast Guard Authorization Act of 1996 provides that reflagged MSP vessels need only comply with ABS class rules (or the rules of another class society accepted by the Coast Guard) and international convention requirements provided that the vessel meets the following eligibility conditions:

(2) ELIGIBILITY CONDITIONS FOR REFLAG UNDER MSP: The Coast Guard may accept previously conducted class society surveys and previously issued international certificates in lieu of establishing equivalency to U.S. regulations for all vessel equipment and systems, provided:

(a) the vessel is classed by and designed in accordance with the rules of the American Bureau of Shipping or another classification society accepted by the Coast Guard,

(b) the vessel complies with applicable international agreements and associated guidelines, as determined by the country in *which* the *vessel was* documented immediately *before becoming a U.S.* documented *vessel,* and

(c) that the country under which the vessel is currently flagged has not been identified by the Coast Guard as inadequately enforcing international vessel regulations on the vessel making application for certification.

In order to carry out the conditions in the paragraph above, the following procedure shall be followed to issue the initial certificate of inspection and international certificates for a foreign vessel entering MSP.

(3) FOR MSP AND APPLICATION FOR INSPECTION:

(a) MARAD Headquarters (MAR-630), will notify Commandant (G-MOC) when a foreign flag vessel is being considered for selection for participation in MSP. G-MOC-2 will conduct a review of the vessel's Port State Control boarding history in MSIS and notify MARAD of any significant instances of past non-compliance with international regulations. MARAD will notify G-MOC-2 and the vessel owner if the vessel has been selected for MSP participation.

(b) The vessel owner will make application for inspection to the OCMI in whose zone the reflag inspection will be conducted. If that location is not known at the time of acceptance into MSP (to facilitate timely plan review) the owner may make application to Commandant (G-MOC-2) who will hold the application for forwarding to the cognizant OCMI when an inspection location has been selected. A copy of the application shall be provided to Commanding Officer, Marine Safety Center.

(4) PLAN REVIEW TO VERIFY SOLAS COMPLIANCE FOR MSP:

(a) The vessel owner shall submit the items below to the Commanding Officer, Marine Safety Center for review in order to verify compliance with SOLAS, MARPOL, ILLC and verification that the vessel is designed in accordance with the rules of the American Bureau of Shipping or other accepted class rules.

(b) Where the vessel has been classed and designed in accordance with rules other than ABS, the Marine Safety Center shall determine acceptance on a case-by-case basis for the purpose of MSP participation only. This acceptance of class rules and design for MSP shall not be construed as acceptance for any other inspection program.

(c) The vessel owner, flag state/class society shall identify all areas where previous equivalence or exception has been granted to SOLAS, MARPOL, ILLC or the design rules of the American Bureau of Shipping or other accepted class rules.

(d) Plans to be submitted:

(i) General Arrangement plans

(ii) Structural fire protection division rating plans (assuming Method I construction, MSC will spot check fire boundary ratings and ventilation details, i.e., penetrations by the ventilation system of fire rated divisions).

(iii) Fire detection system plans (to verify placement and overall system design).

(iv) Fixed fire extinguishing system plans (a minimum 20 second time delay for releases into manned spaces shall be required even though this is not specified in SOLAS).

(v) Automation system plans including a qualitative failure analysis for vital systems, or a letter from the classification society stating that the systems are designed to meet the failsafe requirements of SOLAS.

(e) Plans to be submitted for verification of class approval. The following information/plans and classification society approval letters must also be submitted, but generally will be examined only to verify the approval action of the classification society and will not undergo Marine Safety Center design review or OCMI inspection unless problems or unusual items are noted:

(i) Trim and Stability booklets including lightship properties and stability test data.

(ii) Letter from the flag state/class society indicating the vessel meets probabilistic damage stability requirements - for vessels built after 1 February 1992.

(iii) Letter from flag state/class society indicating review/approval of the following items, with all areas requiring special attention/inspection noted:

- Structures
- Fire main systems
- Bilge systems
- Steering gear and steering gear alarm systems

(5) OCMI INSPECTION FOR INITIAL CERTIFICATION

(a) Issuance of the initial certificate of inspection is subject to:

(i) A satisfactory onboard inspection by the cognizant OCMI, conducted with a surveyor from the vessel's class society or flag administration who can explain interpretations of SOLAS, MARPOL and ILLC of the previous flag state.

(ii) The owner's providing the OCMI with access to the last annual survey report of the classification society, the list of outstanding class recommendations and statutory requirements, the latest drydock survey report (including latest gaugings).

(iii) A list of systems, equipment or other items that meet a standard different from the U.S. Statutory requirements for a vessel of that size and service. (eg. pressure vessels that are not ASME stamped or lifejackets that are not Coast Guard approved). This list is consistent with Coast Guard reflag policy of the past which has shown that the ability to rapidly identify these items greatly speeds the initial reflag inspection. The list will allow inspectors to identify and document items in the vessels inspection record that meet international, class or previous flag administration interpretations of standards. This is necessary to avoid duplication of this effort at subsequent inspections. It will also eliminate the need for the owner to continue providing a representative of previous flag administration at subsequent inspections.

(b) Conduct of the inspection: The initial inspection shall be sufficiently detailed to verify full compliance with international regulations. The procedures applicable to foreign vessel port state control annual examinations described in MSM II-D1 shall be used as a guideline for the scope of the initial examination. The class society/flag administration representative in attendance shall be consulted in all areas where the inspector requires guidance as to the specific application of a particular international regulation. If the class society/flag administration representative in attendance verifies that the item in question is satisfactory under their guidelines, it will be accepted by the OCMI. A record of all items on the vessel that are acceptable to the class society/flag administration representative, but that differ from current Coast Guard enforcement policy for that item, shall be noted by the inspector as a marine inspection special note (MISN) in MSIS at the conclusion of the inspection (NVIC 10-81, CH-1, provides a useful summary of Coast Guard requirements to use as a comparison to international requirements). Satisfactory fire and abandon ship drills are required to be performed in the

presence of the Coast Guard marine inspector. The drills shall be conducted prior to issuance the initial certificate of inspection, but after a U.S. crew has been placed onboard the vessel. In addition to the inspection described in MSM II-D1, the inspector may verify that all current structures, equipment or systems on the vessel are in agreement with the plans reviewed by the Marine Safety Center or approved by the classification society/flag state. The scope of the plan verification shall be at the discretion of the OCMI, but should generally be conducted as a spot check.

(c) Engine Automation test and If the vessel requests reduced manning as a result of engine automation then the automation test procedure and approval shall be in accordance with U.S. regulations and vessel inspection policy (eg. NVIC 169, NVIC 6-84 and NVIC 10-81, CH-1). The test procedure will be reviewed by the Marine Safety Center (see paragraph (C)(4)(e) of this section). *"The final manning requirements shall be established based upon satisfactory results of:* (1) a *complete plan review of* the equipment, and *the monitoring safety and labor saving devices* installed, (2) *a period of proven* operation *and reliability following* the initial *testing and* de-bugging, *(3) a period of Coast Guard on-board observation, and (4) for* unattended *machinery operation, an acceptable* plant maintenance *program which Insures* the continued quality *of the demonstrated* plant reliability" (NVIC 1-69).

(d) Deficiencies. Any area considered deficient as a result of the Coast Guard examination described in D1 (annual examination) shall be subjected to an expanded examination in accordance with the procedures described in Section D, Chapter 1. Expanding the scope of the examination shall be based on the principle of "clear grounds" as defined in D1 of this manual.

(e) Drydocking/Internal Structural examination: A separate drydock examination and comprehensive internal structural examination (including entry and examination of ballast tanks, and double bottoms) shall not be required in conjunction with the initial certification unless "clear grounds" exist to require it. The drydock date will be established and continued in accordance with the schedule previously established by the flag state/classification society. If the credit drydock and/or internal examination is coincidental to initial certification, the inspector shall conduct the examinations) in accordance with the guidelines established by the previous flag state/classification society.

(f) Pollution Prevention: The vessel shall comply with all U.S. regulations and international pollution prevention requirements that would be applicable to a foreign vessel calling in a U.S. port.

(g) Issuance of certificates upon satisfactory initial examination:

(i) Certificate of Inspection: Upon satisfactory completion of the initial inspection the vessel will be issued a certificate of inspection for the route and service specified on its existing statutory certificates. A reduction in manning due to engine automation must be approved and tested as satisfactory in accordance with U.S. regulations and policy for reflags conducted under NVIC 10-81 (CH-1). The OCMI shall place the following endorsement on the certificate of inspection and as a special note in MSIS:

*"This vessel is certificated under the provisions of the Maritime Security Program (MSP) and is inspected and certificated solely in accordance with the requirements of class rules and international convention requirements as applicable. This vessel was issued its initial certificate of inspection in accordance with the MSP on DD MM YY." (Insert date inspection is complete).*

(ii) International Convention Certificates: SOLAS, MARPOL an ILLC certificates will be issued by the Coast Guard or by a classification society that is authorized to issue the certificate on behalf of the Coast Guard. This includes authorization granted under existing agreements, new agreements under 46 CFR Part 8, or the Alternate Compliance Program.

(iii) OCMIs shall document and record in MSIS as a marine inspection special note (MISN) any areas where the previous flag administration or class society accepted a system or equipment which differs either from the Coast Guard's statutory requirements or its enforcement of international regulations.

(h) OCMI action if initial inspection is unsatisfactory: If based on the results of the initial inspection by the OCMI there is sufficient evidence to show that the country under which the vessel is currently flagged has been inadequately enforcing international vessel regulations on the vessel making application for certification, the COI shall be withheld and Commandant (G-MOC) notified. OCMIs are strongly encouraged to call upon the assistance of the traveling inspectors at Commandant (G-MO-1) when the initial inspection of an MSP vessel indicates clear grounds for an expanded examination. Commandant (G-MOC) will notify the Maritime Administration that the vessel is not currently acceptable to receive a COI. Commandant and MARAD will then consult as to whether the vessel should be allowed to make repairs or modifications in order to complete certification for entry into MSP, or whether the vessel should be excluded from MSP participation.

(i) Payment of User fees and Overseas inspection expenses: User fees shall be paid prior to the conduct of the initial inspection for certification. Travel and per diem costs for overseas inspections shall be paid in advance on a cost estimated basis. If owners cannot arrange for advance payment of user fees or travel costs (overseas only) due to scheduling difficulties, then Commandant (G-MOC) shall be contacted to determine if a delay in payment will permitted until after the inspection has commenced.

(6) INSPECTION OF MSP VESSELS SUBSEQUENT TO INITIAL INSPECTION

(a) MSP vessels will continue to be inspected under the preceding guidelines for all subsequent inspections except as noted below.

(i) Intervals for subsequent inspection shall be in accordance with international convention certificate requirements.

(ii) Vessels accepted under MSP reflag shall be reissued a COI biennially upon application from the owner if the vessel has completed all scheduled inspections for the maintenance of class and international convention certificates (including all annual endorsements, surveys and drydockings).

**NOTE:** Future plans are to harmonize the COI period of validity with the intervals prescribed for the issuance of international convention certificates.

(iii) OCMIs shall continue to conduct inspections in accordance with the class rules, SOLAS, MARPOL and ILLC. Areas where the previous flag administration or class society accepted a system or equipment prior to reflag which differs from the Coast Guard's current statutory or policy interpretation for the implementation for that international regulation (at the time of the initial inspection) should have been recorded as a Marine Inspection Special Note (MISN) at the initial inspection. New Installations, or modifications to existing systems, made subsequent to the initial reflag shall conform to the Coast Guard's interpretation of international regulations at the time of the modification in so far as reasonable and practical.

(iv) MSP vessels that elect to enroll in the Alternate Compliance Program (ACP) may employ ACP inspection procedures subsequent to the initial reflag inspection, which will be conducted by the Coast Guard.

(v) User fees shall be paid in a manner consistent with all U.S. certificated vessels.

**15. Vessels of Novel Design**

Proposed Operation

a. From time to time, the OCMI will be approached with some novel operation proposal, that is not covered by any or a part of regulations. In such cases, the OCMI will coordinate the proposed operation and associated inspection requirements through the District Commander (m) to Commandant (G-MOC).

Regulatory Requirements

b. Commandant (G-MOC) in consultation with the cognizant OCMI will determine the level of regulation that will be applied to vessels in “novel” operations not covered by any or part of regulations.

## C. PRE-INSPECTION PROCEDURES

**1. Application for Inspection of U.S. Vessel, Form CG-3752**

Application for inspection of a vessel for certification shall be made by the master, owner, or agent on Form CG-3752 (see 46 CFR 2.01-1 and 176.01-10). The application for initial inspection of a vessel being newly constructed or converted shall be submitted prior to the start of such construction or conversion. This shall be followed by the submittal of plans and specifications required by the applicable regulations. Applications for inspection shall be submitted to the cognizant OCMI. When an application is received by an office other than that having jurisdiction, it shall be forwarded to the appropriate OCMI and the applicant so advised. Inspection for certification shall not commence until a proper application has been submitted by a U.S. citizen and the proposed operation of the vessel (use, route, passengers, etc.) is known to the OCMI and the inspector.

**2. Preparation by the Inspector**

The marine inspector shall be as well informed as possible of the vessel's proposed operation (and its past history, as applicable) before commencing the inspection. Due to the many differing circumstances encountered, the availability of such information will vary. Generally, the following procedures shall be used:

a. Before inspection is begun, previous inspection records shall be reviewed by the inspector. For initial inspection, copies of all approved plans, specifications, and relevant correspondence, and any record of outstanding deficiencies shall also be reviewed by the inspector.

b. When the owner, agent, or master of a vessel previously inspected in another zone applies for inspection, the OCMI should obtain the inspection records for the previous inspection for certification and drydocking examination from the certificating OCMI. Such records shall be returned after the inspection is completed, unless the vessel has permanently changed its principal port of operation to the zone where inspected (See Section A, Chapter 2 of this volume).

## D. CONDUCTING INSPECTIONS FOR CERTIFICATION

### 1. Initial Inspections

Definition

a) The initial inspection for certification is the first inspection held on a vessel during or after construction or conversion. It is a prerequisite to the issuance of the original COI.

Purpose

b) At the initial inspection, the inspector ascertains that the vessel has been built (or converted) and equipped in accordance with the applicable regulations, construction standards, and approved plans and specifications, and that its condition warrants the judgment that it can be operated with safety to life and property in the service and route(s) specified. The inspector also ensures that the condition and installation of all equipment and apparatus thereof comply with applicable regulations. It is intended that the initial inspection be carried out with special attention to detail. All unusual circumstances that require interpretations of regulations, special considerations, the use of substitutions or equivalents, etc., shall be carefully considered; when deemed acceptable, they shall be made a matter of record (see 46 CFR 50.20-35).

Policies Concerning ABS Classed Vessels

c) Guidelines are clearly established in NVIC 10-82 for the acceptance of ABS plan review and inspection during the initial inspection. Areas of shared reviews and inspections and areas retained solely by the Coast Guard are delineated. Most vessels classed by ABS will fall under NVIC 10-82. When the provisions of NVIC 10-82 are not followed, ABS will perform plan review and inspection for class only, and will not review or inspect for regulatory requirements. If an inert gas system (IGS) or crude oil washing (COW) system is installed in a vessel for which the owner has requested ABS review and inspection, the Coast Guard will accept ABS approval and inspection if a letter certifying compliance with regulatory requirements for the systems is provided by ABS. NVIC 10-82 also applies to major conversions. Questions concerning the applicability of NVIC 10-82 shall be referred to Commandant (G-MOC) for resolution. For further information on stability see NVIC 3-84, "Acceptance of Stability Related Review Performed by the American Bureau of Shipping for New U.S. Flag Vessels."

Timeliness of the Inspection

a. When possible, the initial inspection shall be conducted throughout the construction and fit-out period, with a final review of the condition of the vessel and its equipment upon completion of the construction and fit-out. Vessels being converted shall be inspected throughout the conversion period. The inspector shall call to the attention of the builder and contractor any defects noted as soon as possible so that timely corrections can be made. The inspector shall notify the OCMI of any controversial items so that they may be

resolved, if possible, before work continues (See Section A, Chapter 2 of this volume concerning the handling of deficiencies).

Scope of the Inspection

b. The inspection shall be sufficient to determine that the vessel: is suitable for the service and route(s) in which it is to be employed; is equipped with the proper lifesaving and fire protection appliances as prescribed by the regulations; has suitable accommodations for passengers and crew; is in a condition to warrant the judgment that it may be used in navigation with safety to life, property, and the environment; and in all other respects fully complies with the requirements of applicable statutes and regulations, including those for pollution prevention and navigation safety.

Compliance with Plans and Specifications

c. When inspecting new construction or conversion, it is essential for the inspector to have available corrected copies of the approved plans and specifications. These shall be considered work copies, furnished for the use of the inspector during construction, and for the OCMI's files after construction. If additional copies are needed for office use or filing, they shall be requested from the submitter. Most plans and specifications are approved subject to comments placed in their transmittal letters. These letters are referred to in the approved plans and specifications and shall be made available to the inspector who oversees the construction or conversion work. When approval is given subject to comments or recommendations of ABS or another recognized classification society, such comments or recommendations shall also be made available to the inspector. As each deck and engineering installation must be made to the satisfaction of the OCMI, the inspector shall check the complete installation for safety and compliance with applicable standards, as well as the plans and specifications. Any errors or omissions in plans that would result in unsafe conditions or noncompliance with applicable standards shall be promptly brought to the attention of the builder and the OCMI for resolution.

Restricted Visibility from the Navigating Bridge

d. Restricted Visibility from the Navigating Bridge.

(1) General. Restricted visibility from the navigating bridge is most often encountered on container vessels, large tank vessels with the bridge aft, vessels with oversize cargo handling gear, and special purpose vessels such as MODU's and crane ships; however, it may occur on any type of vessel. In most cases, this problem will be identified and resolved in plan review. In those cases when restricted visibility becomes apparent after the start of construction, the matter should be brought to the attention of the owner as early as possible, to avoid costly modifications late in the construction of the vessel. Technical guidelines for bridge visibility are contained in volume IV of this manual.

(2) Causes of Restricted Visibility from the Navigating Bridge.[1] These can be separated into two broad categories: those where the obstruction is movable or temporary (such as container deck loads) and those where the obstruction is permanent (as in a vessel structure). As situations of the first category are operational in nature, certification of a vessel with this type of visibility restriction should not be withheld. However, the problem should be brought to the attention of the owner so that the owner may take appropriate action to remove obstructions to visibility that interfere with the safe navigation of the ship. Situations of the second category are permanent in nature and cannot be operationally controlled after the vessel is in service. Therefore, a vessel with this type of obstruction should not be certificated when, in the opinion of the OCMI, visibility from the navigating bridge is restricted to such a degree that the vessel cannot be navigated safely.

