

UNIFIED FACILITIES CRITERIA (UFC)

OPERATIONS AND MAINTENANCE: INSPECTION AND CERTIFICATION OF BOILERS AND UNFIRED PRESSURE VESSELS



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UNIFIED FACILITIES CRITERIA (UFC)

O&M: INSPECTION AND CERTIFICATION OF BOILERS AND UNFIRED PRESSURE VESSELS

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by \1\ ... /1/)

Change No.	Date	Location
1	January 2004	Appendix C, Page 36.
2	March 2005	Pages 2, 9-15, 17, 27, 28, 34
3	May 2007	Addition of paragraphs 8-2.1 and 8-2.2; subsequent adjustments throughout as marked.
4	March 2014	General editorial formatting throughout; Additional clarifications and updates where required are marked.
5	May 2019	General editorial formatting throughout: New Appendix I, New Appendix F (Figure F-1, Boiler Report and Figure F-4 Boiler Certificate), additional clarifications and update where required are marked.

This UFC supersedes MIL-HDBK-1152 dated 30 September 1996.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with [USD \(AT&L\) Memorandum](#) dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: [Criteria Change Request](#). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

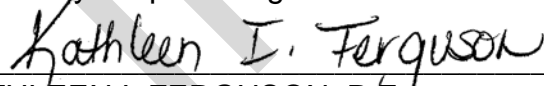
- Whole Building Design Guide web site <http://dod.wbdg.org/>.

Refer to UFC 1-200-01, *General Building Requirements*, for implementation of new issuances on projects.

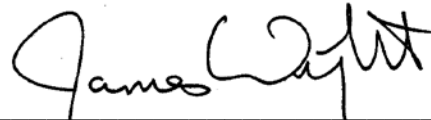
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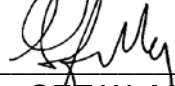
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UNIFIED FACILITIES CRITERIA (UFC) REVISION SUMMARY SHEET

Document: UFC 3-430-07, *O&M: INSPECTION AND CERTIFICATION OF BOILERS AND UNFIRED PRESSURE VESSELS*

Superseding: MIL-HDBK-1152, *Inspection and Certification of Boilers and Unfired Pressure Vessels* dated 30 September 1996

Description: This UFC covers the procedures necessary to determine material conditions of boiler and unfired pressure vessels to ensure their continued safe, reliable, and efficient operation. It presents operation and maintenance requirements as well as inspection and certification procedures of these items, and is applicable to all heating and power boilers and unfired pressure vessels owned or leased by the Department of the Navy (DON), including portable boilers, portable unfired pressure vessels and liquefied petroleum gas (LPG) storage tanks. This UFC also provides updated policy and guidance for the essential services that are required by Naval Facilities Engineering Command (NAVFAC) to support its mission for shore activities while utilizing its resources in an efficient and cost effective manner.

Reasons for Document:

- This update to UFC 3-430-07 incorporate changes to Department of the Navy inspection and certification requirements of boilers and unfired pressure vessels. These changes are based on lessons learned from the previous requirements, new technologies, updated requirements for inspection and certification of boilers and unfired pressure vessels, and new regulations and other reference documents. These changes include, but not limited to updating the references, and requirements for the following:
 - Inspector qualifications and licensing, inspection and test frequencies, procedures for submitting reports and forms, vessel repair and alteration guidance and mishap or property damage reporting.
 - Responsibility, Applicability, Leased and/or Contractor Owned Boilers and Unfired Pressure Vessels, Applicable Codes, and Environmental Compliance in Chapter 1.
 - Inspector Qualifications, Certifications and Licenses in Chapter 2.
 - Inspection and Test Frequencies in Tables 3-1 and 3-2, and Chapters 4 and 5.
 - Hydrostatic Tests in paragraph 6-1.
 - Pneumatic Tests in paragraph 6-2.
 - Operational Tests in paragraphs 7-2 through 7-4.

- Contractor Repairs and Records in Chapter 8.
- Inspection Reports and Certificates in paragraphs 9-1.1 and 9-1.2.
- Mishap or Property Damage Reporting in Chapter 11.
- NAVFAC Boiler and Pressure Vessel Inspection Program in Appendix B.

Impact:

The Boiler Safety Program has a high degree of technical complexity (e.g. power boilers, heating boilers, unfired pressure vessels (UPV's) etc.) requiring certification personnel to be licensed and certified by the regulatory agencies and professional institutions who produce the regulations and Standards they enforce. The Navy's Inspection program has been standardized, Navy Wide, by the Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC). Program requirements remain essentially the same regardless of location of the equipment throughout the world. These certification processes are extremely important to Naval Commanding Officers and other government officials, as in many states, these leaders have personal pecuniary responsibility for assuring the health and safety of shore based facilities within their purview. For Foreign Regions that use Base Operation and Support (BOS) Contracts, the certification personnel shall be licensed by the host nation government agency and approved by the Region Facilities Engineering Command (FEC) Boiler & UPV Lead Certifying Official (LCO) and NAVFAC EXWC Boiler & UPV Inspection Program Manager.

Unification Issues

This UFC references Service-Specific documents, which the Tri-Service boiler and unfired pressure vessel inspection and certification community does not oversee. Army and Air Force documents are currently referenced as an initial step to unify the requirements. Further unification efforts are planned for the next revision.

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CHAPTER 1 INTRODUCTION

1-1 SCOPE.

The Department of the Navy (DON), including the Naval Shore Establishment and the Marine Corps, will use this UFC. It presents basic operation and maintenance guidance on inspection and certification of boilers and unfired pressure vessels.

\5\ The Army will use documents that are referenced in paragraph 1-1.1 below entitled "Army Criteria." The Air Force will use documents that are referenced in paragraph 1-1.2 below entitled "Air Force Criteria." The Army and the Air Force will not need to refer to the remainder of this UFC. /5/

1-1.1 Army Criteria.