[1]**NOTE:** Tinted windows may also restrict visibility. They are prohibited by regulation (e.g., 46 CFR 92.03-1(c) and by policy to meet the intent of the requirements of 33 CFR 164 to maintain clear unobstructive visibility for promoting safe navigation; unless it can be demonstrated that the amount of light transmitted through them is equivalent to that transmitted through clear glass.

Trial Trips

e. Trial Trips. Upon completion, and before initial certification, an inspector is required to observe the operation of each new vessel during a trial trip. The specific regulations covering trial trips are in 46 CFR 58.01-30 and 31.10-40, although others apply as well. A vessel on a trial trip is not required to have a COI nor will it necessarily possess a certificate of documentation issued by the Coast Guard. For practical purposes, the Commandant has not insisted on strict application of COI requirements to a new vessel on a trial trip, because the trip is:

(1) Usually of short duration;

(2) Frequently made with Coast Guard inspectors aboard;

(3) One of the final incidents of Coast Guard inspection prior to the initial issuance of a COI; and

(4) Usually made with the equipment required for a COI, with the vessel operated by licensed and certificated personnel.

The inspector observing a trial trip does not supervise and instruct vessel personnel. Although specific matters may be referred to the inspector for advice, the supervision of the tests according to the trial schedule rests with the builder's representatives. However, as part of the initial inspection of any vessel, the inspector may require such tests as he or she deems necessary to be assured of the safety and seaworthiness of the vessel.

**2. Subsequent Inspections for Certification**

These are the periodic inspections held after the initial inspection.

Intent

a. At subsequent inspections for certification, the inspector shall ascertain that the vessel and its equipment are being maintained in a safe condition, in accordance with applicable laws and regulations, and determine whether changes have occurred in the vessel tending to make its continued operation unsafe. It is intended that these subsequent inspections be carried out with special attention to the condition of the vessel and its equipment. Deficiencies noted shall be handled as provided in chapter 2 of this volume. The inspector shall be especially alert to detect unauthorized changes to the vessel and its equipment. Upon completion, the inspector and the OCMI must be satisfied that the vessel may be operated safely in the proposed service for the period covered by the COI, and that it otherwise complies with the applicable laws and regulations.

Inspector's Obligations

b. In appraising the condition of a vessel and its equipment, the inspector shall use all available evidence, including the latest inspection findings, records of previous Coast Guard inspections, the opinions or records of other interested surveyors or inspectors, information furnished by the officers and crew, facts concerning the vessel's classification, and previous certification. [2] The inspector may seek the advice of experts in the particular field involved, such as boilermakers, shipfitters, and welders, or the opinion of more experienced inspectors or technical personnel assigned to his or her unit. Based on this evidence and his or her own inspection, the inspector shall reach an independent conclusion as to vessel and equipment conditions and shall act accordingly. The OCMI shall be consulted when there is doubt in the inspector's mind as to a proper course of action.

[2] **NOTE:** See 46 U.S.C. 3315 concerning the disclosure of sources of information.

Scope of Inspection

c. The inspection shall be of sufficient scope to determine that the vessel has a structure suitable for the service in which it is to be employed; is equipped with the proper lifesaving, fire protection appliances, pollution prevention, and navigation safety as prescribed by appropriate regulations; has suitable accommodations for passengers and crew; is in a condition to warrant the judgment that it may be navigated safely; and in all other respects fully complies with the applicable laws and regulations. The inspector shall also determine that the boilers and appurtenances thereof, the unfired pressure vessels and appurtenances thereof, the propelling and auxiliary machinery, the electrical apparatus, and all other equipment conform with the applicable laws and regulations, and that the vessel may be safely employed in the service proposed

## E. HULL INSPECTIONS

### 1. General Concerns

The inspector shall determine the adequacy of the complete hull structure by the review of plans before construction; review of approved plans during construction, reinspections of the hull after construction, and examination of any repairs or alterations. Approved plans and the ABS Classification Certificate may be accepted by the OCMI in certain cases as evidence of the structural efficiency of the hull. However, the inspector must perform sufficient examinations and tests of the hull structure at the inspection for certification to determine that the condition of the hull is suitable for the vessel's service and is such that the vessel may be navigated safely. Additionally, all protected and unprotected saltwater ballast tanks shall be inspected at least twice in a 5-year period. Appropriate entries shall be made on the Vessel Inspection Record (Form CG-2832) as to which tanks have been examined. The inspector shall ensure that the regulations regarding watertightness and weathertightness of the hull, including weather decks, are strictly enforced. Particular attention shall be given to cargo hatches, closures, securing devices, gaskets, means of attachment, etc.

Taken from: **TABLE 91.40-3(a) & (b)—SALT & FRESH WATER SERVICE VESSELS EXAMINATION INTERVALS IN YEARS**

| | Single hull ship and barge | | Double hull barge with internal framing[1] | | Double hull barge with external framing[2] | | Single hull barge with independent tanks[3] | | Wood hull ship and barge | | Unmanned deck cargo barge[4] | | Unmanned double hull freight barge[5] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SW=Salt Water Service FW=Fresh Water Svc** | **SW** | **FW** | **SW** | **FW** | **SW** | **FW** | **SW** | **FW** | **SW** | **FW** | **SW** | **FW** | **SW** | **FW** |
| Drydock | 2.5 | 5 | 5 | 10 | 5 | 10 | 5 | 10 | 2.5 | 2.5 | 5 | 10 | 5 | 10 |
| Internal structural | 2.5 | 5 | 2.5 | 5 | 2.5 | 5 | 2.5 | 5 | 2.5 | 2.5 | 2.5 | 5 | 2.5 | 5 |
| Cargo tank internal | [6]2.5 | [6]5 | [6]5 | [6]5 | [6]10 | [6]10 | [6]10 | [6]10 | [6]2.5 | [6]2.5 | ---- | ---- | [6]5 | [6]5 |

NOTE:

1 Applicable to double hull tank barges (double sides, ends, and bottoms) when the structural framing is on the internal tank surface.

2 Applicable to double hull tank barges (double sides, ends, and bottoms) when the structural framing is on the external tank surface accessible for examination from voids, double bottoms, and other similar spaces

3 Applicable to single hull tank barges with independent cargo tanks which have a cargo containment envelope that is not a contiguous part of the hull structure and which has adequate clearance between the tanks and between the tanks and the vessel's hull to provide access for examination of all tank surfaces and the hull structure.

4 Applicable to unmanned/non-permissively manned deck cargo barge which carries cargo only above the weather deck and which provides complete access for examination of the inside of the hull structure.

5 Applicable to unmanned/non-permissively manned double hull freight barges (double sides, ends, and bottoms) the arrangement of which provides access for a complete internal structural examination as defined in §91.40-1(b) without the necessity of entering cargo tanks or holds.

6 Or as specified in Part 151.

## 2. Older Vessels

Inspection of Older Vessels

a. The determination of the true condition of a vessel and its equipment may be more difficult for an older vessel. In this regard, the inspector should make every effort to research an older vessel's records to detect any recent structural, machinery or equipment failures/problems. An increase in the rate of failures may indicate a general deteriorating condition. The inspector should review the most recent hull gauging report as an aid in determining:

(1) Whether additional or new gauging is called for; and

(2) What area(s) of the hull might require special attention?

The inspector is not limited by regulations from making such tests or inspections, as he or she deems necessary to be assured of the safety and seaworthiness of the vessel. Machinery tests, hull gauging (see paragraph B1.F.3 below), inspections of equipment, etc., may be required when deemed necessary by the inspector regardless of regulatory requirements or the type of inspection being performed (e.g., inspection for certification, reinspection, drydocking, or deficiency check).

Notification of Travelers

b. Notification. Commandant (G-MO-1) shall be notified when any vessel 20 years of age or older and over 4,000 GT is scheduled for an inspection for certification and/or drydocking. Traveling inspectors from Headquarters will attend selected older vessel inspections; therefore, notification as far in advance as possible is required.

Special Consideration

c. For those vessels that are not required to meet the Load Line regulations, special consideration must be given to hull structure and arrangement, freeboard, protection of openings, drainage, and the other items normally considered in the issuance of a Load Line Certificate. Since these items will not be checked by a load line "assigning authority," they must be attended to by the inspector.

**3. Hull Gaugings**

NVIC 7-68, "Notes on Inspection and Repair of Steel Hulls," gives guidance as to when limited or belt gauging should be required by the inspector. NVIC 7-68 further urges the inspector to witness gauging at any periodic survey and make use of the results. Additional gauging or gauging at an inspection that does not coincide with an ABS special survey should be required by the inspector when deemed necessary in order to determine the seaworthiness of a vessel. As per ABS rules, "The first Special Periodical Survey becomes due four years after the date of build. Subsequent Special Periodical Surveys are due four years after . . . the previous Special Survey." Special surveys may be deferred by ABS for up to 12 months.

**4. Load Lines**

Certain vessels in ocean, coastwise, or Great Lakes service are required to meet the requirements of 46 CFR, Subchapter E (Load Lines) with respect to strength, closure of openings, protection of openings, guardrails, freeing ports, means of access, etc. Inspections for compliance with these regulations are made by ABS or another assigning authority approved by the Commandant. A current Load Line Certificate shall normally be accepted by the surveyor or inspector as evidence that the vessel meets the requirements of Subchapter E. However, the weathertightness of cargo and other hatchways covered under the Load Line regulations should be examined by the marine inspectors during routine vessel inspections. When it becomes known to the surveyor or inspector that a vessel holding a current Load Line Certificate does not comply with the regulations, or that the condition of any fitting covered by such regulations is not satisfactory, the OCMI shall be informed. It is stressed that load line assignments are made by an assigning authority, while the enforcement of load line requirements rests with the Coast Guard.

a. Weathertight and Watertight. Regulations concerning weathertight and watertight standards are found in 46 CFR Parts 42.09-25(b), 42.09-40, 42.15-15, 42.15-25, and 42.15-30. See also paragraph 6.F.5 below.

b. Master's Responsibility. Regulations also task the vessel's master with the responsibility of ensuring that all exposed cargo hatches are properly secured prior to leaving protected waters. See 46 CFR 78.17-35, 97.15-20, and 196.15-20.

**5. Watertight and Weathertight Inspections**

At inspections for certification, the adequacy of watertight and weathertight fittings and closures will be determined. An operational test of hatch covers will normally be witnessed and tightness of hatch covers verified. If practicable, such tests should be performed at the same time that the load line assigning authority is performing an annual or periodic load line survey. At periodic reinspections, watertight and weathertight closures and fittings shall be examined to the extent necessary to ensure that they are being properly maintained. The following additional guidance and standards apply to watertight and weathertight inspections:

Watertight

a. Watertight closures such as cargo ports, and other similar openings in the sides of vessels below the freeboard deck shall be designed to ensure the same watertightness and structural integrity commensurate with the surrounding shell plating (46 CFR 42.15-55). The small passenger vessel regulations[3] previously defined watertight as to effectively resist the passage of water when subjected to a hose test of 30 psi. Gaskets shall be clean (unpainted) and flexible to provide a tight seal. Coamings and knife-edges should be structurally sound, straight and true.

[3] **NOTE:** For T Vessels, see 46 CFR 179.310, and for K Vessels, see 46 CFR 116.1160.

Weathertight

b. Weathertight means that in any sea condition, water will not penetrate into the vessel in any appreciable amount (46 CFR 42.13-20). Hatchcovers closed by portable covers must be secured weathertight as required in 46 CFR 42.15-25. Weathertight fittings for small passenger vessels[4] shall be so constructed as to effectively resist the passage of water to appreciable degree under continuous exposure to driving rain or spray. Vents, cowlings, coamings, etc., should be sound, properly fitted, and secured to prevent flooding from boarding seas.

[4] **NOTE:** For T Vessels, see 46 CFR 175.400, and for K Vessels, see 46 CFR 114.400.

Vessels of Unique Design

c. Special emphasis on weather deck openings should be placed on vessels of unique design. Even a small amount of flooding can appreciably affect stability on MODU's, hovercraft, pontoon hulls, etc. The OCEAN RANGER casualty emphasized the need to prevent and detect flooding in unmanned spaces when the chain locker flooded from boarding seas. Chain locker covers serve to reduce the amount of downflooding through the spill pipe or "spurling gate" and can be made more weathertight by stuffing rags, cement, or gasket material around the chain prior to heavy weather.

Securing Devices

d. Hinges, locking mechanisms, retaining brackets, dogs, and other securing devices should be sound and operate freely. Covers must be readily available and easily secured for closing in the event of fire as well as heavy weather.

Repairs/Strength

e. All closures and securing devices must be able to withstand the forces of boarding seas. Repairs must maintain the structural integrity of the closure. Inspectors should not allow the use of plastic putty, e.g., "red hand," to repair strength members of cargo hatch covers. NVIC 7-68 shall be used as guidance for the repair of steel hatch covers.

Testing of closures

f. Testing of closures may be done visually by light testing, pressure testing, or hose testing. Watertight closures or fittings should be tested under the design pressure where practicable. Otherwise, a hose test over 30 psi may be accepted. Weathertight fittings should be hose tested for several minutes and allow no more than a slight seepage of water to pass. An operational test shall be performed on hatch cover closure devices.

Freeing Ports

g. When conducting a compliance exam boarding of a fishing vessel or inspecting a charter fishing boat, inspectors should examine the freeing ports to ensure they are clear, and if fitted with “flapper” closures, that they are operable and will allow water on the deck to clear over the side. The charter fishing vessel Cougar is an example of a vessel floundering and sinking due to an accumulation of water on the aft deck due to inoperable freeing ports.

Hatches – Watertight Integrity

h. Manhole covers installed in watertight double bottoms on small passenger vessels shall be inspected to ensure they meet a suitable watertight reliability performance standard. Inspectors should examine all hatch covers to ensure that the gasketing material is in place and that it provides the designed watertight integrity, and that the hinges and securing devices are operable. This includes all watertight doors, hatch covers, and manhole covers to all integral hull tanks (voids, ballast, etc.), especially the o-rings on the single bolt tank covers. A failed tank cover was identified as a problem in the grounding of the small passenger vessel Yorktown Clipper when the void tank cover o-ring failed causing flooding of the accommodation spaces.

**6. Bulkhead Penetrations**

The use of epoxy resin as a pipe seal in watertight bulkheads is considered satisfactory when the maximum piping temperature does not exceed 200F and structural fire protection qualities are not required by the regulations. Its use should be limited accordingly, in the case of passenger vessels, to vessels of less than 100 GT. It would appear possible to design this type of seal so as to provide adequate fire protection properties. However, acceptance for compliance with the requirements of 46 CFR 72 would be subject to passing the appropriate standard fire test satisfactorily.

## F. MACHINERY INSPECTIONS

**1. General**

At each subsequent inspection for certification, the inspector shall examine the machinery as required by law and regulations. Inspections and tests shall be performed to ensure that main and auxiliary machinery, boilers and their appurtenances, and other equipment are in satisfactory operating condition and suitable for the intended service. The chief engineer or officer in charge of the machinery shall be asked about possible defects or imperfections in the equipment, boilers, and machinery of the vessel.

**2. References**

Subchapter F and the Electrical Engineering regulations (Subchapter J) contain the primary standards for the inspection of main and auxiliary machinery installations on all vessels except small passenger vessels (inspected under 46 CFR, Subchapter T). As indicated in 46 CFR 58.01-5, these standards are supplemented by the standards of ABS. Subchapter F regulations apply to "T-Boats" only insofar as they are made applicable by 46 CFR 182. As provided in 46 CFR 167.25, boilers and pressure vessels and their piping and appurtenances on public nautical school ships shall conform to the requirements of Subchapter F, or to U.S. Navy or Coast Guard Standard Construction Specifications.

**3. Vessels that are Not Classed**

When practicable, on vessels that are not classed by a recognized classification society, the inspector shall require and observe an operational test on all main and auxiliary machinery to determine that its condition is satisfactory. The inspector may require an operational test of any machinery when necessary to determine its condition. Safety requirements shall be kept foremost in mind in the inspection of engineering equipment. The requirements of 46 CFR, Subchapter F (Marine Engineering) and the instructions in this manual are not intended to cover all contingencies that may be encountered during the inspection for certification. The inspector may require any reasonable tests or inspections deemed necessary to ensure the safety of the vessel. It is incumbent upon the inspector to be alert to unsafe conditions and to require corrective measures before these conditions can cause casualties.

**4. Inspection of Main Propulsion Machinery**

General

a. The inspector shall be generally guided by section 6.F above in the inspection of main propulsion machinery for certification.

Overspeed and Low Oil Pressure Trips

b. Automatic speed controls for propulsion prime movers of turbo-electric, diesel-electric, or clutched diesel propulsion systems shall be tested periodically. Tests of the operation of overspeed and low oil pressure trips, and the alarm signals of these controls on turbo-electric, diesel-electric, or clutched diesel drive vessels[1] shall be witnessed by a marine inspector.

[1]**NOTE:** Any operational tests of lube oil shutdown controls should not risk shutting off the oil supply to the bearings. Additionally, overspeeding geared turbines and direct drive diesels is considered impractical and unnecessary, and should not be required under normal circumstances. Tests of the overspeed safety devices should be as per the approved automation procedures.

3.Main Engine Gravity-Type Lubricating Systems

c. In a reported casualty aboard an C3-S-A2 cargo vessel, the propulsion turbines sustained extensive damage due to insufficient lubricating oil. Investigation revealed that a closed or partially closed valve in the piping system from the gravity tanks to the main engine caused a reduced flow of oil to the turbines. This valve was marked "L.O. GRAVITY TANKS TO GEARBOX" and was located approximately 4.57 m (15 ft) from the starboard gravity oil tank. The valve was not included in the original approved plans of the piping system and, since it was in addition to the shutoff valves at the tanks, there was no justification for its being in the system. Because a similar condition may exist on other vessels, the following action shall be taken:

(1) During the inspection or reinspection of vessels having gravity-type lubrication, the discharge piping from the gravity tanks shall be examined; and

(2) If shutoff valves are found in addition to those at the gravity tanks and unnecessary to the system, they shall be secured in the open position or removed.

## G. INSPECTION AND HYDROSTATIC TESTS OF BOILERS

Taken from: **TABLE 61.05-10—INSPECTION INTERVALS FOR BOILERS**[1,2,3]

| | Firetube Boilers ≥ 150 PSI | Watertube Boilers | Any Firetube Boiler for Propulsion | Firetube Boilers ≤ 150 PSI |
|---|---|---|---|---|
| Hydro Test: | 2.5 | 2.5 | 1 | 2.5 |
| • Passenger Vessel | 2.5 | 5 | 1 | 5 |
| • Other Vessel | 1 | 2.5 | 1 | 2.5 |
| Fireside Inspection | 1 | 2.5 | 1 | 2.5 |
| Waterside Inspection | 1 | COI | 1 | 1 |
| Boiler Safety-Valve Test | 5 | 5 | 5 | 5 |
| Valves Inspection | 10 | 10 | 10 | 10 |
| Studes and Bolts Inspection | 10 | 10 | 10 | 10 |
| Steam Guage Test | COI | COI | COI | COI |
| Fusilbe Plug Inspection | 2.5 | ---------- | COI | 2.5 |

1 All intervals are in years; where COI is used, the intervals coincide with the applicable vessel's inspection for certification.

2 Where the 2.5-year interval is indicated: two tests or inspections must occur within any five-year period, and no more than three years may elapse between any test or inspection and its immediate predecessor.

Intervals for hybrid boilers are the same as for firetube boilers.

### 1. General

Marine boilers have historically been classed into two general types: firetube (or "tank") boilers and watertube boilers. A new type of marine boiler, called a hybrid boiler, has recently been approved for auxiliary steam use aboard U.S.-flag vessels. The American Society of Mechanical Engineers (ASME) Manufacturers' Data Report forms must be made available to the Coast Guard marine inspector for review at the time of any boiler installation, per 46 CFR 52.01-145. The marine inspector will inspect each boiler after installation and review the Data Report forms to ensure the boiler complies with Coast Guard regulations. See 46 CFR 52.01-135 and 53.10.

Firetube Boilers

a. The most common firetube boiler is that of the familiar "Scotch" type, still in use on Great Lakes and river vessels, and on harbor tugs in some areas. Firetube boilers are usually found on pile-driving barges, steam dredges, OCS platforms, and older vessels propelled by reciprocating engines with very simple boiler feed systems; some are coal-fired. Feed water control is primitive at best and, generally, no provision is made for keeping dissolved oxygen out of the boiler water.

Watertube Boilers

b. These are designed for operation under considerably greater stresses than are those of the firetube type. Tube metal temperatures are higher, and scale deposits that can be tolerated in firetube boilers operated at lower pressures are unacceptable. For these reasons, only distilled water can be used for boiler feed and close regulation of the feed water chemistry is essential to prevent pitting of the boiler metal and to reduce scale deposits to a minimum. In contrast to firetube boilers, the pressure containing parts of watertube boilers are of simple design, without complicated riveted seams and stayed surfaces. Frequency of repair is considerably lower and, when necessary, repairs involve such operations as tube renewals, refractory and insulation repairs and renewals, and boiler casing maintenance.

Hybrid Boilers

c. These incorporate a design feature which combines the concepts of both firetube and watertube boilers. The concept makes efficient use of space and consumes less fuel than a traditional firetube boiler. They usually burn number 6 fuel oil, but can also burn a variety of other fuels, including heavy oils, sludge, and solid waste with a few additional pieces of equipment. Current designs average about 1.53 m (5 ft) in outside diameter, 3.66 m (12 ft) in height, and consist of upper and lower chambers connected by a tube nest. Certain designs have incorporated engine exhaust gas firing along with in-port oil firing, thus eliminating the need for a ship's exhaust gas economizer. The burner and register unit is mounted at the boiler front on the lower chamber and is exactly the same type of unit that would be found on a traditional firetube boiler. Standard appurtenances such as safety valves, water glasses, feed and stop valves, steam gauges, and blow-off valves are also incorporated in present design features. Current furnace designs consist of horizontal cylindrical or vertical torispherical type configurations. Horizontal types are connected to the boiler shell by full penetration welds. The vertical furnaces are attached to the shell by an "ogee ring" which can either be integral to the furnace or be an external support flange. The ogee ring must be joined to the furnace by a full penetration weld. The connection of the ogee ring to the boiler shell must either be a full penetration weld if an external support flange, or a fillet weld if an integral type ogee ring. The integral type ogee ring must meet ASME Section I PFT 20.5. Depending upon size, the furnace may be supported by a number of stays that extend from the furnace to the boiler shell. The number of stays used for support depends on the furnace size and the maximum allowable working pressure (MAWP) of the boiler. In some cases, stiffening rings are used to add support to the furnace in lieu of stays. At the apex of the furnace, an exhaust pipe extends from the furnace into the lower boiler tube sheet. This pipe passes the exhaust gas over the steam generating tubes before the gas exits through the flue. Steam generating tubes connect the lower tube sheet to the upper tube sheet. There may also be downcomer tubes installed in the tube nest between the two tube sheets. Within the tube bundle are several stay tubes whose function is to add support to the tube sheets. Above the upper tube sheet, in the upper chamber, is the steam-generating area. The dry pipe is located near the center of the upper head. Future designs may incorporate variations on this basic theme.

## 2. Examination and Testing of Firetube Boilers

Test and Examination Intervals

a. Test and Examination Intervals. Title 46, Code of Federal Regulations (CFR), Subpart F, requires that hydrostatic tests must be applied to propulsion firetube boilers annually. No extension of this requirement is authorized. However, Officers in Charge, Marine Inspection (OCMIs) are permitted to extend the hydrostatic testing interval for non-propulsion firetube boilers, of not more than 10.55 kg/cm2 (150 psi) maximum allowable working pressure (MAWP) on vessels other than passenger vessels, to a period not to exceed five years (60 months) since the last hydrostatic test. OCMIs are authorized to extend the hydrostatic testing interval for non-propulsion firetube boilers of not more than 10.55 kg/cm2 (150 psi) MAWP on passenger vessels to an interval of not more than three years (36 months) since the last hydrostatic test, provided that not less than two hydrostatic tests are conducted within any five year period. OCMIs may extend the hydrostatic test interval for non-propulsion firetube boilers of 10.55 kg/cm2 (150 psi) MAWP or greater on any type of vessel to an interval not to exceed three years (36 months) since the last test, provided that not less than two hydrostatic tests are conducted within any five year period. OCMIs may authorize fireside and waterside examinations of firetube boilers of less than 10.55 kg/cm2 (150 psi) MAWP to be conducted at an interval not to exceed three years (36 months) since the last examination, provided that not less than two such examinations are conducted within any five year period. It is anticipated that the aforestated authorizations shall be exercised primarily to permit the test and examination interval to coincide with the vessel's drydocking or similar out of service availability period.

➔ **SEE** 46 CFR, TABLE 61.05-10—INSPECTION INTERVALS FOR BOILERS at beginning of Section G for intervals.

Hydrostatic Tests

b. The hydrostatic pressure should be maintained at 1.5 times the maximum allowable working pressure (MAWP) throughout the inspection of the fireside. When repairs are necessary, the methods employed, materials, and workmanship shall comply with the requirements of 46 CFR, Part 59. These boilers are particularly vulnerable to thinning of the plating, tubes, and staybolts by corrosion. This is often seen in the form of pitting, attributed to dissolved oxygen or the use of corrosive boiler water. In Scotch-type boilers, pitting is commonly found on the outside of the tubes and the shell and head plating near the waterline, the combustion chamber top plating, the furnaces, and the bottom shell plating. The numerous highly stressed riveted joints in firetube boilers are prone to attack by stress corrosion cracking, generally resulting from the deposit of corrosive solids contained in the boiler water.

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Interior Examination

c. The interior of the furnaces and combustion chambers should be examined first. Furnaces and flues should be checked for distortion by measuring with a tram bar. When corrugated or plain furnaces or flues are distorted and no longer in true circular shape, they shall be repaired as required by 46 CFR 59.15-1(a) or the boiler pressure shall be reduced as required by 46 CFR 59.15-1(c). Combustion chamber wrapper plates and back plates should be hammer tested, and areas suspected of being thin should be drilled and gauged. Broken combustion chamber stays will generally be indicated by leakage from the drilled telltale holes. The combustion chamber back plate should be checked for evidence of bulging plating between the staybolts. Riveted wrapper plate seams and the furnace connection to the combustion chamber should be checked for leakage. The back tube plate should be carefully examined since leakage in this area, which cannot be corrected by rolling tubes, is sometimes due to cracks in the ligaments between tube holes.

Tube Sheet Examination

d. The front tube sheet should be examined next. This is an area particularly susceptible to corrosion from leaking tubes, and to erosion caused by the use of saturated steam for soot blowing. Leaking tubes should be made tight by rolling, or should be replaced.

Exterior Examination

e. The exterior of the boiler shell and heads should be examined next. All lagging of the shell and heads is not normally taken off during annual inspections; however, all portable sections should be removed while the hydrostatic pressure is maintained. Wherever moisture appears, sufficient lagging should be removed to determine its source, whether leaking seams, broken staybolts, or defective boiler mounting gaskets. The plating in way of the boiler mountings should be examined for evidence of wastage due to leaks from valves and fittings. Leakage from the bottom of the front and back heads in way of the flanging of the plate should be noted for further examination of the inside of the head; cracks induced by flexing of the head sometimes penetrate the plating. Riveted seams showing evidence of leakage should be carefully examined; cracks occasionally occur between rivet holes or extend from rivet holes to the plate edge. The manhole gasket seats and adjacent plating should be checked for signs of wastage due to gasket leaks; the radial clearance between the manhole plate and the head

should not be excessive. The boiler saddles, foundations, and collision chocks should be hammer tested to detect evidence of deterioration; these members are subject to severe wastage from the corrosive action of bilge water. The hydrostatic pressure should then be released and the boiler drained out.

Examination of the Boiler Waterside

f. The inspection of the waterside of the boiler is most conveniently begun by entering through the top manhole. The dry pipe, internal feed lines, and surface blow pipe should be examined first; defective gaskets at the point of attachment of the internal feed lines to the boiler head are frequently the source of erosion of the plating. The butt strap and the rivets attaching the heads to the shell should be sounded with a hammer. Where rivets are found to be loose or rivet heads missing, the rivet holes should be searched for cracks by nondestructive testing methods after the rivets are removed. The stay rods, girder stays, and combustion chamber tops should be examined for evidence of wastage due to corrosion. The screw stays at the back and sides of the combustion chambers are difficult to examine because of close clearances. However, a good evaluation of the condition of these members can be made with the use of a portable electric light lowered successively between the rows of stays. The most common deficiency found in these stays is "necking," a reduction in diameter near the plate surface caused by corrosion and stresses from expansion of the combustion chamber. The boiler tubes are so closely spaced that visual inspection must usually be confined to the top and side rows. Pitting is frequently seen in these tubes. Shallow, widely scattered pits can usually be disregarded, but deep pits extending over a large area may so reduce the wall thickness that replacement of tubes is necessary (from the standpoint of stress, tubes will satisfactorily function with a reduction of wall thickness of up to 50 percent). In any event, when evaluating the condition of boiler tubes, a distinction must be made between plain tubes and stay tubes, the latter having a much greater initial wall thickness.

Completing the Boiler Examination

g. Finally, the lower part of the boiler interior is inspected. The most common defects in this area are corrosion of the plating of combustion chambers, furnaces, shell, and heads by pitting, and grooving of the flanged plating of the heads and furnaces. Pitting often attacks the plating of the furnaces, combustion chamber wrapper plates, back plates, and the bottom plating of the boiler shell. Grooving due to thermal stresses is frequently seen in the flanges of the front and back heads, and at the connections of the furnaces to the combustion chambers. Radial grooving, originating in the holes drilled in the front and back heads for the stay rods and extending in a "spider web" from these holes, is occasionally encountered.

### 3. Inspection of Watertube Boilers

Test and Examination Intervals

a. Title 46, CFR, Subpart F, requires that hydrostatic tests must be applied to all watertube boilers quadrenially (annually in the case of passenger vessels). Excepting passenger vessels, OCMIs are authorized to extend the hydrostatic testing interval for one year (12 months), to a period not to exceed five years (60 months) since the last hydrostatic test. In the case of passenger vessels, the hydrostatic test interval may be extended up to a period not to exceed 30 months since the last test, provided that no less than two hydrostatic tests are conducted within any five year period. OCMIs may extend fireside and waterside examination intervals for watertube boilers, including economizers, auxiliary boilers, low pressure heating boilers, and unfired steam boilers to an period not to exceed 30 months since the last examination, provided that no less than two such examinations are conducted in any five year period. It is anticipated that the aforestated authorizations shall be exercised primarily to permit the test and examination interval to coincide with the vessel's drydocking or similar out of service availability period. Hydrostatic pressure tests are applied annually to passenger vessel boilers, and at 5-year intervals to the boilers of other vessels. Following repairs and at the conclusion of inspections, watertube boilers should always be hydrostatically tested to a minimum of 1.25 MAWP (if substantial modifications or repairs have been made, to 1.5 MAWP).

➔ **SEE** 46 CFR, TABLE 61.05-10—INSPECTION INTERVALS FOR BOILERS at beginning of Section G for intervals.

Interior Examinations

b. The inspection is most conveniently begun inside the furnace. The waterwall tubes and screen tubes should be examined with the aid of a spotlight for evidence of blistering or distortion. Severely blistered tubes should be renewed. A minor amount of tube distortion is acceptable if the insides of the tubes are clean. If there is evidence of tube leakage at the ends of the waterwall tubes, sufficient refractory should be removed to expose the waterwall headers so that the leakage can be traced to its source. The superheater and part of its support structure can generally be seen from inside the furnace. In this area, burned support brackets and badly warped superheater elements are common defects. The baffles above and below the superheater in D-type boilers should be examined. Some boilers of this type are fitted with feeder tubes in the furnace floor, which can be examined only when the brickwork is removed. Defects in these tubes, however, are rarely encountered; the furnace floor should be disturbed only when leakage is suspected or for refractory repairs. Furnace refractory is subject to damage from erosion due to direct flame impingement, fusion occurring at high rates

of combustion, and destruction of insulation due to improper drainage during water-washing operations. When the damage is local, the defective area may be repaired; however, it is sometimes necessary to rebuild the walls or floor.

c. Exterior Examinations

Exterior Examinations

(1) General. The inspector should continue with an exterior examination. The tubes and headers of economizers and gas air heaters are vulnerable to external corrosion due to condensation and should be examined through the access openings. The steam drum and its accessories should be carefully checked; if a hydrostatic pressure test is applied, the nozzles, gaskets, and welded pipe connections should be searched for leakage. In D-type boilers, the sliding feet that permit linear expansion of the water drum should be examined. Expansion of the generating tubes of straight tube boilers is accommodated by bolting the front headers rigidly and securing the back headers with loosely fitted bolts; the condition of these bolts should be checked. In sectional header boilers, the riser tubes, drum nipples, and top row of generating tubes can be reached for examination from the access opening below the steam drum. Removal of the superheater access doors in D-type boilers will permit access to the superheater and the lower part of the steam drum. In both boiler designs, the casing in way of the steam drum should receive attention; gas leakage in this area is common. The casing below the steam drum should be examined; burning or bulging of this casing or distortion of access door frames is usually due to destruction of the insulation. If these conditions are found, the buckled casing must be removed so that the insulation can be replaced.

(2) Header Examinations in Sectional Header Boilers. The headers of sectional header boilers should be examined next. Leaking handhold plates should be marked for later removal and renewal of gaskets. The gasket surface should be examined with the aid of a mirror; chronic leakage is sometimes due to steam cuts across the seating surface. The handhold plates of superheater headers should be similarly examined, and the superheater tubes should be checked for leakage where these tubes are rolled in the headers. The short nipple connections of the transverse mud drum to the front headers and the bottom blow valve connection to this header should be checked for leakage; external corrosion of the nipples is sometimes encountered. The tube joints, handhold plates, and drain nipples of the waterwall headers should be checked for evidence of leakage and external corrosion. The air duct beneath the furnace floor should be examined to ensure that it is free from accumulation of oil.

(3) Header Examinations in D-Type Boilers. The superheater headers and waterwall headers of D-type boilers should be similarly examined. The vestibule below the economizer or air heater should be opened and cleaned. In this area, the ends of the generating tubes, at the connections to the bottom drum, can be seen. Because of the close spacing of the tubes, inspection is usually limited to the outer rows; however, external corrosion of these tubes, due to soot deposits and improper water-washing, is not uncommon. The bottom drum manhole opening, bottom blow valve connection, and drum support saddles should be examined. In this area, leakage and associated wastage are rarely seen; however, the foundations of boilers installed directly on the tank tops are subject to wastage from the corrosive action of bilge water.

(4) Examinations of the Waterside. The interior of the steam drum is the best starting point for inspection of the waterside of the boiler. The flanged piping connections of the desuperheater and internal feed lines should be hammer tested; if the tightness of the desuperheater piping is in doubt, it should be hydrostatically tested. The steam drum should be thoroughly cleaned prior to inspection; portions of the drum internal platform should be removed to permit a close examination of the drum interior and the tube ends. Pitting along the waterline, in the bottom of the drum, and in the ends of the riser tubes and generating tubes, is occasionally found. The brackets supporting the dry pipe, internal feed lines, and desuperheater should be examined to ensure that the securing bolts are tight.

(5) Examination of Tubes. A sufficient number of handhold plates should be removed from the headers of the generating tube bank, superheater, economizer, and waterwall tubes to permit a comprehensive examination of these tubes. In addition to tube inspection, handhold plates should be opened to permit inspection of header baffle plates, orifice plates, drain locators, branch lines, inlet/outlets, elbows, thermometer wells, and other locations subject to high stresses or corrosion. Generally, removal of 5 percent of the handhold plates will suffice; however, if internal pitting or an excessive amount of scale is found, it may be necessary to remove all of the handhold plates for a complete examination. Scale deposits exceeding 1/32" in thickness will seriously impair heat transfer, especially in screen tubes and waterwall tubes, and may result in blistered and distorted tubes. Scale should be removed by mechanical means or by chemical washing. Examination of tube interiors is difficult in D-type boilers because the tube bends preclude sighting more than a short

distance inside each tube. However, the tubes should be inspected from within the lower drum and, with the aid of a mirror, from the waterwall and superheater headers. The inside surface of the bottom drum should be examined for evidence of pitting; this is occasionally seen in boilers that have been out of service for long periods of time.

**4. Examination of Hybrid Boilers**

General

a. As a result of the design efforts to comply with size restrictions imposed by ship builders, hybrid boilers are very compact in their construction. They are considered to be auxiliary heating boilers, and their operating controls are regulated under 46 CFR 63.05 or 63.10, depending upon fuel consumption and rated heat output.

Tests

b. For test purposes, these boilers are considered to be of the firetube type and shall be hydrostatically tested at least annually, per 46 CFR 61.05-10.