\5\ Operation and Maintenance requirements for boilers and unfired pressure vessels on Army installations are contained in *Army Facilities Management* AR 420-1, *Army Technical Manual (TM) 5-650, Central Heating Plants* and *TM 5-642, Small Heating Systems*. /5/ \4\ /4/

1-1.2 Air Force Criteria.

\5\ Requirements for boilers and unfired pressure vessels on Air Force installations are contained in *Air Force Manual (AFMAN) 32-1068, Heating Systems and Unfired Pressure Vessels* \4\ /4/. /5/

1-2 PURPOSE.

This UFC covers the procedures necessary to determine the material condition of boilers and unfired pressure vessels to ensure their continued safe, reliable, and efficient operation. The procedures also require determination of combustion efficiency and proper operation of boilers, boiler auxiliaries, and controls. For the DON, exceptions to these requirements will not be made without the formal concurrence of the Naval Facilities Engineering Command's (\4\ NAVFAC /4/) Boiler Inspection Certification Board (NBICB). \5\ The authority for these requirements is a Chief of Naval Operations letter dated 22 October 1970, *Inspections of Boilers, Unfired Pressure Vessels, Elevators, Dumbwaiters and Escalators*, the Commander Naval Facilities Engineering Command letter dated 18 September 2015, *Boiler and Unfired Pressure Vessel Inspection*, the NAVFAC Building Management System (BMS) B-5.2.4, *Boiler and Unfired Pressure Vessel (UPV) Inspection and Oversight* and the Navy Shore Boiler Guide dated March 2019. /5/ The frequency of inspection and testing, the various items or components to be inspected or tested, and the forms to be used are specified in this UFC.

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1-3 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, General Building Requirements. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein. /4/

1-4 RESPONSIBILITY.

The Commanding Officers of the cognizant activities ensure that the boilers and unfired pressure vessels installed at their facilities and covered by this UFC are certified as specified. \5\ Inspection and testing of boilers and unfired pressure vessels must be made by a boiler inspector certified by the NAVFAC EXWC Boiler & UPV Inspection Program Manager. /5/ This boiler inspector will be on the cognizant activity's rolls, except where:

- Inspection responsibility has been assigned to the Commanding Officer of \3\ the Region or respective /3/ Public Works.
- Commanding Officers of major or lead activities are responsible for performing the maintenance of public works and public utilities at adjacent activities.
- It may be impractical to employ qualified personnel for such inspections because of the limited workload. \5\ In such situations, request assistance in obtaining inspection services from the appropriate NAVFAC Facilities Engineering Command (FEC) Boiler & Unfired Pressure Vessel (UPV) Lead Certifying Official (LCO) or the NAVFAC EXWC Boiler & UPV Inspection Program Manager. The NAVFAC FEC Boiler & UPV LCO or the NAVFAC EXWC Boiler & UPV Inspection Program Manager will arrange for the performance of those inspection services by a Navy or contract inspector located near the requesting activity. /5/ When assistance is required, such assistance will be rendered on a reimbursable basis. The requesting activity is responsible for providing the funds to accomplish the inspections.

\3\

1-5 APPLICABILITY.

This UFC is applicable to all heating and power boilers and unfired pressure vessels owned or leased by the DON, including portable boilers and portable unfired pressure vessels, \4\ and liquefied petroleum gas (LPG) storage tanks. /4/ The following equipment is not covered by this UFC:

/3/

- Cylinders, including Department of Transportation (DOT) flasks, for shipment of compressed or liquefied gases. Defense Logistics Agency (DLA) Instruction 4145.25, *Storage and Handling of Liquefied and*

Gaseous Compressed Gasses and their Full and Empty Containers \4\
/4/governs.

- \3\ Shore-based hyperbaric facility support pressure vessels, including, but not limited to, vessels used for manned operations or for testing animals or equipment, gas storage flasks, volume tanks, fire water tanks, and filters. (these are under the authority of NAVFAC System Certification Authority.) /3/
- Air tanks for air brakes on vehicles.
- Unfired pressure vessels operating at an internal or external gage pressure not exceeding 15 pounds per square inch gage (psig) (103.42 kilopascals (kPa)) with no limitation on size \2\, except deaerators. /2/
- Unfired pressure vessels that do not exceed the following volume, pressure, and dimension limits:
 - 5 cu ft (0.14 cu. meters) in volume and 250 psi (1723.69 kPa) design pressure; or
 - 3 cu ft (0.08 cu. meters) in volume and 350 psi (2413.17 kPa) design pressure;
 - 1-1/2 cu ft (0.042 cu. meters) in volume and 600 psi (4136.85 kPa) design pressure.

Note: In an assembly of vessels, the limitations apply to each vessel and not the assembly as a whole.

- Vessels having an inside diameter, width, height, or cross section diagonal not exceeding 6 inches (152.4 mm), with no limitation on length of vessel or pressure.
- \5\ \4\ Unfired pressure vessels containing only water, with or without additives, under pressure, including those containing compressed gas which serves only as a cushion, and do not exceed a design pressure of 300 psi (2.1 MPa) and/or a design temperature of 210 degrees F (99 degrees C) /4/ with external heating source. /5/
- Unfired pressure vessels used as refrigerant receivers for refrigerating and air conditioning equipment.
- Coil type steam vapor cleaners unless requested by the activity.
- \5\ Domestic Hot Water Storage Tanks with external heat source (Hot Water Storage Tanks with internal heat source shall be inspected)
- Hot water system expansion tanks
- Cryogenic Tanks - (Helium, Hydrogen, Neon, Nitrogen, Fluorine, Argon, Oxygen) /5/
- Unit heaters (gas, electric, or steam).

- Boilers and direct fired and domestic water heaters under 400,000 BTUs/hour (117124.2 W) input capacity unless requested by the activity.
- Residential and commercial warm air furnaces.
- Fire extinguishers.
- \5\ Breathing Air Tanks /5/ \3\ /3/

\3\ \4\

1-6 LEASED AND/OR CONTRACTOR-OWNED AND OPERATED.