Fireside and Waterside Examinations

c. The limited access available for internal examinations of these boilers presents some unique inspection problems. Methods available to perform internal examinations are few, and certain areas of these hybrid designs demand special attention by the marine inspector. The tube sheet ligaments, if accessible, should be thoroughly examined for cracks, especially near the furnace area. To the extent possible, the tube sheets should be examined for distortion or other indications of surface deterioration. Uptake/flue pipe between the top of the furnace and the lower tube sheet should be examined for possible yielding of the material caused by excessive heat either from normal firing with a low water level or extreme high firing rates for extended periods of time. The external pressure exerted on a horizontal cylindrical furnace or an uptake pipe will eventually cause the pipe to fail after being subjected to these conditions. The fireside of the furnace should be examined for brickwork damage or deterioration. All accessible waterside areas of the furnace should be examined for signs of pitting, cracks, and scale. A serious scale build-up or pitting on the furnace plate's waterside can be indicative of a poor boiler water treatment program. During the waterside exam, the furnace and shell surfaces in the vicinity of the ogee ring (and the ring itself) should be thoroughly examined. This area supports a majority of the load and is susceptible to very high stresses. If evidence of deterioration or distortion is found, nondestructive testing should be performed on the welds, which connect the ogee ring to the shell, and to the furnace. Any problem involving the ogee ring should be investigated from both the internal and external vantages, on the ring inner and outer diameters.

Stays

d. Boiler stays should be carefully examined for cracks, especially in way of the welds. Stays should be examined to detect "necking" or similar evidence of deterioration. One method to evaluate the condition of a boiler stay is to strike it with a hammer and listen carefully to the resulting sound. Generally, if the stay is in good condition, it will make a ringing sound when struck. A dull sound is indicative of a cracked or otherwise deteriorated stay and it should be thoroughly inspected for defects. Other forms of nondestructive testing, such as dye-penetrant or magnetic particle, can be used to determine a stay's condition. In case several stays in one area are found to be defective, the problem is nearly always due to uneven loading on the support structure, a condition that should receive immediate corrective action.

## 5. Repairs to Boilers

Introduction

a. It is difficult to describe all of the many types of repair procedures that the inspector may have to consider. Boiler defects will seldom involve only certain specific areas. Severely pitted tubes will often be accompanied by pitting in headers or in steam and water drums. Similarly, a distorted corrugated furnace frequently is evidence of wastage of combustion chamber plates or adjoining furnaces. Repairs, whenever they are undertaken, must comply with the requirements of 46 CFR 59.

Firetube Boilers

b. In firetube boilers, visual inspection of the outside of the tubes is limited to the outer rows, because of close tube spacing. Heavy scale buildup on these tubes is common, and thorough cleaning of the tubes, even by chemical means, is very difficult. In addition to pitting on the waterside, these tubes are subject to wastage of that part of the tube that projects beyond the tube sheet, particularly in the smoke box area. This condition is easily detected. When it is found, the defective tubes should be renewed. On the other hand, thinning of the tube walls due to corrosion can usually be discovered only by cutting out and sectioning tubes. This procedure should be followed only when a substantial number of the tubes are found to be leaking or plugged. In general, when tubes look satisfactory on the waterside, when the boiler has no history of tube failure, and when leakage can be corrected by rerolling, the tubes may be kept in service. Tubes from which the beading has been burned off should not be built up by welding, but shall be renewed (see Figures 6-1 through 6-3 for examples of defects and repairs to firetube boilers).

Watertube Boilers

c. In watertube boilers, tube replacement is one of the most frequently encountered repair procedures. Boiler tube life is influenced by such factors as original wall thickness, thermal stresses due to location within the boiler, waterside corrosion, fireside damage, and service history of the boiler. The external surfaces of tubes are exposed to loss of metal from corrosion by sulfur and vanadium in the oil burned, as well as overheating and slag damage. Deterioration of this type may result in abnormal bends, bulges, blisters, ruptures, and mechanical fatigue cracks that are fairly obvious during visual inspection of the firesides. The following procedures are recommended for inspection of boiler tubes:

(1) Conduct a detailed and thorough visual inspection of all uncovered tubes. In general, when tubes look satisfactory from a visual inspection, they may be kept in service until some degree of failure is encountered. When the same type of tube failure occurs often, a major tube replacement should be considered. A number of failed tubes may be plugged in an operating boiler, generally not exceeding 10 percent of the tubes in any one tube bank, section, or pass. However, this 10 percent figure is for guidance purposes only, and any recommendations for tube replacement by the manufacturer's representative should be followed. Tube location is important in determining whether they can be plugged. Superheater tube plugging should be limited to 10 percent of each pass. Renewal of tubes at less than 10 percent may be justified if the tubes in question are in a group, may cause poor gas flow, or overheating. Support tubes should be renewed. Major circulating tubes, such as downcomer or riser tubes that are defective should be replaced.

(2) If there is a suspicion that deep corrosion product scabs exist in waterside pits, or if any other condition prevents minimum thickness determination, chemical cleaning to bare metal should be required. If this process shows pits in a large number of tubes, and more than one or two in many tubes, a sample tube should be cut out of the boiler and sectioned and its minimum thickness determined.

(3) If the sample tube has deteriorated generally to less than 50 percent of the original thickness, a representative number of tubes (20-30) should be cut out of the tube bank and the process repeated. If more than half of the sample tubes are found to be in the same general condition of deterioration, consideration should be given to retubing the boiler.

FIGURE 6-1
DEFECTS AND REPAIRS TO FIRETUBE BOILERS (1)

(To be included in future revision)

FIGURE 6-2
DEFECTS AND REPAIRS TO FIRETUBE BOILERS (2)

(To be included in future revision)

FIGURE 6-3

DEFECTS AND REPAIRS TO FIRETUBE BOILERS (3)

(To be included in future revision)

## 6. Inspection of Boiler Mountings

Introduction

a. The regulations concerning boiler mountings in 46 CFR 52.01-3 and 61.05-15 were written when more attachments were connected directly to the steam drum or boiler shell than in today's more modern boiler which have welded mountings. However, the intent and concerns of these regulations apply to modern boilers regardless of mounting types. The inspector should recognize the importance of all connections and piping to the first isolation valve. It should not be necessary to require removal of all first isolation valves to comply with the "mounting" inspection intent. All major valves, which are the first isolation or control of steam or feedwater, should be treated as "mountings" for inspection of the valve and piping toward the boiler. At a minimum, the following valves are subject to valve and mounting inspection requirements: main steam stop; generator steam stop; auxiliary steam stop; main and auxiliary feed stop; blowdown (surface and bottom); superheater vent; superheater drain; and soot blower stop.

Inspection Criteria

b. The following inspection criteria shall be observed:

(1) Five-Year Valve Inspection. This should be adequate to ascertain the condition of the valve body, adjacent piping, and valve condition to ensure isolation of the system down from the valve. The interval for opening and examination of boiler valves may be extended by the OCMI for a period of one year (12 months) to a maximum interval of not more than five years (60 months) since the last such examination, in order to coincide with the vessel's drydock exam or similar out of service availability period.

➔ **SEE** 46 CFR, TABLE 61.05-10—INSPECTION INTERVALS FOR BOILERS at beginning of Section G for intervals.

(2) Ten-Year Mounting Survey. This includes studs that are subject to high heat and stresses. Valves should be required to be removed if internal piping and valve conditions cannot be adequately examined from inside the steam drum or other open connections. The eight year interval for boiler mounting examination (i.e., removal of boiler mountings, examination of mounting studs or bolts) may be extended by the OCMI for a period of up to two years (24 months) to a maximum interval of not more than ten years (120 months) since the last such examination, in order to coincide with the vessel's drydock exam or similar out of service availability period.

(3) Studs. Boiler mounting studs must be made in accordance with ASME Standard 193. Studs are heat treated and marked on one end with a grade and manufacturer's symbol. A common stud grade is "B7" which indicates a heat treated austenitic steel alloy for "high strength" bolting materials. Studs should be checked for proper heat number. Examination of the stud may be made in place. If the stud is removed, it should be examined for cracks, "necking" down, or deterioration. If studs are bend tested, experience and sound judgment is necessary to determine whether the studs are brittle. Even a new stud will break at the notch of a thread when bent more than 30 degrees. Therefore, bend testing is not recommended.

(4) Flanged Valves. When flanged valves are removed from the boiler pads, the condition of the studs or bolts that connect the valves to the pads shall be determined. When valves are bolted to pads or spools that are riveted or welded to the boiler, the riveted or welded joints should not be broken unless there is evidence of leakage or deterioration. These examinations may also be made at intermediate periods if there is any evidence that defects have developed or that excessive corrosion has occurred. When one or more flanged joints intervene between a stop valve and the boiler drum or superheater outlet, such flanged joints need not be opened at the time the valve is removed from its flanged joint. A flanged joint may be opened at any time by the inspector if, in his or her opinion, examination is considered necessary.

Removal of Mountings and Attachments on High-Pressure Boilers

c. The requirement to remove boiler mountings at 8-year intervals has been modified for certain vessels having unusually high steam pressures. This modification has been permitted due to the difficulty of attaining a steamtight joint and the fact that some valves are welded directly to the steam piping. For these vessels, only the bonnets of the valves need be removed to permit the inspection required at 10-year intervals. Valves, mountings, and attachments need not be removed unless defects are found that require their removal for further examination, repair, or replacement. Credit shall be given for an 8-year boiler mounting inspection for these vessels if the boiler valve bonnets are opened and the inspector is satisfied with the examination. A mirror shall be used to check all inaccessible parts of the mountings. A record of the inspection of the mountings shall be made on Form CG-840B (Boiler Inspection Book - Condition of Vessel) and a notation made on the COI. This notation shall be carried on each succeeding certificate until the next inspection.

Boiler Safety Valves

d. Boiler Safety Valves

(1) General. Testing of boiler safety valves is typically conducted at the inspection for certification. Extensions are not authorized for the testing of safety valves. In most cases, the testing of these devices can be accomplished without taking the vessel out of service. Proving satisfactory operation of boiler safety valves is now especially important given the potentially increased intervals between boiler internal examinations and hydrostatic tests. The inspector shall observe the lifting and reseating pressures of the boiler safety valves and examine the valves to determine if there are any signs of weakness or malfunctioning. Whenever evidence of leakage appears, the inspector may require the safety valves to be opened at intermediate periods for examination. The inspector shall carefully check the setting of each boiler drum and superheater safety valve and require any adjustments necessary to maintain the boiler within MAWP.

(2) Inspection of Piping. The safety valve escape piping shall be examined for freedom of expansion and proper drainage. At the time the safety valves are tested, the inspector shall also ascertain that the drain opening in the valve body and the escape piping are free. Improper drainage or plugged drains may result in serious corrosion of the valve body and internal parts. The inspector shall examine the boiler casings to ascertain that there is no accumulation of soot, ash, or scale that may drop into the escape piping and cause malfunctioning of the safety valve. The inspector may require the discharge connections to be removed to determine the freedom of discharge from the safety valves.

Cast-Iron Valves

e. See subparagraph B1.G.8.b below.

Water Columns, Test Cocks, and Gauges

f. The water columns and gauge glasses shall be carefully examined at each annual inspection. It must be ascertained that water cannot accumulate in the pipe forming the steam connection to the water column. The connections to the boiler should be free, as indicated by the action of the water in the glass. The water columns and gauge glasses shall be blown down on each boiler to determine the freedom of the connections to the boiler and to see that the blow off piping from the water columns and gauge glasses is free. The operating condition of the gauge cocks shall be determined by test. All steam gauges on the boilers and main steam lines shall be checked for accuracy with a standard test gauge.

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**7. Inspection Procedures for Externally Fired Lap Seam Boilers**

Before Inspections

a. Before inspection, all lagging or other material covering longitudinal lap joints shall be removed on the entire length of the seam, to a width of at least 4 inches from the nearest course of rivets, after which the seam shall be thoroughly scaled and wire brushed outside (and inside if possible). All deposits of electric welding, whether on rivets or plates, shall be entirely removed. The joints should then be thoroughly examined for indications of grooving or other defects. Grooving in the initial stages is characterized by a line of irregular surface cracks extending along the caulking edges or running parallel with the line of rivets, and is particularly noticeable on the waterside. When grooving is evident, steps should be taken to ascertain its depth and extent so that a lower working pressure may be calculated, based on the premise that the groove exceeds the maximum measurable depth by 10 percent.

During Inspections

b. During inspection, and while the boilers are under full hydrostatic stress, the exposed seams shall be shock tested over their entire length by striking the plates in the vicinity of the rivets with a smooth-headed hammer weighing at least 7 pounds. Should this procedure reveal a leak, however slight, in the solid plate, a crack is indicated. In this case, the lap seam must be cut away and butt straps installed or the shell plate renewed.

Fusion Welding

c. Fusion welding for any purpose or to any degree must not be applied or allowed to remain on rivets or solid plate forming a longitudinal lap joint. Should leaks develop as a result of slack seams or rivets, sufficient rivets shall be renewed to obtain a tightly caulked joint. Rivet removals, when necessary, should be done by chipping off the rivet points (heads) and driving out the shank, but never by burning. In every case where rivets are removed, appropriate nondestructive testing should be used to detect the presence of cracks. Seams found to be satisfactory may be relagged or otherwise covered so that the covering can be easily removed intact at subsequent inspections.

Alternative Repair Methods

d. Should a departure from these methods of repair become necessary, full details shall be transmitted to Commandant (G-MOC) for approval before alternative action is taken. A separate entry shall be made on Form CG-840B in each case, indicating that the foregoing procedures have been carried out. A statement of the conditions found and the nature and extent of repairs, if any, shall be included.

Reports of Defective Seams

e. Reports of Defective Seams. Commandant (G-MOC) shall be furnished with a detailed report, including photographs if obtainable, in each case where defective seams are detected.

## 8. Lessons Learned About Boiler Operation

Explosions in Firetube Boilers

a. Explosions in Firetube Boilers

(1) Facts developed during the CAPT C. MATHIASEN investigation indicated that a weakened condition of the flanged plate, forming part of the combustion chamber, escaped detection during the annual inspection. It is evident that hydrostatic and hammer tests alone are not sufficient to establish the integrity of a boiler for continued service. Defects that show up under hydrostatic tests can easily be observed from the outside or fireside of conventional boilers. Often, however, the most serious defects are indicated only by the surface condition of the plates or other parts seen from the waterside or steamside. Some of these interior defects are:

(a) Grooving, which is usually found along the edge of lapped plates;

(b) Fatigue cracking, which occurs on the knuckles of flanged plates and on the underside of the first corrugation forming the horse collar of Morison-type furnaces; and

(c) General deterioration of plates and stays caused by corrosion, which is often concealed by a thick layer of scale.

The extent to which these defects have advanced can be determined only through most careful examination after the boiler has been thoroughly scaled and cleaned.

Superheater Erosion

c. Superheater Erosion

(1) Inspection Procedures. When inspecting boilers that have superheater headers installed vertically or nearly vertically, the inspector shall use all means available to determine if there is grooving or pitting of the header in the area of the baffle. This examination shall include the use of mirrors and finger touch, as necessary. If serious pitting or erosion is found in such superheater headers, the drain holes should be relocated in the baffle near the center thereof and the original holes welded closed. Whenever pitting or erosion is noted, necessary repairs should be made to prevent a potential boiler casualty.

Cast-Iron and Malleable Iron Valves

d. Cast-Iron and Malleable Iron Valves

(1) Introduction. Failures of cast-iron boiler valves used in main and auxiliary steam feed and blow off lines installed prior to 1 July 1935 have resulted in a number of serious casualties and deaths. Because of the thinning down of the valve bodies due to corrosion and wear, with a consequent decrease in the factor of safety, cast-iron valves and fittings used in boiler mountings and in steam feed and blow off lines should be subjected to thorough examination, particularly at the time of the annual inspection. Since the brittle properties of cast iron may produce fractures under conditions of shock and sudden applications of load, such as "water hammer" and rapid changes in temperature, cast-iron valves and fittings should be carefully and thoroughly examined for cracks and corrosion defects at the time of inspection.

(2) Inspection Procedures. At the end of the 4-year period when boiler mountings are opened, and the end of the 10-year period when they are removed in accordance with 46 CFR 61.05-15, cast-iron valves and fittings should be subjected to a thorough visual inspection, both internally and externally. The valve bodies should be inspected to ascertain whether there has been a reduction in wall thickness below the requirements specified in 46 CFR 56.60-10. If the thickness of the material has fallen below the specifications, such valves and fittings should be removed from service. Special consideration should be given to installations in which cast-iron valves and fittings have been repaired or have had parts replaced or altered. The bodies of cast-iron valves and fittings should not be tapped for drainage or bypass connections, etc., except when a boss has been cast integral with the valve. Inasmuch as cast iron and Grade B malleable iron have somewhat similar properties, valves of this latter material should receive the same thorough inspection as required for cast iron.

Steam Piping to Soot Blowers

d. In a reported casualty, a 600 psi steam supply line to the soot blower elements ruptured, causing serious injuries to the person who was blowing tubes. Examination of the ruptured pipe showed that the rupture occurred in a bend where erosion had, over a period of years, virtually eaten away the pipe from the inside. Particular attention during periodic inspections shall be given to areas where erosion or corrosion are likely to occur in soot blower piping. The location of these areas can best be determined from a visual examination of the piping installations aboard the vessel.

## H. INSPECTION OF AUXILIARY MACHINERY AND EQUIPMENT

The purpose of tests and examination of auxiliary equipment is the same as for main equipment. We need to ensure that it will operate safely at the design pressure, temperature and condition for a specified minimum period of time.

### 1. Turbine Driven and Diesel Driven Auxiliary Machinery

Overspeed trips, low-lube oil pressure trips, and low-lube oil pressure alarms of turbine or diesel driven auxiliary generators should be tested at each inspection.[3] Other turbine driven auxiliary machinery, e.g., feed pumps, fire pumps, etc., should be examined under operating conditions to ensure proper functioning of the local and remote startup and shutdown controls, as well as speed controls under various load conditions.

[3]**NOTE:** Any operational tests of lube oil shutdown controls should not risk shutting off the oil supply to the bearings.

### 2. Steering Gear

See Section C, Chapter 4 of this volume for guidance on inspecting the steering gear.

## I. INSPECTION OF PIPING SYSTEMS

**1. General Considerations**

The inspector shall be generally guided by 46 CFR, Subchapter F for the inspection of piping systems and ANSI B31.1. Particular attention shall be given to material type and rating, pipe securing arrangements, couplings, and alignment. Material and equipment must be suitable for the service intended and meet melting point, ductility, strength, and compatibility requirements for the system. Piping must be well secured to reduce vibration and stresses. Couplings shall be suitable for the pressure and service. Proper alignment of piping systems should also be checked. (See MSM II B3 and C2 of this volume regarding expansion joint and dresser coupling requirements.)

**2. Test and Examination Intervals**

The hydrostatic test interval for firetube boilers' main steam piping shall be in accordance with the intervals permitted in paragraph H.2.a. The hydrostatic test interval for watertube boilers' main steam piping shall be in accordance with the intervals permitted in paragraph H.3.a. Hydrostatic testing of steam piping subject to main boiler pressure, other than main steam piping, may be extended one year (12 months) to an interval not to exceed five years (60 months) since the last hydrostatic test.[4]

[4]**NOTE:** Vital System Automation, see 46 CFR 61.40 and 46 CFR 62

**3. Safety and Relief Valves**

The inspector shall observe that the safety valves (or relief valves) installed on reduced-pressure lines, evaporators, and feedwater heaters operate satisfactorily. These valves shall be tested to determine if they can prevent the build up of excessive pressures before the shutoff valve can be closed, and if they serve as a warning in the event of failure of the reducing valve. The setting of such valves shall be checked at each inspection and adjusted if necessary.

## 4. Internal Bilge Suction Valves

General

a. Internal valves are required to be installed on bilge suction lines on passenger vessels by 46 CFR 56.50-50. They are not required on cargo or tank vessels, but are fitted in many instances as an additional safety measure. These valves often consist of screw-down valves that, in many instances, become frozen in the open position. In some collisions and groundings, damage to the vessels could have been greatly reduced if the proper precautions and maintenance had been taken with internal valves. Often, the initial damage was confined to one watertight compartment but because internal valves had been left open, other compartments were flooded, cargo holds were damaged, and personnel were endangered. In the course of some investigations, it was reported that no officers knew the purpose of the valves, or even that they existed. For these reasons, the inspector shall check such valves and require them to be operable, whether or not they are required under 46 CFR 5 6.50-50. The inspector shall also ensure that the ship's officers understand the purpose of these valves.

Neutralizing Valves, or Incapacitating Remotely operated valves

b. Should the operator of a cargo vessel equipped with remote control suction valves in bilge suction lines wish to remove these valves or render them permanently inoperable in the open position, the operator may do so through one of the following procedures:

(1) Removing the remote control rod, operating wheel, and suction valve and replacing the valve with a spacer of equivalent size;

(2) Removing the remote control rod, operating wheel, remote control suction valve bonnet, valve disc, body seat ring, and guide bridges and replacing the valve bonnet with a steel cover plate of appropriate size; or

(3) Removing the remote control rod, valve stem, and disc and installing a screwed plug or bolted gasket and washer over the stuffing box hole to create a tight valve bonnet.

**5. Cargo and vital or critical system Piping Repairs**

Repairs to cargo and vital or critical system piping systems are classified as emergency, temporary, or permanent in nature. Emergency repairs are made to permit the completion of cargo discharge. Temporary or permanent repairs shall be required prior to loading of another cargo. Temporary repairs are made to a pit or other isolated defect in a line. Temporary repair methods include the use of substantial pipe clamps, repair sleeves, and similar devices capable of withstanding operating pressures and temperatures. Permanent repairs are made by an isolated welded doubler or renewal in kind, and are required upon the next gas-freeing or repair period, whichever is sooner. Generally, piping with a localized, isolated defect and otherwise in good condition may be repaired with a doubler.

> **NOTE:** Piping restored to service by any of these methods should be appropriately tested upon completion of repairs.

**6. Diesel Piping Systems**

Diesel supply and service piping, including that provided by engine manufacturers, should be carefully inspected. Several fires have resulted from the cracking of diesel supply lines and injector couplings due to vibration. All fuel systems should be checked for proper mounting, expansion joints, filter arrangements and spray shields.

## J. ELECTRICAL INSPECTIONS

**1. Introduction**

At each inspection for certification, the inspector shall examine the vessel's electrical equipment and apparatus, the arrangement and materials of the installation, and the operating condition of the installation as required by the regulations. The primary purposes of electrical inspections are to ensure the adequacy and reliability of shipboard electrical systems, to maximize safety to personnel from electrical shock, and to minimize the danger of fire originating within the electrical system.

**2. Scope of Inspection**

The scope of the electrical inspection for small passenger vessels is detailed in 46 CFR 176.25-15; for other vessels in 46 CFR 110.30. The inspection includes the examination and testing, when necessary, of all electric generators, motors, wiring circuits, junction boxes, fixtures, and other electric installations. No electrical repairs or alterations affecting the safety of the vessel, its equipment, and crew shall be made without the knowledge and approval of the OCMI. Drawings must be approved before work is started when the repairs will involve alterations (See Section A, Chapter 4 of this volume concerning the inspection of electrical equipment used on vessels).

**3. References**

The standards for the inspection of electrical installations on all vessels except small passenger vessels are contained in 46 CFR, Subchapter J. As indicated in 46 CFR 110.10, they are supplemented by recognized specifications, standards, and codes. Subchapter J applies to small passenger vessels only insofar as they are made applicable by 46 CFR 183. Vessels contracted for prior to November 19, 1952, are not fully subject to the requirements in Subchapter J. The electrical installations on these older vessels may be maintained as long as their condition is satisfactory to the OCMI, unless amended regulations specifically apply to these vessels. However, major alterations or extensions to such electrical installations shall be made to the requirements of Subchapter J. Additional references can be found in the Institute of Electrical and Electronic Engineering (IEEE), American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), National Electric Code (NEC), International Electrotechnical Commission (IEC), the old 46 CFR Subchapter J (pre-June 1996 editions), NVIC 2-89 *Guide for Electrical Installations on Merchant Vessels and MODUs*, NVIC 9-84 *Electrical Installations in Agricultural Dust Locations,* and Underwriters Laboratory Inc. (UL) Publications.

## 4. Initial Electrical Inspections

Introduction

a. In carrying out tests and inspections prescribed in 46 CFR 110.30, the inspector shall pay particular attention to the items listed below. These tests and inspections are intended as guides to the inspector; they are not mandatory unless the OCMI judges them to be necessary. Extreme caution shall be exercised during all inspections and tests. They will be conducted by the shipbuilder, the owner, or the owner's representative. They should be observed by an inspector, and the recorded data obtained for checking and reference purposes. For more detailed plan approval information, see Marine Safety Manual Volume IV.

Electrical Cable

b. Electrical cable shall be checked during installation for size and type as shown on the approved plans. The adequacy of cable supports shall also be checked. It shall be ascertained that cables are not located near pipes and hot objects, and that they have not been damaged during installation by excessive pulling, sharp bends, sharp or rough edges of cable supports or bulkhead penetrations, or similar conditions. Cable penetrations required to be watertight shall be checked for proper packing of terminal or stuffing tubes, including areas provided for future take-up of gland units. Cable penetrations through Class A and Class B bulkheads and decks shall be checked for compliance with approved methods.

Insulation Resistance

c. All electric power and lighting cables, generators, and vital systems motors shall be checked for proper insulation to ground and between conductors. The insulation resistance measuring instrument (megger) used should be of the 500 volt, direct-current type, except for equipment where the normal operating voltage is less than 100 volts in which case a direct reading ohmmeter of the appropriate voltage should be used. Insulation resistance varies considerably with humidity, amount of exposed copper, etc. Therefore, it is difficult to establish firm rules to guide the inspector. Generally, Figure B1-4 should be used as a guide in determining minimum acceptable values of insulation resistance. Ordinarily, on a dry day and with new, clean equipment, resistance should not be less than the values indicated in the figure. The insulation resistance in megohms shall be at least equal to that determined by the formula in Figure 6-4.

Group Control Panels

d. When two or more motor controllers are grouped into a central panel and supplied by a common feeder, the panel shall be checked for compliance with the requirements of 46 CFR 111.70. Each controller, its associated motor overcurrent protective device, its motor branch circuit overcurrent protective device, and disconnecting mechanism shall be mounted in a common enclosure with a disconnect device that prevents the door being opened when the circuit is energized. The enclosure shall be either drip-proof or watertight, depending on its location. Adequate working space should also be provided. This generally should be no less than 76 cm (30 in) in front,

**FIGURE B1-4**
**INSULATION RESISTANCE**

1. GENERAL INSULATION RESISTANCE FORMULA FOR VITAL MOTORS AND GENERATORS

$$R \text{ (In Megohms)} = \frac{E}{\frac{KVA + 1{,}000}{100}}$$

Where: E = Rated line to line voltage of the machine.

KVA = Rated kilovolt amperes.

2. GENERAL RESISTANCE TABLE FOR CABLE1

| MINIMUM CIRCUIT | INSULATION RESISTANCE |
|---|---|
| 0 – 5 amperes, inclusive | 2.0 megohms |
| 6 – 10 amperes, inclusive | 1.0 megohms |
| 11 – 25 amperes, inclusive | 400,000 ohms |
| 26 – 50 amperes, inclusive | 250,000 ohms |
| 51 – 100 amperes, inclusive | 100,000 ohms |
| 101 – 200 amperes, inclusive | 50,000 ohms |
| Over 200 amperes | 25,000 ohms |

1. The values for a circuit should be determined with the circuit de-energized, with all switches or circuit breakers connected in the circuit closed, and with all panelboards, controllers, fuses, and fuseholders in place. and in no case less than 18 inches in the rear, when access to the rear may be necessary.

Generators

e. Generators shall be checked for general condition (both electrical and mechanical), voltage regulation, parallel operation, operation of safety devices such as reverse-current or reverse-power trips, overcurrent trips, overspeed trips, low-oil pressure trips, and similar devices (see 46 CFR 111.12).

Rotating Electric Machinery

f. This equipment shall be checked to ensure that rotating and uninsulated electric parts are adequately shielded from accidental contact by personnel. Nameplate data shall be examined for correct ratings for the particular application (see 46 CFR 111.01 and 111.25).

Switchboards

g. Switchboards shall be checked for nonconducting handrails, guardrails, working spaces, insulating floor coverings, drip covers, and shields. Switchboard enclosures shall be checked for proper construction in accordance with 46 CFR 111.30. Switchboard mounted apparatus shall be checked for identifying nameplates. Circuit nameplates shall be compared with the rating or setting of the overcurrent devices and with approved plans. The accessibility of items requiring maintenance or adjustment shall be checked. Meters shall be checked for proper operation. The operation of automatic switchgear and interlocks shall be observed (see 46 CFR 111.30).

Panelboards

h. The rating or setting of the overcurrent devices shall be compared with the values given on the circuit directory and the approved plans. The accuracy of the directory description of loads served by each circuit shall also be checked (see 46 CFR 111.40).

Motor Starters

i. Motor starters shall be checked to ensure proper starting under service conditions with properly rated motor overload protective devices. Enclosures shall be checked to ensure that they are dripproof or watertight, and that required door positioners are installed on doors with a height of more than 45 inches or a width greater than 24 inches. A fixed heat-resistant wiring diagram for each motor starter must be on the inside of its enclosure door. Each motor starter not disconnected from all sources of potential when the disconnect switch is opened, due to electrically interlocked circuits that are necessary for proper operation of the apparatus or for other valid reasons, shall have attention directed to these conditions by a warning sign (see 46 CFR 111.70).

Disconnect Switches

j. The presence and location of disconnect switches required for motor starters, fuses, etc., shall be checked. When a switch or circuit breaker is intended to serve as a motor and controller disconnect switch, the inspector shall ensure that the applicable requirements have been met (see 46 CFR 111.55 and 111.70 and National Electrical Code Article 430, Part H).

Accessibility

k. The accessibility of electrical apparatus for inspection and maintenance shall be observed. The accessibility of junction boxes and similar apparatus in way of paneling shall also be noted. Hinged doors of motor starters and similar apparatus shall be checked for interference with adjacent structural parts or apparatus.

General Alarm Systems

l. The general alarm system shall be checked with a sound level meter, the sound level of the bells being measured in each stateroom with the doors closed. Where the background noise level is questionable, the sound level should be measured while the vessel is underway (see 46 CFR 113.25-9).

Electric Installations in Hazardous Locations

m. During the initial inspection for certification, the emergency loudspeaker system shall be checked with a sound level meter at each lifeboat handling station, each lifeboat embarkation station, each passenger assembly station, and throughout the crew's quarters. Where the background noise level is questionable, the sound level should be measured while the vessel is underway (see 46 CFR Table 113.50 for the required sound levels).

Emergency Loudspeaker Systems

n. Electric equipment and wiring in hazardous locations shall be checked for compliance with 46 CFR 111.105. Intrinsically safe systems shall be checked to ensure that they are installed in accordance with the plans and instructions required by 46 CFR 111.105-11. Equipment required to be explosion-proof or intrinsically safe shall also be checked for proper Underwriters Laboratories, Inc. (UL), Factory Mutual Research Corporation (FM), Canadian Standards Association (CSA), or MET Electrical Testing Company (MET) labels.

Steering Gear Circuits

o. Steering gear circuits shall be separated to meet the requirements of 46 CFR 111.93. Steering gear motor controllers shall be located in the steering gear room (see chapter 14 of this volume).

Emergency Firepump Circuits

p. Circuits for emergency firepumps shall not pass through the engine room or boiler room.

Low Voltage Release Tests

q. It shall be determined that motor controllers required by 46 CFR 111.70-3(f) and (g) to have low voltage release, do so, and that motor controllers prohibited from having low voltage release have low voltage protection. All motors should be run simultaneously and all generators then tripped off the line. One generator should be placed back on the line; it should not trip because of the oncoming load. Motor controllers requiring low voltage release should start their motors automatically; those prohibited from having low voltage release should not start their motors automatically. If the motor load exceeds the total ship's service generating capacity, this test should be conducted with all motors that have low voltage release and sufficient motors with low voltage protection, adding up to the total generating capacity running. A second test shall then be conducted with the remaining motors; none of the motors in this second test should start automatically.

Equipment—

Miscellaneous Electrical

r. The Coast Guard no longer grants type approvals for miscellaneous electrical equipment. Electrical equipment can basically be divided into the following categories:

*Required to be Approved*

(1) This equipment is listed in Subchapter Q and will have an approval number assigned.

*Required to Meet Various Standards*

(2) This equipment is discussed in Subchapter J. It is important to note that the requirement is to meet the standard, not to be listed by a listing service. The burden of proof that the standard is met rests with the manufacturer.

*Having Specific Requirements in Subchapter J*

(3) The index following Subchapter J may be used to identify if certain equipment must satisfy additional 46 CFR requirements.

*Required to be Explosion-proof or Intrinsically Safe*

(4) This equipment must be listed by UL, FM, MET, or CSA.

**NOTE:** Some equipment approvals may require combination of the above factors.

**5. Subsequent Electrical Inspections**

Introduction

a. In subsequent tests and inspections, inspectors shall pay particular attention to the items listed in this section of the manual. The inspector shall determine mechanical and electrical conditions, performance, safety of personnel against shock hazards, and safety of the vessel from fire hazards.

New and Modified Circuits

b. Circuits and equipment added or modified since the last inspection shall be given special attention to determine that they comply with the regulations.

Navigation Lights

c. Navigation lights shall be examined for corrosion of materials and for satisfactory condition of portable cable and receptacles. Navigation light panels shall be tested for satisfactory operation and proper functioning of alarms.

Lifeboat Winch Electrical Equipment

d. All enclosures for electrical lifeboat winch control equipment, such as limit switches, master switches, and emergency disconnect switches, shall be opened and examined for evidence of water or corrosion. In particular, attention shall be given to the proper functioning of limit switches and emergency disconnect switches in the control circuits of lifeboat winches. Casualty investigations have indicated the need to specifically examine the clutch interlock switches on dual winches, such as those on Victory-type cargo ships. It is essential that satisfactory limit switches and emergency disconnect switches be used with gravity davits and power-operated winches. Therefore, a test operation of the lifeboat winch controls, including limit switches, emergency disconnects, and clutch interlocks where employed, shall be conducted at each reinspection and as the inspector may require.

Watertight Doors

e. The inspector shall thoroughly check the watertight door systems to verify that they are in satisfactory operating condition. The enclosures for all local control door switches and controllers should be examined for evidence of water or corrosion. It has been found that faulty operation of electrically operated watertight doors may be caused by seawater entering the local control switch located at the watertight door. If seawater has entered the switch enclosure, it may short circuit the motor starter and motor so that the door opens even with the wheelhouse control indicating the "closed" position. To the extent practical, the inspector shall also be satisfied that the ship's personnel are familiar with the watertight door system, location of disconnect switches, etc.

Electrical Cables

f. The condition of cables should be determined by insulation resistance readings (see subparagraph 6.L.4.c above) and by visual observations. Deterioration of the armor of a cable that is otherwise in good condition should not be considered as sufficient cause for requiring replacement.

Ground Detection Systems

g. Ground detection systems should function properly. Where lamps are used, they should be of the proper wattage with the connections between the lamps grounded. Ground faults shall be cleared.

Temporary Wiring and Installations

h. Long extension cords, "jury-rigs," or temporary modifications are not satisfactory installations.

Portable Electric Equipment

i. New and replacement items shall meet the requirements outlined in chapter 18 of this volume. Existing equipment shall be serviceable and free from potential shock or fire hazards. Metal bodies of these items shall be grounded through grounding leads in the portable cord. To be effective, the grounding conductor on a tool or light must be connected to a grounding terminal. This conductor must be electrically continuous (the wire should not be broken anywhere along its length), this can be checked with an ohmmeter or megger. For portable devices made entirely of nonconducting material, or so constructed that dead metal parts will not become energized under any condition (double insulated construction), the grounding conductor in the portable cord and the grounding pole of the attachment plug need not be furnished. No splices or patching should be permitted in portable leads smaller than No. 12 American Wire Gauge (AWG). Splices shall be in accordance with 46 CFR 111.60-19. Careful checks shall be made of the condition of the cord where it enters the light or tool. This is a location of severe stress and bending fatigue, especially on items such as portable cargo lights. Cracking, brittleness, and heat discoloration of the cord at this point are sufficient reasons for rejection. If the device is to be rewired, only cords indicated in 46 CFR Table 111.60-13 for hard or extra-hard service should be used. Lighting fixtures should be examined to see that the interior insulation is satisfactory, particularly the lamp holder. Cracked porcelain or plastic lamp holders should be replaced. Devices in which the exterior case is cracked or damaged should be replaced or repaired.