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\5\ Leased and/or Contractor-Owned and Operated boilers and UPVs must be inspected by a contractor-provided boiler inspector meeting the requirements of the paragraph in Chapter 2 entitled, "Contract Employees". For the DON, the Facilities Engineering Command (FEC)/Commanding Officer (CO) reserves the right to have these boilers inspected by a NAVFAC inspector. Foreign Leased and/or Contractor-Owned and Operated boilers and UPV's can be inspected by the Host Nation Government Agency Inspector that meets the Host Nation Government Agency Codes and licensing requirements that align with this UFC and approved by the NAVFAC EXWC Boiler & UPV Inspection Program Manager and FEC Boiler & UPV LCO. /5/

/3/

1-7 APPLICABLE CODES.

The latest versions of the following codes are applicable in the inspection and testing of boilers and pressure vessels:

- American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code (BPVC)*.
- American Society of Mechanical Engineers (ASME) CSD-1, *Controls and Safety Devices for Automatically Fired Boilers*.
- \5\ National Board of Boiler and Pressure Vessel Inspectors (NBBPVI) *National Board Inspection Code (NBIC), Part 1 Installation, Part 2 Inspection and Part 3 Repairs and Alterations*. /5/
- National Fire Protection Association (NFPA) *National Fire Codes*.
- \4\ Department of Defense (DOD) /4/ \3\ UFC 3-240-13FN, /3/ *Industrial Water Treatment*.
- \5\ Acceptable and/or equivalent International Codes. /5/

This UFC governs when a conflict occurs between this UFC and the codes.

\4\

1-8 ENVIRONMENTAL COMPLIANCE.

Military installations must comply with an increasing number of federal, state, and local environmental regulations that affect the operation, maintenance, and testing of external combustion devices such as boilers, unfired pressure vessels, furnaces, process heaters, and incinerators. Failure to comply with these regulations can present a significant liability to installation commanding officers. While environmental compliance is not a primary responsibility of a boiler inspector, boiler inspectors are in a unique position as equipment and subject matter experts to assist installation commanding officers with environmental compliance by ensuring that equipment is operated and maintained in accordance with manufacturer specifications and facility operating procedures and by ensuring that equipment or operational deficiencies are promptly reported to the chain of command for correction. Boiler inspectors are strongly encouraged to communicate with installation environmental offices in order to gain a basic understanding of the environmental compliance requirements for the equipment they are inspecting and to communicate with the appropriate chain of command if a possible compliance deficiency is observed during the course of equipment inspection and certification.

/4/

CHAPTER 2 INSPECTOR QUALIFICATIONS, CERTIFICATIONS AND LICENSES

2-1 NAVY EMPLOYEES.

Navy employees who perform the inspections, witness the tests, prepare the reports, and issue the certifications described in this UFC must satisfy the following two conditions:

- Possess a valid \4\ NAVFAC /4/ Certificate of Competency.
- \5\ Possess a current "License to Inspect" issued by the NAVFAC EXWC Boiler & UPV Inspection Program Manager. /5/

2-1.1 Qualifications for Certification.

Candidates for the Certificate of Competency must be qualified as follows:

2-1.1.1 The Candidate Inspector:

\5\ \3\

- Graduation from an accredited school, a degree in mechanical engineering plus 2 years of experience in design, construction, operation, or inspection of boilers and pressure vessels. Accredited school is defined as an engineering school accredited by the Accreditation Board for Engineering Technology (ABET);
or
- Graduation from an accredited school, a degree in a branch of engineering other than mechanical engineering plus 3 years of experience in design, construction, operation, or inspection of boilers and pressure vessels; /3/
or
- High school diploma or GED or the equivalent plus 5 years of experience in one of the following categories:
 - in boiler and pressure vessel construction, operation, maintenance or repair.
 - in the inspection of boilers and pressure vessels.

/3/ /5/

2-1.1.2 Job Requirement:

\5\ Inspect and certify a minimum of 20 boilers and/or unfired pressure vessels per year.
/5/

2-1.2 Certification Procedures.

\5\ The Navy or Marine Corps activities must recommend only qualified candidates for certification to the \4\ NAVFAC /4/ Boiler Inspection Certification Board (Appendix I) via the NAVFAC EXWC Boiler & UPV Inspection Program Manager. Prior to hiring, activities are encouraged to schedule a phone interview between prospective candidate and NAVFAC EXWC Boiler & UPV Inspection Program Manager prior to recommending certification. The candidate's application package must include the following:

- Full Name, address, phone number(s), e-mail address.
- Current position and grade/step.
- 5-year occupational history, directly related to Stationary Engineering Principles: steam/hot water plant operation and maintenance, power generation equipment, pumps, compressors, water science and process equipment, chemical treatment systems, industrial processes, measurement and control devices.
- Educational background; include all Certifications, Licenses, Diplomas.
- Supervisor's "Letter of Recommendation."
- Commanding Officer's or Public Works Officer's signed recommendation.
- Proposed inspection workload. Minimum workload is the inspection of 20 boilers and/or unfired pressure vessels per year as specified in the paragraph in this chapter entitled, "Job Requirement".
- Copy of the National Board of Boiler Inspectors (NBBI) qualification examination.

2-1.2.2 National Board of Boiler Inspectors (NBBI) Qualification Exam.

The NBBI Qualification Examination tests the ability of the candidate to understand the ASME Boiler and Pressure Vessel Code (BPVC). Candidates may wish to attend one of the commercially available boiler inspector preparatory schools. Information must be received at the NBBI prior to the date of the examination to ensure the candidate is scheduled. \3\ The preparation for and taking of this test can take several weeks of effort, to avoid wasting resources, we strongly recommend the activity discuss and review a candidate's qualifications with the NAVFAC EXWC Boiler & UPV Inspection Program Manager before they prepare and take this exam. /3/ The FEC Boiler & UPV LCO in each region shall establish and maintain a list of perspective candidates to insure they meet all requirements and recommend qualified candidates to the NAVFAC EXWC Boiler & UPV Inspection Program Manager when the candidate is ready for the NBBI examination.

\3\

2-1.2.3 Employment.

Only employees of the Navy and Marine Corps will be certified. Prolonged gaps in employment may affect certification.

/3/

2-1.3 Qualifications for NAVFAC License to Inspect.

The NAVFAC EXWC Boiler & UPV Inspection Program Manager administers licenses to Navy and Marine Corps employed inspectors every 2 years, providing they satisfy the following six conditions:

- Possess a valid \4\ NAVFAC /4/ Certificate of Competency
- \3\ Are full or part-time employees of the Navy. /3/
- Maintain an inspection workload of at least 20 boilers and/or unfired pressure vessels per year.
- Conduct inspections in accordance with this UFC and all other applicable U.S. Codes: ASME Section I, ASME Section IV, ASME Section VIII, ASME CSD-1, NBIC Part 1, Part 2 and Part 3, NFPA 85 and the BMS.
- Conduct inspections in accordance with all applicable Foreign National Boiler Code and Environmental Governing Standards as mandated in the Status of Forces Agreement (SOFA) between a host country and the U.S. military forces (Outside the Continental United States (OCONUS only).
- Are not employed in a capacity that constitutes a conflict of interest, as defined in the paragraph below entitled, "Reasons for Not Issuing, Renewing or Revoking a NAVFAC License."

2-1.4 Reasons for Not Issuing, Renewing or Revoking a NAVFAC License.

The NAVFAC EXWC Boiler and UPV Inspection Program Manager does not license inspectors whom:

- Have a conflict of interest:
 - Operate or maintain any of the boilers to be inspected.
 - Supervise the operation or maintenance of such boilers.
 - Report directly to the boiler operations or maintenance supervisor in any capacity of their employment.
- Fail to attend the NAVFAC Boiler Inspectors Workshop.
- Fail to provide inspection reports in accordance with this UFC.
- Has been counseled by supervisor and/or FEC Boiler & UPV LCO for sub-par job performance and have not shown improvement after additional training and probation.
- Are no longer serving in a position as a NAVFAC Boiler Inspector.

- Officially retired from Government Service.
- Deliberately violate boiler and/or UPV operational safety that resulted in personal injury/death and/or severe equipment damage resulting in costly repair and had negatively impacted mission readiness and/or capability.
- Lose their Security Clearance.
- Conduct themselves unprofessionally in the work place and/or job site.

2-1.5 Inspector Support.

Before licensing inspectors, NAVFAC will seek the following assurances from the employing activity:

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- Provide inspector with all current applicable ASME codes, Navy UFC's, NBIC Part 1, Part 2, and Part 3, NFPA 70, 85 and 87, UL 353 and 873.
- Ensure that test equipment, and tools are maintained and available to the inspector. Some of the required test equipment and tools shall include:
 - Combustion Analyzer (capable of measuring oxygen from 0 to 21%, carbon monoxide in ppm, and Exhaust Gas Temperature)
 - Ultrasonic Thickness Gauge
 - Boroscope (Hand-held Inspection Camera)
 - Digital Camera (if allowed)
 - Flashlight, mirror, magnifying glass
 - Personal Protective Equipment (PPE)
 - Multimeter
- Records of inspection are maintained and available for examination by NAVFAC EXWC Boiler & UPV Inspection Program Manager and/or FEC Boiler & UPV LCO.
- The inspector is available to other activities for inspection, at their request, on a reimbursable basis, depending on workload and advance notice.

/4/ /5/

2-2 CONTRACT EMPLOYEES.

All persons employed by contractors that perform the inspections, witness the tests, prepare the reports, and issue the certificates described in this UFC must, as a minimum, \3\ \4\ /4/ meet the qualifications and /3/ possess a Certificate of Competency or the equivalent (see note 3 of Table 2-1) issued by any political subdivision (such as

state, province, territory, county, or city) of the United States or Canada that is a member of the NBBI except for contractors performing inspections outside the U.S. \5\ Requirements for contract employees outside the U.S. vary depending on the country; check with your respective FEC Boiler & UPV LCO and/or NAVFAC EXWC Boiler & UPV Inspection Program Manager. \4\ Contract Employees shall have access to up-to-date Code Books, test equipment and tools outlined in the paragraph above entitled "Inspector Support". /4/

For Foreign Regions, inspectors contact the NAVFAC EXWC Boiler & UPV Inspection Program Manager for contract inspections outside the U.S. At a minimum the Foreign Inspectors must meet the qualifications from the Host Nation Government agency licensing requirements that align with this UFC and are approved by the NAVFAC EXWC Boiler & UPV Inspection Program Managers and FEC Boiler & UPV LCO for Boilers & UPV's manufactured under the Host Nations Codes and stamping requirements. For all U.S manufactured boilers and UPV's that are installed at U.S. overseas bases shall be inspected by an inspector employed by NAVFAC that meets all the requirements of this UFC. /5/

2-3 CREDENTIAL REQUIREMENTS.

\5\ \4\ NAVFAC /4/ Form 9-11014/32 (09/15), *Inspection Certificates*, for boilers and unfired pressure vessels may only be issued by inspectors who meet one of the two category requirements in Table 2-1. /5/

Table 2-1 Credentials Required

Category	Credentials Required		
	State Certificate of Competency	\4\ NAVFAC /4/ Certificate of Competency	NAVFAC License/ Authorization to Inspect
1. Contract Inspector	X		X
2. Civil Service Inspector		X	X

Notes:

1. A \4\ NAVFAC Certificate of Competency issued after September 1983 requires passing the NBBI examination. A NAVFAC Certificate of Competency issued before September 1983 required passing a Navy examination. In addition, authorization to issue NAVFAC \4/ Inspection Certificates requires a NAVFAC license.
2. \3\ A contract inspector may not be \4\ an employee of a contractor utilized to operate or maintain the equipment to be certified. \3/ A contract inspector may not report directly to the boiler operations or maintenance supervisor in any capacity of their employment. \4/
3. \5\ In addition to the State Certificate of Competency \4\ and/or current NBBI card \4/, contract inspectors must \3\ meet the qualifications outlined in the paragraph in Chapter 2 entitled, "Qualifications of Certification" and \3/ have written Authorization to Inspect from the NAVFAC EXWC Boiler & UPV Inspection Program Manager. \5/ An official letter from a member jurisdiction of the NBBI stating that the individual has passed the NBBI examination can be considered equivalent to the State Certificate of Competency.