Fire and Smoke Detection Systems

j. Fire and smoke detection systems shall be checked regularly, and faulty detectors shall be recalibrated or replaced. The following test methods may be used:

Thermal detectors

(1) Thermal detectors may be tested by replacing the guard and globe with a sheet metal shield and using a portable light as the heat source; this will not cause damage to the adjacent paintwork. The activation temperature range should be as specified in 46 CFR 161.002-11.

Photoelectric and ionization smoke detectors

(2) Photoelectric and ionization smoke detectors may be tested by holding "pink sticks" or other smoke source near the detector.

Infrared detectors

(3) Infrared detectors may be tested with a candle or other flame source.

**NOTE:** Infrared detectors often have a response delay.

Vital Machinery

k. Motors, motor starters, and control switches used with machinery vital to the safety or propulsion of the vessel shall be visually examined for condition and suitable nameplate ratings. When there is evidence of deterioration, they shall be opened for closer inspection.

| | | |
|---|---|---|
| Electrical Cooking Equipment | l. | Electrical cooking equipment shall be maintained in good condition. There should be no evidence of grease or dirt buildup nor deterioration of the equipment. |

## K. LEAKAGE ONTO PROPULSION CONTROL CIRCUITS, SWITCHBOARDS, ETC.

The 1974 casualty to the tank vessel TRANSHURON was caused by water spraying onto the main propulsion control area, from a failed cooling water gauge nipple for the vessel's air conditioning system. In a similar casualty, water leaked onto a vessel's main switchboard from an exterior electrical junction box that had filled with water. The conduit and wire provided the path to the switchboard. These casualties demonstrate clearly that shielding or other measures must be used to guard against accidental discharge of water onto electrical propulsion installations. All water lines must be located clear of control circuits, electrical equipment, and areas of high voltage whenever possible. Cables to switchboards, controllers, etc., should be connected so as to prevent water from entering connectors, through use of drip loops, joining cables to the bottom side of the installation, or similar methods.

## L. EMERGENCY LIGHTING AND POWER SYSTEMS

### 1. Introduction

Recent casualty reports indicate that in some instances emergency diesel generators and associated equipment were not maintained in a satisfactory state of readiness for emergency use. Periodic testing by vessel personnel of the emergency lighting and power systems installed, and the recording of such tests in official logbooks, are required by 46 CFR 35.10-15, 78.17-45, and 97.15-30. The regulations for tank vessels, passenger vessels, cargo and miscellaneous vessels, and the electrical engineering requirements intend that emergency lighting and power installations are tested in the presence of an inspector. Testing of a properly functioning emergency plant can be accomplished quickly with little or no interruption of normal service. 46 CFR Table 112.05-5(a) notes vessels required to have an emergency source of power meeting the requirements of 46 CFR 112. Also, see NVIC 2-89 *Electrical Installations on Merchant Vessels and MODUs.*

### 2. Testing

At each inspection, and whenever emergency drills are conducted, light and power emergency systems shall be tested as follows:

Automatic Starting and Connecting Power Systems

a. These systems should be tested by using the test switch required in 46 CFR 112.45-5. When the switch is put in the test position, the following should occur in less than 45 seconds:

(1) Bus-tie breaker opens;

(2) Power source should automatically start (if the power source is a battery, this step will be skipped); and

(3) Required loads will be transferred to the emergency power source when the voltage reaches 85-95 percent of final value, i.e., the generator circuit breaker closes. This will happen immediately for a battery source. Upon completion of the test, loads should be transferred back to the normal source and the emergency system set up for automatic operation.

Manual Transfer System

b. Test as indicated above, except that step (2) will occur as the result of a manual action. All other functions remain automatic.

Alarm Relay Circuits

c. When conducting operational tests of the emergency diesel generator, for initial certification or after modifications have been made, inspectors should have the shipboard personnel conducting the test temporarily disconnect any remote alarm relay circuits. When this is done, the emergency diesel generator should continue to function. If the generator fails to operate with the remote alarm relay circuits disconnected, a requirement should be issued to modify the installation to allow operation of the emergency diesel generator with these circuits disabled. At the conclusion of this test, the inspector should ensure that remote alarm circuits are properly reconnected.

Alternatives

d. Some passenger vessels contracted for prior to 19 November 1952 may not be arranged for testing as outlined above. Tests of such vessels should be performed in a manner compatible with their arrangements. Many older vessels have an inport or standby generator (and no "emergency plant" as such). These are usually arranged to feed directly to the main switchboard, and cannot be tested in the manner outlined above. The testing of such standby units shall be prescribed by the OCMI.

## M. INSPECTION OF RADIO EQUIPMENT

### 1. General Practices

Cooperation with the FCC

a. When the OCMI is notified by representatives of the FCC that technical deficiencies exist in a vessel's radio installation, the Safety Radiotelephony or Radiotelegraphy Certificate should be withheld until the deficiencies are corrected and the OCMI receives formal notice to that effect from the FCC.

Interagency Resolution of Deficiencies

b. In cases where such deficiencies exist on a vessel already in possession of a Safety Certificate, the OCMI shall withdraw the certificate upon the FCC's request. Inspectors should consult with local FCC representatives before taking action in such circumstances, and shall cooperate fully with FCC inspectors to carry out the intent of these instructions. The COI should not be withheld or withdrawn for technical deficiencies in radio installations.[1]

[1]**NOTE:** See MSM II-E2 regarding Safety Radiotelegraphy and Safety Radiotelephony Certificates, and MSM II-C2 regarding portable lifeboat radio equipment.

[2]**NOTE:** All electrical wiring in the radio room not connected with the radio installation itself is under the sole jurisdiction of the Coast Guard.

c. It should be remembered that the technical adequacy of the radio installation, the suitability of electrical wiring to interconnect components of the radio, and the proper maintenance and efficient operation of the equipment are determined solely by FCC inspectors.[2] The suitability of power leads from the main power supply to the main installation in the radio room is solely the responsibility of the Coast Guard. The amount of power and character of the supply, however, must be determined by the FCC to operate the radio installation and its auxiliary equipment properly and efficiently. The FCC will notify the OCMI of any observed inadequacies in the power supply; the OCMI shall ensure that such deficiencies are corrected.

➔ See Table 47 CFR 80, for good general information and cites on FCC regulations

**2. Emergency Radio Gear**

The installation of all ship's radio equipment must be approved by the Coast Guard. In this regard, the inspector shall be satisfied that the main and emergency radio installations are located in the superstructure of the ship, as high as practical above the highest marked load line. The emergency installation shall be provided with a source of power independent of the propulsion and main electrical systems; it must be capable of being energized rapidly and operating continuously for at least 6 hours.

**NOTE:** Use of the emergency radio power for other than radio equipment and emergency lights in the radio room is prohibited.

## N. HAZARDS AND UNSAFE PRACTICES

**1. Introduction**

The following policy is intended to promote the detection, reporting, and correction of those practices and situations that tend to cause injury or death to personnel and damage to the vessel or its cargo. Safety considerations based on "good marine practice" are directly related to the equipment and construction to which attention is directed by the regulations, and for which separate reports are required. Obviously, a vessel with defective cargo gear, dangerous gangways or access ladders, unguarded openings in the holds, poorly lighted working spaces, or similar hazards is not in a condition sufficient to warrant the judgment that it is suitable for service. Traditionally, it is the duty of the vessel's officers to see that dangerous conditions are corrected immediately. Aspects of "good marine practice" may not always be spelled out in statutes or regulations, because to do so would be impractical. Practices of good seamanship and good shipkeeping will vary according to the size, design, and operating conditions of a particular vessel. However, it is of paramount importance that general safety considerations are kept in mind aboard vessels at all times. When hazards are noticed, immediate steps shall be taken to keep working conditions as safe as reasonably possible.

**2. Statutory Requirements**

Congressional enactment's for safety of life and property on board vessels apply at all times when a vessel is in service, whether alongside the dock, anchored, or underway. The basic responsibilities of the Coast Guard to inspect ships periodically for safety purposes are imposed by 46 U.S.C. Chapter 33. The statutes contained therein authorize the Coast Guard to inspect ships periodically for safety purposes.

**3. Respons - bility of the Crew**

The master and other ship's officers are responsible for maintaining safe working conditions, and for supervising or establishing proper supervision of all employment aboard a vessel. All hazardous work should be personally supervised by a competent ship's officer. Inattention to duty or negligence on the part of any officer in permitting unsafe conditions or practices should be admonished or, if sufficiently severe, charged against that officer's license. The primary objectives are to improve safety and to indoctrinate ship's officers in their responsibilities. However, all persons employed aboard have a mutual responsibility to carry out established procedures for the safety of themselves and their fellow mariners.

**4. Responsibility of the Coast Guard**

A marine inspector or other Coast Guard boarding officer, when aboard an inspected or uninspected vessel for any purpose, should be alert to unsafe practices and hazardous situations. The inspector must take proper and immediate action to have unsafe practices stopped and hazardous situations remedied. Such action will, of course, vary with the situation encountered. In many cases, calling the attention of the ship's officers or master to the situation will be sufficient. In certain instances, it may be necessary to issue a Form CG-835 (Merchant Marine Inspection Requirement) to cover a deficiency. Serious cases, or those in which there is disagreement over the proper course of action, should be brought to the attention of the OCMI immediately. Revocation of the vessel's COI, action against an officer's license, or submittal of a Report of Violation should be undertaken when necessary. The OCMI shall give personal attention to reported instances of unsafe practices and hazardous situations, to the end that the greatest possible safety is obtained on vessels operating under the OCMI's jurisdiction.

**5. Remedies for Hazardous Situations**

General Practices

a. All dangerous areas and installations that are exposed must be properly protected with covers, guards, or rails, in accordance with 46 CFR 32.01-10, 32.01-15, 58.01-20, 72.40, 92.25, and 190.25-15. These regulations also specify the height and number of courses of rails on passenger and crew decks. Two avenues of escape should be provided from every area within a vessel where passengers or crew may be quartered, or where anyone may normally be employed (see 46 CFR 32.01-1, 72.10, 92.10, and 190.10). While it is not always possible to provide such exits from cargo holds, the means of escape provided from these should be adequate and easily accessible.

Refrigerants

a. Refrigerants. The dangers inherent in the use and transportation of dry ice and carbon dioxide as refrigerants are often overlooked. The inherent dangers of dry ice were published, but only after a series of deaths of stevedores and crewmembers related to circumstances where dry ice was used as a refrigerant. Container cargo may be refrigerated by introduction of liquid nitrogen into the container, where it evaporates and thus chills the contents. Unless sufficient time elapses for complete evaporation before the container is loaded aboard ship, there is a risk of spillage of the liquid nitrogen. Since the temperature of liquid nitrogen (-320F) cannot be withstood by ordinary ship steel, spillage can result in fractures. Carbon dioxide and nitrogen can be asphyxiating when concentrated in tanks or holds. All refrigerants must be recognized as potentially dangerous substances and treated accordingly.

Boiler Torch Pots

b. Pots should be secured in a vertical position, not at an angle. Low-flash point liquids should never be used in torch pots, and fireroom personnel should be instructed in the dangers of any highly combustible liquid having a flash point lower than that of commercial kerosene, which is used for moistening the torch.

Gratings

c. Some machinery spaces lack gratings over the top of the main condensers to provide safe platforms for oiling the intermediate pressure links, adjusting the cutoffs, and accessing the indicator cocks. A grating with handrails over the main condenser is required to ensure the safety of engineroom personnel during the performance of their duties; its requirement comes within the intent of 46 CFR 32.01-15 and 58.01-20. (See also Sec. A, Ch. 5 of this volume.)

Fuel Oil in Bilges

d. At annual inspections, the inspector shall examine the bilges and tank tops beneath the boilers and in any compartment in which oil burning equipment or fuel tanks are installed, to ensure that there are no accumulations of fuel oil that constitute a fire hazard.

Sparks and Stack Fires

e. Sparks or stack fires can result from the heating of soot and carbon deposits in preheaters, economizers and uptakes in boilers, and in exhaust manifolds and mufflers in diesels. A stack fire is particularly hazardous in that it can develop undetected and then materialize many hours after the machinery plant is secured, when fresh air reaches the hot carbon deposits. Some vessels have had stack fires long after the crew has departed at a shipyard or layup pier. As a precaution against stack fires or sparking, it is necessary to keep all uptakes and mufflers clean. This is best accomplished by efficient combustion and plant operation and attention to periodic maintenance and cleaning. Inspectors require the opening of adequate access plates to inspect thoroughly those areas where carbon may accumulate.

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**6. Preventing Boiler Gas Explosions (Flarebacks)**

Flareback in the furnace of a watertube boiler may be caused by the ignition of gases accumulating from vaporized oil that entered the furnace improperly, or ignition of vapors that have not been purged from the furnace before the "lighting off." The following procedures shall be brought to the attention of all engineering personnel, to reduce the hazards of flarebacks:

a. Before attempting to light off the first or additional burners, ensure that properly heated oil is available at the burner to be lighted. The recirculation line is provided for this purpose.

b. Before installing an atomizer, ensure that it is fitted with a sprayer plate, and that the burner tip is tightly made up.

c. Before lighting the first burner or again lighting off a burner after all have been extinguished, the forced draft fan should be run long enough, with double front damper and burner registers wide open, to ensure that the furnace is properly purged.

d. When lighting off the first burner or additional burner, always use a torch. Never attempt to light a burner from an adjacent burner or from hot furnace brickwork;

e. With the torch lit and in proper position, the last valve in the branch connection leading from the fuel oil header supply line to the burner should be slightly opened. As soon as ignition occurs, this valve should be fully opened. If ignition does not immediately occur, the burner valve should be closed and the furnace thoroughly purged. This entire operation shall be repeated until ignition occurs.

f. While a burner or burners are in service, the register door(s) should be wide open, and the oil temperature and pressure should be closely monitored. Cold oil or low oil pressure may cause the fires to die out; water in the oil may do the same. Should all burners be extinguished, the valves in the individual branch connections to the burners should be closed, the forced draft fan should be kept on, the double front damper and all burner register doors should be opened wide, and the furnace should be thoroughly purged before another attempt is made to light the burner.

**Lighter-Aboard-Ship (LASH) Vessel Lighter Cranes**

The extension of lighter guides aboard LASH barge-handling cranes may create significant personnel safety hazards. In separate incidents, despite various safety precautions, two mariners and three longshoremen were killed while lighters were being discharged. These people were caught by the hydraulically extended lighter guides of the LASH cranes and crushed against the barges. Operators of LASH vessels must take corrective action in accordance with 46 CFR 92.25-15. No specific method of personnel protection is required. However, such action must provide a degree of safety equivalent to that afforded by:

a. A mechanism to provide a delay of at least 3 seconds' duration, from actuation of the lighter guide extension controller and initial movement of the guide arms; and

b. A distinctive, continuously sounding alarm, to begin sounding at the delay period before guide extension. An alarm speaker shall be located on each crane leg, in immediate proximity to the point(s) of danger.

**INSPECTION NOTE:** At each inspection and reinspection for certification, the lighter crane on every LASH vessel shall be examined to ensure that the hazards described above have been corrected, through the installation of guards, rails, and warning devices. Plans and specifications for such installations shall be reviewed by the cognizant OCMI.

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**7. Explosions in Diesel-Fired Boilers**

A number of explosions have occurred in auxiliary boilers that burn diesel oil. Many of these explosions have occurred on dual-fuel fired boilers upon switch over from diesel to heavy oil. These vessels had common fuel piping and heater systems. When the heavy oil and heater were switched in, a slug of diesel was also heated that altered the fuel-air mixture. Common fuel piping is prohibited because of fuel and burner nozzle tip contamination problems. An explosion can occur when the fuel-air mixture in the furnace is not properly controlled. Even very small accumulations of fuel oil in the boiler can produce explosive mixtures. Automatic control systems for diesel oil should therefore be very reliable and properly designed, operated, and maintained. At each inspection of a vessel equipped with diesel-fired boilers, the inspector shall ensure that the following procedures are followed:

a. Fuel oil shutoff valves shall be inspected or tested to ensure that there is no leakage;

b. Controls to shut down the boiler due to flame failure shall be tested to ensure safe boiler operation;

c. To prevent a vapor buildup from residual fuel in the furnace, no time should elapse between a furnace purge and a light off or ignition trial; and

d. Dual fueled boilers that heat a heavier oil should be examined to ensure that the piping of the lighter oil does not go through the heater.

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**8. Galley and Laundry Room Exhaust Ducts**

A number of shipboard fires have originated in the exhaust ducts of galley ranges and fryers, and recently in laundry room ventilation systems. These fires have resulted in serious damage, injury, and loss of life aboard the vessels involved. Unmaintained exhaust duct work will become saturated with cooking grease and pose a fire hazard. Unfortunately, such areas have been overlooked during vessel inspections. The following procedures shall be followed during biennial and mid-period inspections of U.S. vessels and during SOLAS verification examinations of foreign vessels:

All Vessels

a. All Vessels.

(1) Remove the inspection plate from the galley exhaust duct.

(2) Disconnect the fusible link, if installed, and test the operation of the fire damper.

(3) Remove sufficient inspection plates to ensure that the duct work is clean and free of grease. Particular attention shall be given to long, horizontal duct runs.

(4) Examine all hood screens for cleanliness.

(5) If an extinguishing system is installed, ensure that it is in proper working condition.

(6) Examine laundry room vents, ask if the company has a cleaning and maintenance program (check records – part of ISM/SMS responsibility).

Passenger Vessels Only

b. Passenger Vessels Only.

(1) Remove sufficient overhead panels to ensure that the galley exhaust duct is suitably insulated, in accordance with SOLAS standards and applicable U.S. regulations. Unless changes are made to the duct work, this part of the examination need be made only once.

(2) Check all main and zone control valves of the sprinkler system to ensure that they are in the full open position.

## 9. Noise Factors in the Marine Environment

Introduction

a. The problem of excessive noise on commercial vessels and offshore drilling and production units has been the focus of an ongoing Coast Guard sponsored study. It has been found that personnel on virtually any type of vessel or unit may be exposed to damaging noise. Noise-induced hearing loss is a slow, progressive disorder that often goes unrecognized until it has become a pronounced handicap, generally in later years. Related problems, such as tinnitus (ringing in the ears) can be even worse. Excessive noise poses a potential threat to vessel safety by interfering with shipboard communications and the drowning out of signals and alarms.

Initial Coast Guard Actions

b. Previously, the Coast Guard dealt with maritime noise problems through existing regulations, in a general way or on a case-by-case basis. For example, 46 CFR 72.20-5 and 92.20-5 require accommodations aboard vessels to be insulated from undue noise. Similarly, 46 CFR 32.40-15 requires tankships and manned tank barges to have crew's quarters suitable for the accommodation and protection of the crew. 46 CFR 58.10-15(e) and 33 CFR 150.509(c) specify noise protection for personnel on gas turbine-propelled vessels and deepwater port facilities, respectively.

Establishment of Standards

c. In November 1981, the International Maritime Organization (IMO) published a Code on Noise Levels On Board Ships, Resolution A.468(XII). The Code applies to all vessels over 1600 GT built after publication of the Code. In June 1982, the Coast Guard published NVIC 12-82, "Recommendations on Control of Excessive Noise." These were developed in light of the IMO Code and are considered satisfactory implementations of the Code's standards. Therefore, vessels and units meeting the NVIC's standards are considered to meet those of the IMO Code as well. NVIC 12-82 deals with the entire spectrum of maritime noise and recommends a broad based program of noise control and hearing conservation. Its two major recommendations are a 24-hour noise exposure limit of 82 dB(A) for all personnel, and periodic audiometric examination of all personnel exposed to noise levels above a certain low exposure level of 77 dB(A). The only limits on noise levels (as opposed to exposure levels) apply to berthing spaces, and messing spaces on vessels over 1600 GT. These limits are 75 dB(A) for existing vessels and units, and 70 dB(A) on vessels and units constructed after December 31, 1985.

Inspection Procedures

c. The policy in NVIC 12-82 is based on the expectation that the maritime industry will voluntarily implement and maintain an effective noise control program, without direct Coast Guard involvement. The policy was developed with the assistance of industry and the Commandant anticipates its wide implementation. The role of inspection personnel is primarily to promote the policy contained in NVIC 12-82 and to note its effects. Therefore, there should be minimal Coast Guard enforcement concerning noise control. Inspectors should be alert to excessive noise levels during inspections, and require noise measurements to be taken to quantify levels of exposure. If excessive noise levels are verified, inspectors should require correction of deteriorated systems that permit production of unwarranted noise or the unnecessary transmission of noise to adjacent spaces. Inspectors should also examine the condition of hearing protection devices and the posting of warning signs, and verify that the vessel or unit's hearing conservation program is being followed.

**NOTE**: Complaints alleging that crewmembers have suffered hearing loss from long-term exposure to excessive noise shall not be considered as reportable marine casualties involving personal injury.

Handling Complaints

e. If a crewmember files a written complaint to eliminate a specific noise hazard, the situation should be evaluated and all discrepancies corrected. However, these measures should be taken by the vessel owner, upon the request of the OCMI. Only when the OCMI has reason to question the owner's evaluations should inspection personnel become involved in noise measurement. Criteria for determining whether noise levels or exposure periods are excessive should normally be those stated in NVIC 12-82, namely, the noise limits for berthing and messing spaces and the 24-hour noise exposure limit. If there is objection to the application of these criteria, the owner may suggest another recognized standard that meets or exceeds the standards of NVIC 12-82. It should be remembered that noise control is a complex science, requiring professional expertise to evaluate problems and develop effective remedies.

Program Review

f. NVIC 12-82 was issued to promote an industry standard, and to provide a methodology to evaluate noise in the marine environment. Over the next several years, the effectiveness and content of this policy will be reviewed. Effective program review can be obtained only through feedback from field units relating noteworthy experiences and observations of noise conditions and actions. Such reports and questions concerning NVIC 12-82 should be directed to Commandant (G-MOC-2).

## O. INSPECTION OF PRESSURE VESSELS (P/VS)

**1. Test and Examination Intervals**

Periodic inspections of unfired P/Vs are required by 46 CFR 61.10. These regulations require the testing and examination to be conducted twice in 5 years. The testing and examination interval for bulk storage tanks containing refrigerated liquefied CO2 gas for use on board vessels as a firefighting agent should not extend beyond 10 years (120 months) from the last such test/exam. The aforestated authorization shall be exercised primarily to permit the test and examination interval to coincide with the vessel's drydocking or similar out of service availability period.

**2. Purpose**

Periodic examinations of P/Vs are intended to assess a P/Vs present condition to determine that it is satisfactory to continue in service at the pressure and environment of the system for which it is being used.

**3. Factors Affecting P/Vs in Service**

Pressure vessels are subject to different factors that can affect their physical conditions.

Internal

a. Water vapor, other gases, and particulate matter can cause corrosion in P/Vs. Interior coatings can affect the thoroughness of an internal examination if they "mask" the condition of the covered surface. Conversely, they can give an indication of trouble if deterioration of the metal results in a change to the appearance of the coating.

External

e. Depending on where and how the P/V is mounted, cyclic loading can be transmitted to the P/V through its saddles/support framework if the foundation is subject to movement. Vibration loads are commonly transmitted to a P/V through attached piping and rotating machinery. The motion of other machinery located in adjacent areas can transmit loads through the deck and bulkheads to a P/V. Mechanical damage can occur if heavy objects contact the P/V or any of its attached piping.

**4. Inspection Descriptions**

Visual Examinations

a. Accessibility to the internal surfaces is the primary consideration when conducting visual examinations. Each pressure vessel stamped with the Coast Guard symbol, and each pressure vessel in a system regulated under 46 CFR 58.60 that is fitted with a manhole or other inspection opening so it can be satisfactorily examined internally, must be opened twice within any 5 year period, except that no more than 3 years may elapse between any examination and its immediate predecessor. Each pressure vessel must be thoroughly examined internally and externally. No pressure vessel need be hydrostatically tested except when any defect in a pressure vessel is found that, in the marine inspector's opinion, may affect the safety of the pressure vessel. If a hydrostatic test is warranted, the pressure vessel shall be tested at a pressure of 1 ½ times the maximum allowable working pressure. Section VIII, Part UG-46 of the ASME Code has standards for openings in P/Vs. An elliptical manhole must not be less than 11" X 15" or 10" X 16"; a round manhole must not be less than 15" in diameter. Smaller openings may be acceptable if the inspector can satisfactorily examine the internal surfaces. The presence of a backing strip eliminates the possibility of a visual examination of the weld and may contribute to internal corrosion as a moisture trap. The presence of a backing strip does not, however, prevent the acceptance of an otherwise satisfactory visual examination. The inspector should consider other factors, such as the pressure vessel's service, condition, other signs of internal corrosion, age, and date of last hydrostatic test, when determining whether additional testing is warranted.

What To Look For

(1) All internal surfaces should be carefully examined for evidence of fractures or indications of deterioration. The heat affected zone adjacent to all welds should be given special attention. All welded joints, as well as all nozzle connections and similar openings, should be thoroughly examined. Problem areas of the internal surfaces include low spots where water and grit accumulate, areas adjacent to openings (particularly the drain), welds, and their heat affected zones. Problem areas associated with the external surfaces include welded attachments, such as support webs, and areas around openings, particularly if the P/V is insulated. The external appearance of insulating materials should not be accepted as indicative of the condition of the welds or the shell and head material. If the insulation materials separate from the P/V, condensate can be trapped beneath the insulation and cause metal deterioration. The insulation should be carefully examined visually and any "suspect" areas should be sounded to determine the extent of separation from the P/V. These areas should have their insulation excavated back to a zone of good adhesion, the metal examined, and the insulation then repaired in accordance with the manufacturer's recommended procedures.

Presently there are no regulatory or industry requirements for insulation to be periodically removed to allow visual examination of the P/V. Areas that often suffer separation are those surrounding view ports, areas surrounding pipe connections that transmit vibration to the P/V, and any projection in the upper portion of the P/V where rain or condensation normally contact the P/V.

How to Look

(2) Two critical factors are illumination and accessibility. There must be sufficient light to allow a thorough examination of all welds and plate surfaces. Bright illumination is necessary for all visual examinations. If access to the internal areas is limited to small "inspection openings," a flashlight beam directed through such openings may not provide sufficient illumination for examination. When this occurs, other types of lighting can be used, e.g., flexible lights, borescopes, etc. If the P/V is equipped with a manhole the inspector should be able to get inside, close enough to scrutinize all internal areas. The P/V must be clean enough to allow a thorough examination of all surfaces; the presence of water, grit, or other matter inhibits examination. If the inspector cannot satisfactorily see the area of concern with a bright light directed at the area being examined, a "satisfactory" internal examination cannot be conducted and the vessel should be tested by means acceptable to the OCMI to satisfy the periodic inspection requirement.[1]

**NOTE:** It is a prerequisite that a satisfactory internal examination of a pressure vessel be completed by a marine inspector before that inspector is authorized to exempt the pressure vessel from hydrostatic testing in accordance with 46CFR 61.10-5(b). For any pressure vessel which is constructed in such a way so as to restrict or limit visual accessibility to internal areas of interest to an inspector, in lieu of an internal exam, or when deemed necessary by the attending inspector, a hydrostatic testing or a suitable alternative acceptable to the OCMI is not only mandated by regulation but is also prudent from an operational standpoint.

**SAFETY NOTE:** *Precautions concerning entry into a pressure vessel (P/V).* If the P/V has suffered heavy rusting there may be dangerously low levels of oxygen inside. Similarly, if the P/V has carried a hazardous substance or has been cleaned with a product that can affect a person's health, the P/V should be cleaned, vented, and certified "safe for entry" prior to doing an internal.

Alternatives

(3) No pressure vessel need be hydrostatically tested except when a defect is found that, in the marine inspector's opinion, may affect the safety of the pressure vessel. In this case, the pressure vessel should be hydrostatically tested at a pressure of 1 ½ times the maximum working pressure (see 46 CFR 61.10-5 for specific guidance). Nondestructive testing (NDT) methods can be authorized as a substitute for the required hydrostatic test. A plan to employ NDT should be discussed with the cognizant OCMI. The methods used must provide examinations of all welds and high stress areas as well as thickness gauging of the lower portion of the P/V. Usually this will include shear wave ultrasonic procedures for crack detection in welds or the shell (high stress areas adjacent to the heads), and standard compression wave procedures for thickness gauging. The amount and type(s) of NDT used must satisfy the OCMI, the test action(s) should be witnessed by a Coast Guard inspector, and the details of the test should be appropriately noted in the inspection record. Items to be considered when evaluating the plan include the P/Vs age, service, conditions of operation, and examination history, especially the methods used and results of past inspections. The use of NDT in lieu of hydrostatic testing may be appropriate when there is a question of compatibility between the water and the working fluid or interior coatings. Additionally, when the working fluid cannot be used for the test because of personnel hazards or flammability (see 46 CFR 61.10-5(f) and (h)) and when the weight of the water used during the test cannot be safely supported by the P/Vs substructure, the OCMI may accept NDT in lieu of hydrostatic testing.

**NOTE:** Backing strips (rings) and butt welded joints with one plate edge offset (see UW 13.1(k) of the ASME Code) may prevent adequate interpretation of NDT.

(4) Problems Found During Visual Exams. If deterioration affecting the strength of the heads, shell, or welds, or evidence of a fracture is found, the extent of the problem should be determined by NDT so that repairs, if possible, can be made. If any condition causes doubt, NDT should be used to confirm that a problem exists. Whenever possible, a 125 percent MAWP hydrostatic test should be conducted to determine the suitability of a P/V for continued service. If a condition requires repair, it may be necessary to remove the P/V from service until the problem has been corrected. Repairs of P/V's should be made only as allowed by 46 CFR 59 and the ASME Code. Weld procedure information and similar guidance for repairs are available through Commandant (G-MOC) and the Marine Safety Center (MSC). Additional NDT and a hydrostatic test should be required for any P/V after repairs have been completed. The test pressure should be the same as that required by the Code at original construction: 150 percent MAWP for Section VIII, Division 1 or 125 percent MAWP for

Division 2. Foreign-built P/V's that have been accepted with design safety factors less than 4:1 should have a test pressure specified by the Coast Guard as noted above.

Hydrostatic Test

b. A hydrostatic test at a pressure equal to 125 percent of the MAWP subjects the P/V to loads that it will not be exposed to, but is reasonable to assume the P/V can withstand, under ordinary conditions. The test pressure should be applied for a sufficient period of time to allow the load to act on any defect. For air receivers, a period of 5 to 10 minutes is normally adequate. If the P/V has developed a crack or has suffered deterioration, the hydrostatic test will be proof of its present condition. Simply stated, if the P/V under test pressure does not rupture, then it can be assumed that it is acceptable for continued service. If the P/V fails while under hydrostatic pressure, the load will be quickly relieved as the water vents through any resulting fracture. In some special circumstances the appropriate test pressure to satisfy the periodic testing requirements is less than 125 percent of the P/V's MAWP. Many foreign-built P/V's and some domestically-built P/V's, such as those built to ASME Section VIII, Division 2, do not meet the allowable stress criteria of ASME Section VIII, Division 1. Instead, they are designed for higher allowable stresses and for this reason are allowed to be tested at a pressure designated by the Coast Guard during the plan review process. This fact may not always be obvious and marine inspectors should carefully review the P/V's data plate to determine the appropriate test pressure. Hydrostatic leak tests for P/V's used for the storage of air or similar compressible gases require the P/V to be depressurized and then filled with water. In order to properly fill the P/V with water it must be vented at its highest point. The relief valve must be removed and its opening plugged tightly. All other connections to the P/V must be closed tight or removed and plugged. The inspector should trace the water source upstream from the P/V to verify supply, and should also verify water pressure in the P/V. This is normally accomplished with a pressure gauge installed on the P/V. A word of caution is offered against the use of very cold water as the test fluid. In rare instances, with water at temperatures near freezing, embrittlement can result and cause failure of welds during a test. The test fluid should be no less than 60 degrees Fahrenheit if possible. After the pressure has been increased to 125 percent MAWP, the supply should be secured and the pressure held for a period of time sufficient to determine that there are no leaks. During this time the inspector should examine all the exterior surfaces of the P/V, with special attention given to the welds and their heat affected zones of all nozzles, manways, and similar openings.

Other Test Considerations

c. The regulations in 46 CFR 197.462(b) and (d) require periodic pneumatic and hydrostatic tests of pressure vessels for human occupancy (PVHO's) and contain guidelines for these tests. Whenever a compressed gas "leak" test or pneumatic "overpressure test" is performed, certain additional safeguards should be employed. The regulations include a general requirement for "suitable precautions" for these tests. Such items would include ensuring that the P/V is substantially bolted down to a firm foundation, conducting the test in a remote location (or, requiring all persons not involved with the test to leave the area until the test has been completed), and conducting the test with the P/V behind some form of a barrier or substantial structure (if possible). If the P/V is a multi-lock chamber, each lock should be pressurized separately.

Intervals for Testing

d. Each tank shall be subjected to the tests and inspections described in 46 CFR 38.25. Intervals for internal examinations and hydrostatic tests for Pressure Vessel Type Cargo Tanks (PVCTs) are to be computed from the date of the last credit internal examination or hydrostatic test. It is not intended that extensions for testing intervals be granted except in the most unusual circumstances. All requests by industry for extensions of internal examination or hydrostatic test intervals of PVCTs should be forwarded to Commandant (G-MOC) with an endorsement by the OCMI.

## P. INSPECTION OF LIFESAVING SYSTEMS

**1. Introduction**

Each Title 46 CFR subchapter on inspected vessels requires that inspections for certification include tests and inspections of the lifesaving equipment. This section provides guidance on how to conduct those inspections and tests. The inspections and tests in this section are designed to verify that the equipment, as installed on the vessel, complies with regulations in 46 CFR Chapter I, and where applicable, the International Convention for the Safety of Life at Sea (SOLAS).

Conditions of Approval

a. The installation of each lifeboat, rescue boat, liferaft and their respective launching appliance must meet any special conditions of its approval. Any such conditions are identified on the equipment's Certificate of Approval (CGHQ Form 10030). Check approval records on MSIS.

b. Excess Lifesaving Equipment. Excess lifesaving equipment carried aboard inspected vessels shall be of approved types and kept in good operating condition.

**NOTE:** MSIS product is MIAE. Free-form command is "-MIAE,QNUM=160.035/0075" to see approval record for a lifeboat with an approval number 160.035/75/0, for example. The number after the "/" must have 4 numerics, zero-filled from the left if necessary. An approval number like "160.035/A75/0" is entered in MSIS as "160.035/A0075." Note that the number after the last "/" in the approval number is not used in MSIS commands.

Repair, Modification, and Special Inspection Procedures

c. See C2.H of this manual and various NVICs for more detailed information on repairs, modifications, and special inspections of lifesaving equipment. Under current SOLAS requirements (Regulations III/19.3 and III/52), maintenance instructions for all lifesaving equipment are required on board, and equipment is to be maintained according to the instructions. Some instructions may state or imply that certain inspections and repairs must be done by a manufacturer's representative. This is not enforceable, except for servicing of inflatable liferafts, servicing of non-disposable hydrostatic release units, and permanent repairs to inflated rescue boat components, all of which must be done by a Coast Guard approved facility. The inspector should be satisfied that other inspections and repairs are carried out by competent persons. In some cases, a manufacturer's representative may be the only available choice.

Loading Procedures

d. Many of the tests for launching appliances in this section require the boat to be loaded or overloaded with deadweight. Adequate safety precautions should be taken during loading of the boat. Personnel should not be permitted to be used in the tests that load the boat to or beyond rated capacity, except as is absolutely necessary to load or unload the boat, or perform some part of the test once the boat has reached the water.

(1) Open lifeboats are required to have engine boxes that are watertight up to the level of the cover. Although not recommended, the owner or shipyard may elect to load an open boat by filling it with water. (See NVIC 6-81 for details on using water for this purpose and use of a test waterline.)

(2) Enclosed and partially enclosed boats do not normally have watertight engine boxes and can not be flooded. Any weights that can be properly distributed can be used.

(3) Experience has shown that bags of sand or other fine material inevitably leak and create a cleanup problem. Bags of lead shot with carrying handles are more efficient and less likely to be a problem.

(4) Large water containers can be used. Large capacity water bags may be difficult to use successfully. These bags, without baffles or compartments, allow a free surface effect that can destabilize the lifeboat, especially if the bags are at or above seating level, raising the center of gravity. This method may also not provide for a thorough distribution of weight. Smaller bags or buckets of a capacity easily handled should be used and distributed uniformly, including the area in way of the keel.

Weight Conditions "A" And "B"

e. Lifeboats have two weights stamped on their approval plates. The condition "A" weight is the empty boat without equipment and fuel. The condition "B" weight is condition "A" plus the weight of all equipment, fuel and the number of persons for which the boat is approved. The standard weight used to compute the "B" weight is 165 lb. or 75 kg per person.

Definitions

f.

(1) Auxiliary Launching Systems consisting of a winch and davit arrangement, are provided for free-fall lifeboats for use in those cases where it may be unsafe to launch the boat in free-fall. These systems must meet many of the same requirements as a conventional davit and winch.