2-4 QUALITY ASSURANCE FOR INSPECTIONS.

Appendix B shows the NAVFAC Boiler and Unfired Pressure Vessel Inspection Program Quality Assurance Organization. This organization provides a method of monitoring the performance of Navy and contract inspections. \5\ The key elements of the organization are the NAVFAC EXWC Boiler & UPV Inspection Program Manager and the FEC Boiler & UPV LCO. The duties of the NAVFAC EXWC Boiler & UPV Inspection Program Manager are outlined in Appendix C, and the duties of the FEC Boiler & UPV LCO are outlined in Appendix D. \5/

2-5 GUIDELINES FOR INSPECTION CONTRACTS.

The inspection of boilers and pressure vessels is highly specialized work requiring qualified personnel and, in many cases, specialized testing equipment. \5\ The Contracting Officer is responsible for ensuring that boiler and UPV inspections performed by companies awarded Navy inspection contracts are inspected and certified in accordance with this UFC. Foreign National inspections on Navy leased property must meet requirements in paragraph above entitled "CONTRACT EMPLOYEES." \5/

2-5.1 Contractor Abilities.

Contractors' and their inspectors' ability to provide adequate inspections can be highly variable. The NBBI commissions inspectors of jurisdictions, which have adopted and administer one or more sections of the ASME *Boiler and Pressure Vessel Code* as a legal requirement and has a representative serving as a member of the ASME Conference Committee; or to an insurance company which is licensed by a U.S. state to write boiler and pressure vessel insurance. An Authorized Inspection Agency (AIA) is not working within the NBBI charter when performing inspections on a Federal reservation because a state's jurisdiction does not encompass military reservations and the Government does not insure its equipment. \4\ \4/

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2-5.2 Companies Other than Authorized Inspection Agencies.

Quality assurance for such companies may not be structured according to a standard recognized by the NBBB or may even be non-existent. Contracting officers must ensure adequate inspections by requiring qualifications of the contractor before awarding the contract. These assurances, at a minimum, include requiring the contractor to supply inspectors meeting the credential requirements of the paragraphs in this chapter entitled, "Qualifications for Certification", "Certification Procedures" and "Credential Requirements".

/3/

2-5.3 Assistance.

\5\ When an activity elects to administer its own inspection contract, NAVFAC EXWC Boiler & UPV Inspection Program Manager and/or FEC Boiler & UPV LCO can provide assistance to the Contracting Officer by reviewing the contract requirements and determining the suitability of a company to perform inspections. The NAVFAC EXWC Boiler & UPV Inspection Program Manager and FEC Boiler & UPV LCO provide this service on a reimbursable basis. They also provide quality control by monitoring the performance of contractors and their inspectors. Upon satisfactory review, the NAVFAC EXWC Boiler & UPV Inspection Program Manager can issue an Authorization to Inspect to the firms qualifying inspectors for the term of the contract. The Authorization to Inspect identifies the ability of the inspector to perform the work satisfactorily and authorizes the inspector to sign the Inspection Report-Boiler or the Unfired Pressure Vessel Report and issue the Inspection Certificate, NAVFAC Form 9-11014/32 (09/15).

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2-5.4 Activity Administered Contracts.

\5\ When the activity's Contracting Officer elects to administer the contracts, the Contracting Officer must ensure the contractor provides enough information to determine positively that the firm has qualified inspectors and has the capability to do the required work. /5/ The scope of work for the inspection contract should include the number, function, type (such as boiler or pressure vessel), construction (such as the American Society of Mechanical Engineers' (ASME) *Boiler and Pressure Vessel Code* or military specification), capacity, and pressure rating of each vessel. In addition, the contract will require that the contractor have:

- Inspectors with credentials complying with \3\ the paragraphs in this chapter entitled, "Qualifications for Certification", "Contract Employees" and "Credential Requirements" /3/
- An inspection work history similar to that required for the proposed work.

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2-5.5 Certification Extensions.

Inspectors are allowed to give a onetime extension for an expiring certificate up to 60 days past the reinspection date for inspections they have performed. The activity is to post the written extension next to the certificate. \5\ This must be in writing and name all applicable boilers and or UPVs with copy to the NAVFAC EXWC Boiler & UPV Inspection Program Manager. Acceptable reasons include unforeseen disruption in inspection support. NAVFAC EXWC Boiler & UPV Inspection Program Manager may provide an activity with a blanket extension of 90 days to an activity previously inspected by themselves or by anyone within their area of responsibility. /5/ Acceptable reasons include unforeseen disruption in inspection services and/or inspection support.

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CHAPTER 3 INSPECTION AND TEST FREQUENCIES

3-1 BOILERS.

Inspection and test frequencies for boilers are shown in Table 3-1.