(2) Fleet Angle for a wire rope leading to a winch drum means the angle included between an imaginary line from the lead sheave perpendicular to the axis of the drum, and the line formed by the wire rope when led from the lead sheave to either extremity of the drum. (See Figure B1-5.)

(3) Free-Fall Launching Systems launch a survival craft by allowing it to fall from its stowage position into the sea, with persons on board. Most free-fall systems include a ramp that the survival craft slides down before it begins its free-fall. Special seating, hull design, and fall trajectory provide for the safety of those on board, and also ensure that the craft moves away from the vessel when it enters the water, whether or not the engine has been started.

(4) Inflatable Buoyant Apparatus (IBA) are similar to inflatable liferafts, except they do not have canopies. Larger IBAs can be used either side up. IBAs must be serviced in the same way as inflatable liferafts. On vessels IBAs can be used interchangeably with conventional life floats and buoyant apparatus. With the approval of the Commandant (G-MOC), they may be allowed to be substituted for inflatable liferafts on inshore waters.

(5) Marine Evacuation Systems (MES) consist of a slide or chute, an inflatable platform, and associated survival craft, designed to rapidly transfer large numbers of persons from an embarkation station directly to the survival craft, or to the platform for subsequent embarkation into the survival craft.

(6) SOLAS 74/83 means the 1983 Amendments to the International Convention for the Safety of Life at Sea, 1974. These amendments include a completely revised Chapter III on Lifesaving Appliances and Arrangements, including upgraded performance requirements for almost all lifesaving equipment. The SOLAS 74/83 requirements apply in full to ships built on or after 1 July 1986. With some exceptions, equipment for older ships brought on board on or after 1 July 1986 must also meet the SOLAS 74/83 requirements. (See NVIC 3-87 for more details on the applicability of SOLAS 74/83.)

**2. Initial Inspections**

The following inspections are intended for a vessel undergoing its initial inspection for certification. The applicable tests should also be conducted whenever new lifesaving equipment is installed on any vessel, or whenever any item of lifesaving equipment is structurally repaired, altered, or undergoes any other major repair which could affect its performance. This section is written assuming that equipment on a vessel undergoing its initial inspection is new.

Davit and Winch Launching Systems for Lifeboats

a. Davit and Winch Launching Systems for Lifeboats, Including Auxiliary Launching Systems for Free-Fall Lifeboats. (See sections C2.H.6 through C2.H.8 for detailed information on certain situations concerning boat handling equipment.)

*Preparation for Launching*

(1) Preparation for Launching

(a) Procedure. Determine the time required for two crew members to prepare the boat for launching. Time starts with the two crew members at the boat launching station, and the boat stowed as it normally would be when the vessel is at sea. Preparation is complete once a launching crew (at least three persons) is on board and ready for launch.

(b) Acceptance Criteria. The time to prepare the boat for launching must be 5 minutes or less.

*Light Load*

(2) Operating the launching system at light load demonstrates that the mass of the boat is sufficient to overcome the frictional resistance of the winch, falls, sheaves, blocks, and associated gear. It verifies that the minimum lowering speed can be achieved in this condition. For boats with a hydrostatic lock on the release mechanism, it verifies that the lock operates at the lowest operational hydrostatic pressure. This test can generally be completed quickly, since no special loading is required for a fully equipped boat.

(a) Procedure.

(i) The boat should approximate its condition "A" weight for this test, with added weight of equipment and fuel on board. Precise loading and load measurement is not necessary, however. In addition, one person may be on board to operate an on-board winch brake control or the release mechanism. If additional personnel are needed to complete the test and to recover the boat, they may board when the boat reaches the water.

(ii) Release the gripes, if necessary. Tricing, frapping, and/or bowsing gear do not need to be used for this test if they are not needed.

(iii) Lower the boat by releasing the winch brake. If the winch brake is arranged for control from within the boat, a person on board the boat should operate the winch brake control.

(iv) Determine lowering speed by timing the boat as it drops through a measured distance marked on the side of the vessel or on the falls, or by any other reliable means. The speed measurement should be taken only after the winch has accelerated to full-governed speed.

(v) Launch the boat into the water using the normal launching procedure. There are three different operational modes for approved release mechanisms, with the "normal" procedure being different for each.

- "SOLAS 74/83" type release mechanisms have a hydrostatic lock that allows the hooks to be released once the boat is in the water. With the keel of the boat at or just in the water and tension on the falls, it should be verified that the hydrostatic lock prevents operation of the release mechanism. Then with the boat lowered into the water, the hydrostatic lock should open and permit operation of the release mechanism.

- An automatic release mechanism is sometimes used on a boat or survival capsule with a single fall launching system. Once set or cocked, these devices release as soon as tension is off the fall. Set these devices for automatic operation for this test. If a person will be on board the boat as it is lowered, that person should set the release mechanism for automatic operation just before the boat reaches the water.

- On-load release mechanisms such as "Rottmer" and "Viking" gear will release the boat whenever the release handle is moved, whether the boat is in the water or not. Persons in command of the boat and operating this mechanism must fully understand the danger of serious injury or death resulting from premature operation. Release the boat from the falls using the on-load release mechanism control as the boat reaches the water. The keel of the boat should be at or in the water, but there should still be tension on the falls when the release mechanism is operated. The safety pin should not be removed until the boat is in position for release.

(vi) Recover the boat with the winch. Anyone on board the boat should disembark when it reaches deck level. No one should be on board the boat when the weight of the davit is taken up by the winch, and the davit moves into its stowage position. This is when most fall and fall attachment failures occur.

Acceptance Criteria

(b) Acceptance Criteria

(i) There shall be no deformation of or damage to the launching appliance or its connections to the vessel.

(ii) Except for free-fall lifeboat auxiliary launching systems, the lowering speed for systems with "SOLAS 74/83" winches (160.115 approval series) must be at least:

$$S = 0.7 (0.4 + (0.02 H))$$

where S is the speed of lowering in m/s, and H is the height in meters from davit head to the waterline at the lightest seagoing condition. (See figures B1-6 and B1-7.) For the purposes of this calculation, H shall not be greater than 30, regardless of the actual height of the davit head.

In English units, the formula is

$$S = 0.7 (79 + (1.2 H))$$

where S is in ft/min and H is in ft, with H not greater than 99.

(iii) Auxiliary launching systems for free-fall lifeboats shall safely and successfully lower the lifeboat, but no minimum speed applies.

(iv) The lowering speed for systems with winches approved only under the 160.015 approval series shall be at least 40 ft/min (0.2 m/s), except that in the case of winches designed for passenger vessel emergency lifeboats, the speed shall be at least 60 ft/min (0.3 m/s).

**NOTE:** A "SOLAS 74/83" winch in the 160.115 approval series may be used to replace a winch in an older davit installation where the higher speed requirements do not apply. In this case, the winch may be set up to meet the speed requirement in this paragraph, rather than the requirement in paragraph (ii).

(v) The brake must be a "deadman" type, always applied unless the operator holds the control handle or mechanism in the position to lower the boat. If the operator releases the brake handle/mechanism, the handle/mechanism returns to the "stop" position, thus applying the brake and stopping the boat. No additional force is permitted.

(vi) Each winch drum shall be arranged so the fall wire winds onto the drum in a level wrap. There shall be no more than one layer of wire on the drum when the davit is in stowed position, except that if the maximum fleet angle is not more than 4° on a 160.115 approval series winch, two layers of wire are acceptable on a grooved drum. Otherwise, each winch drum that has a maximum fleet angle of more than 4° shall be a grooved drum. The fleet angle shall not exceed 8° in any winch installation.

(vii) For a multiple fall system, the falls must wind off the drums at the same rate when lowering. The falls must wind onto the drums evenly and at the same rate when hoisting.

(viii) For launching appliances arranged for control from within the boat, there are two basic types of control. One of these types uses a control wire that pays out as the boat lowers. The control wire must properly operate the winch brake throughout the launching sequence. There must be sufficient length of control wire available inside the boat to operate the winch brake until the boat is released from the falls. The other type is a "pull-and-go" system. An operator in the boat pulls a control lever or handle on the launching appliance that is accessible from a position on board the boat. Once the control is activated, it holds the brake control in the "lower" position, until a crew member on deck returns it to "stop."

(ix) The release mechanism must open all hooks simultaneously and release the boat into the water in the intended manner.

(x) Except for free-fall lifeboat auxiliary launching systems, survival craft installations meeting the SOLAS 74/83 requirements must be capable of launching the survival craft under unfavorable conditions of trim of up to 10° and with the vessel listed up to 20° either way. For other installations, the trim requirement is 10°, but the list requirement is 15°. Prototype launching systems are tested at these extremes prior to approval. It will not normally be possible to test launching systems installed on a vessel at these extremes, but the inspector should verify that nothing about the installation would appear to impede launching under these conditions.

10 % Overload

(3) The 10% overload test demonstrates that the launching system can safely launch a fully loaded boat, with a 10% margin for overloading.

(a) Procedure.

(i) The boat must be in its embarkation position. Tricing pendants, if any, must be disconnected. The boat should be held alongside the ship during loading by means of the installed frapping, and/or bowsing gear.

(ii) Load the boat so that its total weight is 110% of the condition "B" weight shown on its data plate. Hold the boat in position for at least ten minutes and check for deformation, especially at davit and winch foundations and other load-bearing members.

(iii) Lower the boat using the normal lowering procedure, using the on-deck winch control position.

(iv) Determine lowering speed by timing the boat as it drops through a measured distance marked on the side of the vessel or on the falls, or by any other reliable means. The speed measurement should be taken only after the winch has accelerated to full governed speed.

(v) After the boat passes through the measured distance, stop lowering by releasing the winch brake control. Then alternately release and apply the brake so the boat stops at approximately 2 m (6 ft) intervals. Complete at least three start-stop cycles. The lowering operation should be carefully planned, so that the boat will not have to be raised to complete the start-stop cycles. Most winches will not be capable of raising the loaded boat.

(vi) Stop lowering just as the boat reaches the water. The keel of the boat should be at or in the water, but there should still be tension on the falls. Release the boat from the falls using the on-load release mechanism control. Release mechanisms with a hydrostatic lock will require use of the emergency override device to permit on-load release.

(vii) Unload the boat, recover it with the winch, and return it to its stowed position. Observe operation of the limit switches as the davit approaches the stowed position. Anyone on board the boat should disembark when the boat reaches deck level. No one should be on board the boat when the weight of the davit is taken up by the winch, and the davit moves into its stowage position. This is when most fall and fall attachment failures occur.

Acceptance Criteria

(b) Acceptance Criteria

(i) There shall be no deformation of or damage to the launching appliance or its connections to the vessel.

(ii) Except for free-fall lifeboat auxiliary launching systems, the lowering speed for systems with "SOLAS 74/83" winches (160.115 approval series) must be at least:

$$S = 0.4 + (0.02\ H)$$

where S is the speed of lowering in m/s, and H is the height in meters from davit head to the waterline at the lightest seagoing condition. (See figures 6-6 and 6-7.) For the purposes of this calculation, H shall not be greater than 30, regardless of the actual height of the davit head.

(In English units, the formula is

$$S = 79 + (1.2\ H)$$

where S is in ft/min and H is in ft, with H not greater than 99.)

(iii) Auxiliary launching systems for free-fall lifeboats shall safely and successfully lower the lifeboat, but no minimum speed applies.

(iv) The lowering speed for systems with "SOLAS 74/83" winches (160.115 approval series), including auxiliary systems for free-fall lifeboats, shall not exceed 1.3 m/s (256 ft/min).

(v) The lowering speed for systems with winches approved only under the 160.015 approval series shall not normally exceed 120 ft/min (0.6 m/s). The lowering speed for winches designed for passenger vessel emergency lifeboats shall not normally exceed 160 ft/min (0.8 m/s). Check certificates of approval, or approval records on MSIS for approved deviations from these requirements.

**NOTE:** A "SOLAS 74/83" winch in the 160.115 approval series may be used to replace a winch in an older davit installation where the higher speed requirements do not apply. In this case, the winch may be set up to meet the speed requirement in this paragraph, rather than the requirements in paragraphs (ii) and (iv).

(vi) The brake must be a "deadman" type, always applied unless the operator holds the control handle or mechanism in the position to lower the boat. If the operator releases the brake handle/mechanism, the handle/mechanism returns to the "stop" position, thus applying the brake and stopping the boat. No additional force is permitted.

(vii) The action of releasing the winch brake control must bring the boat to a stop within 1 m (39 in). No additional force on the winch brake control is permitted. The brake action must be smooth and positive.

(viii) Each winch drum shall be arranged so the fall wire winds onto the drum in a level wrap.

(ix) For a multiple fall system, the falls must wind off the drums at the same rate when lowering. The falls must wind onto the drums evenly and at the same rate when hoisting.

(x) For launching appliances arranged for control from within the boat, the untended control wire must feed out properly with the boat. The winch brake operation must not be affected by the mass of the fully extended control wire.

(xi) The release mechanism must open all hooks simultaneously and release the boat into the water.

(xii) The limit switches must disconnect the winch power source 0.3 m (12 in) or more before the davit reaches its fully stowed position.

Exposed Wet Brake

(4) Conduct this test if any winch brake surface is exposed to the weather.

(a) Procedure. Thoroughly wash down the exposed brake surfaces with water. Repeat the 10% overload test under section 6.R.2.a.(3) while the brake surfaces are still wet.

(b) Acceptance Criteria. The brake must stop the winch when the brake surface is wet, but the 1 m stopping distance requirement does not apply.

Launching Underway

(5) This test is intended to demonstrate that the boat can be launched satisfactorily when the vessel is underway at 5 knots, and also that the boat can be launched satisfactorily when the vessel is moored in a current. This test should normally be completed during the trial trip. The test may be waived if the builder, owner, or equipment manufacturer can provide evidence that such a test has been successfully completed for the boat/davit/winch combination on a sister vessel. For the purposes of this test, a sister vessel is one which is generally of the same size and hull form, and where the launching position, including height above the water line, is the same.

(a) Procedure. Launch one boat of each type on board with the vessel proceeding at a speed of approximately 5 knots. No special loading of the boat is required. Use the manufacturer's recommended launching procedure.

(b) Acceptance Criteria. The boat must not give any indication that it is unstable or out of control during the launching procedure. The boat's painter release device must operate as intended.

Free-Fall Lifeboat Launching Systems.

b. Free-fall lifeboat and launching system installation tests are conducted with the vessel within 3 degrees of even keel at its lightest seagoing draft. The tests described in this section may be conducted in any order appropriate to facilitate test loading. Inspectors and persons conducting these tests should have the International Maritime Organization's (IMO) circular on "Evaluation of Free-Fall Lifeboat Launch Performance" (MSC/Circ.616, 22 June 1993). This document may be purchased from:

International Maritime Organization
Publications Section
4 Albert Embankment
London SE1 7SR
ENGLAND

Telephone: +44 (71) 735-7611
Telefax: +44 (71) 587-3210
Telex: 23588

The Coast Guard Survival Systems Branch can provide copies to Coast Guard units or provide a current list of U.S. commercial sources for IMO documents:

U S COAST GUARD
SURVIVAL SYSTEMS BRANCH (G-MSE-4)
2100 SECOND ST SW
WASHINGTON DC 20593-0001

Telephone: (202) 267-1444
Telefax: (202) 267-1069
Telex: 892427 COASTGUARD WSH

Light Load

(1) Light Load

(a) Procedure.

(i) The boat may be arranged for launching by the on-deck control, or by a launching crew on board the boat. The on-deck control should be used with no one on board the boat the first time the boat is launched after its installation to make sure that the launching system is working properly. Although not required, trial launchings would normally be carried out by the manufacturer's representative before the inspection for certification begins.

(ii) The boat should approximate its condition "A" weight for this test, with added weight of equipment and fuel on board. Precise loading and load measurement is not necessary, however. In addition, the minimum launching crew may be on board to operate the on-board launching control. If additional personnel are needed to complete the test and to recover the boat, they may board when the boat reaches the water.

(iii) Launch the boat in free-fall, then retrieve and examine it.

Acceptance Criteria.

(b) Acceptance Criteria

(i) There shall be no deformation of or damage to the launching appliance or its connections to the vessel.

(ii) There shall be no deformation of or damage to any seat or seat mounting in the lifeboat.

(iii) There shall be no cracks or other structural damage to the hull of the lifeboat or any other structurally important part of lifeboat. Cracks in structural members of a free-fall lifeboat indicate that the structure must be replaced.

(iv) There shall be no cracks in non-structural members that could break loose during a free-fall launching.

(v) The free-fall release mechanism must operate properly and release the boat from the launching appliance.

(vi) The launching system must operate smoothly, must launch the boat into the water at the intended angle, and must not show any evidence of improper operation.

(vii) The lifeboat must not show any evidence of instability or dangerous characteristics during the launching sequence. Water entry angle will normally be between 40 degrees and 70 degrees from the horizontal. The momentum of the boat should move it away from the vessel after it enters the water.

(viii) There shall be no injury to any personnel in the boat attributable to the free-fall performance of the boat.

(ix) If the inspector has reason to believe that the boat is not being launched in a safe and proper manner, the inspector may order that the test be repeated with the boat instrumented with acceleration monitoring equipment. Consult the IMO Recommendation on "Evaluation of Free-Fall Lifeboat Launch Performance" for a discussion of free-fall launching theory and performance, as well as information on conducting tests. The monitoring and analysis should be done by, or under the supervision of, an independent laboratory accepted by the Commandant (G-MOC) for this purpose. The test results are compared with the approval test data to determine whether or not the boat is being launched in a safe and proper manner.

(2) Light Load Test

(a) Procedure.

(i) Load each seat in the lifeboat with 75 kg to 100 kg (165 lb. to 220 lb.) of deadweight properly secured in place to simulate the weight of one person. Add additional weights using equipment lockers, if necessary, to bring the total boat weight to 1.1 times the condition "B" weight.

(ii) Launch the boat in free-fall, then retrieve and examine it.

(b) The acceptance criteria are the same as those for the light load test.

(3) If the light load test was conducted without a launching crew on board, a free-fall launch must be made using a launching crew in the boat.

(a) Procedure. The launch must be completely controlled by the crew in the boat, as intended in an emergency situation. Any loading condition within the boat's approved limits may be used.

(b) Acceptance Criteria. The acceptance criteria are the same as those for the light load test.

(4) Conduct this test if the launching system incorporates an adjustable ramp.

(a) Procedure.

(i) Load each seat in the lifeboat with 75 kg to 100 kg (165 lb. to 220 lb.) of deadweight properly secured in place to simulate the weight of one person.