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Table 3-1 Inspection and Test Frequencies – Boilers

Item	Internal Inspection	External Insp. & Operational Test	Hydrostatic Test
Boilers – Wet or dry lay-up	Annually or at the discretion of the inspector. At resumption of active service.	External at least annually. External and operational at resumption of active service.	Hydrostatic testing in accordance with NBBI, Part 2, paragraph 4.3.1. Test pressure should not exceed 90% of the lowest setting pressure relief device at the resumption of active service.
Boilers –Heating ASME Section IV			
Hot Water Heating or Hot Water Supply Boilers	\3\ /3/ At least every three years or at the discretion of the inspector. After any repair or alteration of pressure parts. \3\ Check firesides on oil fired units annually /3/	At least annually. After any alteration or modification to boilers, control equipment, or Auxiliaries.	Hydrostatic test in accordance with NBBI, Part 2, paragraph 4.3.1. Test pressure should not exceed 90% of the lowest setting pressure relief device at least annually. Strength test in accordance with NBBI, Part 3, paragraph 4.4.1 after repair or alteration of pressure parts. Additional times at the discretion of the inspector.
Steam Heating Boilers	At least annually. After any repair or alteration of pressure parts.	At least annually. After any alteration or modification to boilers, control equipment, or auxiliaries.	Hydrostatic testing in accordance with NBBI, Part 2, paragraph 4.3.1. Test pressure should not exceed 90% of the lowest setting pressure relief device at least annually. Strength test in accordance with NBBI, Part 3, paragraph 4.4.1 after repair or alteration of pressure parts. Additional times at the discretion of the inspector.
High Efficiency and Condensing Hot Water Heating Gas Fired Boilers	At least every three years or at the discretion of the inspector. (See Note 2 Borescope)	At least annually. After any alteration or modification to boilers, control equipment, or	Hydrostatic testing in accordance with NBBI, Part 2, paragraph 4.3.1. Test pressure should not exceed 90% of the lowest setting pressure relief

	auxiliaries.	device at least annually.
Boilers – Power ASME Section I		
High Pressure Steam and Water Boilers	At least annually. After any repair or alteration of pressure parts.	At least annually. After any alteration or modification to boilers, control equipment, or auxiliaries.
		Hydrostatic testing in accordance with NBBI, Part 2, paragraph 4.3.1. Test pressure should not exceed 90% of the lowest setting pressure relief device at least annually. Strength test after repair or alteration of pressure parts. Additional times at the discretion of the inspector.
Domestic Hot Water Heaters (HLW) ASME Section IV	If \3\ practical /3/: At least every two years or at the discretion of the inspector. Check oil fired units annually. (See Note 2)	At least every two years. Check oil fired units annually.
		Discretion of inspector. Note: Glass-lined vessels not to exceed Maximum Allowable Working Pressure (MAWP).
Notes: 1. All manhole and handhole gaskets must be replaced after application of the strength test unless they are of the non-compressible steel type. 2. The inspector should use good judgment when inspecting the firesides and watersides of these type boilers. Borescopes should be used when possible to avoid damage to the units. If removal of the burner assemblies and watersides is warranted by the inspector the maintenance personnel shall have proper training in the safe removal of components without damaging the unit. Ensure that all required gaskets are on hand before disassembly of components.		

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3-2 UNFIRED PRESSURE VESSELS.

Inspection and test frequencies for unfired pressure vessels are as shown in Tables 3-2, 3-3, or 3-4, as applicable.

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Table 3-2 Inspection and Test Frequencies - Unfired Pressure Vessels (UPVs)

Item	Internal Inspection	External Insp. & Operational Test	Hydrostatic Test
Pressure Vessels & Heat Exchangers (15 to 250 psig) (100 kPa to 1.7 MPa) MAWP	Every 3 years or more frequently as determined by procedures in the NBBI Code for vessels subject to corrosion. After any repair or alteration of pressure parts. For LPG see Table 3-3. (See Note 5 Borescope)	Every 3 years or more frequently as determined by procedures in the NBBI Code for vessels subject to corrosion. After any repair or alteration of pressure parts. Inspection must include test and calibration of safety valves and pressure and temperature gages.	Hydrostatic Testing at the discretion of the inspector. If required, it shall be conducted in accordance with NBBI, Part 2, paragraph 4.3.1. Test pressure should not exceed 90% of the lowest setting pressure relief valve. Strength test is required in accordance with NBBI, Part 3, paragraph 4.4.1 after repair or alteration of pressure parts. (See Note 5)
Pressure Vessels & Heat Exchangers (greater than 250 psig) (1.7 MPa) (MAWP)	Every 3 years or more frequently as determined by procedures in the NBBI Code for vessels subject to corrosion. After any repair or alteration of pressure parts. For LPG see Table 3-3. (See Note 5 Borescope)	Every 3 years or more frequently as determined by procedures in the NBBI Code for vessels subject to corrosion. After any repair or alteration of pressure parts. Inspection must include test and calibration of safety valves and pressure and temperature gages.	Hydrostatic Testing at the discretion of the inspector. If required, it must be conducted in accordance with NBBI, Part 2, paragraph 4.3.1. Test pressure should not exceed 90% of the lowest setting pressure relief device. Strength test is required in accordance with NBBI, Part 3, paragraph 4.4.1 after repair or alteration of pressure parts. (See Note 5)
<p>Notes:</p> <ol style="list-style-type: none"> 1. Test frequencies and inspections may be increased at the discretion of the inspector or owner if the UPV is subjected, by the nature of its service, to an accumulation of deposits or thermal or mechanical stresses that could affect the integrity of the vessel. 2. A hydrostatic pressure test not to exceed 1.5 times the MAWP for BPVC ASME Section VIII Division 1 vessels and 1.25 times the MAWP for BPVC ASME Section VIII Division 2 vessels may be substituted for the internal inspection. 3. If the tube bundle of the heat exchangers is a higher pressure than the shell, both sides of the heat exchanger must be hydrostatically tested. 4. Unfired pressure vessels are to be inspected externally and re-certified anytime they are relocated or moved. It is the activity's responsibility to inform the inspector of the move. For UPVs designed and built to be portable, reinspection is not required after a move as long as the vessel does not leave the base. The inspector will indicate the UPV is "portable" on all appropriate reports. Once a UPV designed to be portable is relocated outside the base, any certified NAVFAC boiler inspector or NAVFAC-approved contract boiler inspector may issue a certificate (9-11014/32) for the length of the deployment period but not exceeding the original certificate's expiration date. A copy of the original inspection report and certificate must accompany the pressure vessel during the deployment/transfer period. The extent of reinspection after the move for pressure vessels designed to be portable consists of an external inspection to check for damage incurred while in transit, a visual examination to determine if the installation is conforming to applicable codes and a visual examination to verify that all code required safety devices are installed. If any of these inspection processes indicates discrepancies with the pressure vessel and/or installation, then the full inspection requirements of this UFC apply. 5. Use of ultrasonic thickness (UT) and borescope testing in addition to internal inspection is highly encouraged. Nondestructive Testing (NDT) in lieu of Hydrostatic Testing may be used to evaluate the properties of a material, component or system without causing damage. NDT testing such as Ultrasonic Thickness (UT), Acoustic Emissions (AE) or Shear Wave (SW) may be required by the inspector. 			

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Table 3-3 Inspection and Test Frequencies - UPVs (Special Cases)

Item	Internal Inspection	External Insp. & Operational Test	Hydrostatic Test
High Pressure (H.P.) ASME & MILSPEC Vessels See note 1	Every 3 years of service. Inspection must include test and calibration of safety valves and pressure and temperature gages. See Note 1. For MILSPEC Vessels (Pressure Vessels Design, Built and Stamped to 4 MIL-DTL-22606 /4/) or any non-ASME vessels see Note 3.	Every 3 years of service. Inspection must include test and calibration of safety valves and pressure and temperature gages.	See note 2
3\ /3/	3\ /3/ For MILSPEC Vessels (Pressure Vessels Design, Built and Stamped to 4 MIL-DTL-22606 /4/) or any non-ASME vessels see Note 3.	3\ /3/	3\ /3/
Carbon Dioxide (CO2) Storage Tanks See note 4	Only if the vessel has been depressurized or has been opened to the atmosphere other than for immediate repair or maintenance; or when directed by an authorized boiler inspector.	Every 3 years; or after any repair or alteration of pressure parts; or when directed by an authorized boiler inspector. See note 5	After any repair or alteration of pressure parts; or when directed by an authorized boiler inspector. Caution should be taken in performing hydrostatic testing. It is essential that all water be removed from the vessel before returning it to service. Water will freeze and create blockages.
Liquid Petroleum Gas (LPG) Storage Tanks	Every 3 years or more frequently as determined by procedures in the NBBI Code. After any repair or alteration of pressure parts. Use ultrasonic testing instead of visual internal inspection.	Every 3 years or more frequently as determined by procedures in the NBBI Code. After any repair or alteration of pressure parts. Bench test or replace the UL or ASME safety valves every 6 years. See note 6	After any repair or alteration of pressure parts, otherwise at the discretion of the inspector.
Notes: 1. A visual internal inspection for H.P. ASME or MILSPEC vessels 3\ /3/ is not required every 3 years provided the vessel (or vessel bank) successfully passes a gas analysis with oil mist plus particulate matter concentration equal to or less than 5 milligrams per cubic meter and dew point equal to or colder than -40 degrees F (-40 degrees C); and an ultrasonic thickness measurement check in accordance with the Paragraph in Chapter 5 entitled, "Ultrasonic Examination Military Specification". The maximum acceptable interval between visual inspections is 12 years. 2. At intervals indicated in <i>Naval Ship's Technical Manual</i> S9086-SY-STM-010, Chapter 551, vessels will be required to be tested according to "551-1.14.1". The flask(s) requiring re-certification is to be tested by Ultrasonic (UT), Acoustic Emission (AE) or Shear Wave (SW) testing. Hydrostatic testing is being eliminated because it does not provide data on flask wall cracking which has been determined to be the primary failure mode."			

3. Activities may elect to prepare and inspect MILSPEC vessels using NAVSEASYSCOM boiler inspectors according to *Naval Ship's Technical Manual S9086-SY-STM-010*, Chapter 551, *Compressed Air Plants and Systems*. However, if either a NAVSEASYSCOM or NAVFAC boiler inspectors are used they will be required to perform internal and external inspections as explained above every 3 years (as opposed to the 6-20 year re-certification intervals allowed in *Naval Ship's Technical Manual S9086-SY-STM-010*, Chapter 551). A pressure vessel that is neither MILSPEC nor ASME code may only be certified when design drawings and engineering calculations from the manufacturer are available to the inspector to positively determine whether the vessel is safe to operate. The inspector may ask for proof of the manufacturer's quality control procedures and tests prior to issuing a certificate.

4. We recommend inspectors familiarize themselves with current versions of Compressed Gas Association (CGA) G-6.1, *Standard for Insulated Carbon Dioxide Systems at Consumer Sites*, and CGA G-6.7, *Safe Handling of Liquid Carbon Dioxide Containers That Have Lost Pressure*.

5. Inspection must include testing of relief valves by an ASME Repair Facility Holding a "VR" stamp or replacement with new ASME stamped valves. Also required is calibration of all pressure and temperature gages. Note: The external inspection should be limited to the visible portions of the system, including the vessel and appurtenances such as pressure relief devices, the piping system, and hose lines. Initial inspections may require adding an isolation valve between the vessel and relief valve. The mandatory isolation valve requirements are listed in the ASME *Boiler and Pressure Vessel Code*, Section VIII, Division I, Appendix M, Paragraph M-5.

6. The minimum required rate of safety valve discharge for aboveground LPG tanks is to be in accordance with the following table:

Tank Surface Area ft² (m²)	Flow Rate (CFM) Air ft³/min (m³/sec)	Tank Surface Area ft² (m²)	Flow Rate (CFM) Air ft³/min (m³/sec)
20 (1.9) or less	626 (0.295)	250 (23.23)	4960 (2.341)
25 (2.32)	751 (0.354)	300 (27.87)	5760 (2.718)
30 (2.79)	872 (0.412)	350 (32.52)	6540 (3.087)
35 (3.25)	990 (0.467)	400 (37.16)	7300 (3.445)
40 (3.71)	1100 (0.519)	450 (41.81)	8040 (3.794)
45 (4.18)	1220 (0.576)	500 (46.45)	8760 (4.134)
50 (4.65)	1330 (0.628)	550 (51.10)	9470 (4.469)
55 (5.11)	1430 (0.675)	600 (55.74)	10170 (4.800)
60 (5.57)	1540 (0.727)	650 (60.39)	10860 (5.125)
65 (6.04)	1640 (0.774)	700 (65.03)	11550 (5.451)
70 (6.50)	1750 (0.826)	750 (69.68)	12220 (5.767)
75 (6.97)	1850 (0.873)	800 (74.32)	12880 (6.079)
80 (7.43)	1950 (0.920)	850 (78.97)	13540 (6.390)
85 (7.90)	2050 (0.967)	900 (83.61)	14190 (6.697)
90 (8.36)	2150 (1.015)	950 (88.26)	14830 (6.999)
95 (8.83)	2240 (1.057)	1000 (92.90)	15470 (7.301)
100 (9.29)	2340 (1.104)	1050 (97.55)	16100 (7.598)
105 (9.75)	2440 (1.152)	1100 (102.19)	16720 (7.891)
110 (10.22)	2530 (1.194)	1150 (106.84)	17350 (8.188)
115 (10.68)	2630 (1.241)	1200 (111.48)	17960 (8.476)
120 (11.15)	2720 (1.284)	1250 (116.13)	18570 (8.764)
125 (11.61)	2810 (1.326)	1300 (120.77)	19180 (9.052)
130 (12.08)	2900 (1.369)	1350 (125.42)	19780 (9.335)
135 (12.54)	2990 (1.411)	1400 (130.06)	20380 (9.618)
140 (13.01)	3080 (1.454)	1450 (134.71)	20980 (9.901)
145 (13.47)	3170 (1.496)	1500 (139.35)	21570 (10.180)

150 (13.94)	3260 (1.539)	1550 (144.00)	22160 (10.458)
155 (14.40)	3350 (1.581)	1600 (148.64)	22740 (10.732)
160 (14.86)	3440 (1.623)	1650 (153.29)	23320 (11.006)
165 (15.33)	3530 (1.666)	1700 (157.94)	23900 (11.280)
170 (15.79)	3620 (1.708)	1750 (162.58)	24470 (11.549)
175 (16.26)	3700 (1.746)	1800 (167.23)	25050 (11.822)
180 (16.72)	3790 (1.789)	1850 (171.87)	25620 (12.091)
185 (17.19)	3880 (1.831)	1900 (176.52)	26180 (12.356)
190 (17.65)	3960 (1.869)	1950 (181.16)	26750 (12.625)
195 (18.11)	4050 (1.911)	2000 (185.81)	27310 (12.889)
200 (18.58)	4130 (1.949)		

Table 3-4 Inspection and Test Frequencies - Deaerators

Item	Internal Inspection & Operational Test	External Inspection	Hydrostatic Test
Deaerators	Every 6 years. After any repair or alteration of pressure parts. Inspection must include test and calibration of safety valves and pressure and temperature gages. Inspection must include test and calibration of safety valves and pressure and temperature gages.	Every 3 years. After any repair or alteration of pressure parts.	Tightness test every 6 years. Strength test after repair or alteration of pressure parts. \4\ Strength test in accordance with NBB, Part 3, paragraph 4.4.1. /4/ Additional times at the discretion of the inspector.
Notes: 1. In addition to the \4\ /4/ inspection, the operators of the vessel should periodically examine and test the deaerators for proper operation. Improperly operating deaerators result in excessive corrosion and cracking. The key to satisfactory operation is proper water treatment. 2. Scheduling of deaerator inspection at many facilities requires scheduled downtime for many heating and power plants. The activity should prepare to hire a company specializing in deaerator evaluations to determine if the vessel is repairable if cracking or excessive corrosion is found during the visual inspection. Options to lease deaerators prior to the inspection should be considered.			

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CHAPTER 4 BOILER INSPECTIONS

4-1 GUIDANCE.

\5\ Inspectors traveling to perform boiler & UPV inspections shall offer to conduct an in-brief and out-brief with the Public Works Department (PWD) front office. The briefings will inform the PWD Leadership about why the inspector is on base and what to expect from the visit. If the PWD is interested in an out-brief but unable to accommodate prior to the inspector departing, the inspector is to offer alternate means of addressing the out-brief requirements, such as a phone call at a mutually agreed upon time. The activity operating and maintaining the boiler provides all material and labor necessary to prepare the boilers for inspection in accordance with this UFC and the NBBI Code. The activity assists the inspector as required during the inspections. Exception to this policy occurs when the operation and maintenance of a boiler is under the cognizance of a contractor. In this case, the contractor provides material, labor, and assistance. Inspections of boilers located on Navy bases in foreign countries must comply with this UFC under the constraints of the Status Force Agreement in effect. Inspectors should not compromise \4\ on the code's intent /4/, but should exercise restraint when interpreting the fine points of the ASME Code. Obtain further guidance on foreign inspections from the NAVFAC EXWC Boiler & UPV Inspection Program Manager or the cognizant FEC Boiler & UPV LCO serving the activity.

4-2 NEWLY INSTALLED BOILERS.

4-2.1 Design Requirements.

- As applicable, all boilers shall be designed, tested and installed in accordance with UFC 3-430-07, National Board Inspection Code, ASME BPVC SEC I or SEC IV, NFPA 85 or NFPA 86, ASME CSD-1, NFPA 70, NFPA 54 or NFPA 58, NFPA 31 and ANSI Z21.13/CSA 4.9.
- Boilers shall be installed in accordance with National Board Inspection Code (NBIC), Part 1, Installation.

4-2.2 Design, Submittal Reviews & Acceptance & Certification Inspection.

- To eliminate or minimize boiler problems on all contracts involving new boiler installations, Public Works Departments shall coordinate boiler specification, design and contractor submittal reviews as well as Acceptance and Certification Inspections with the FEC Boiler & UPV LCO, NAVFAC EXWC Boiler & UPV Inspection Program Manager or local NAVFAC Inspector.
- Boiler Acceptance and/or Certification Inspections shall be conducted by a NAVFAC Certified Inspector. Contract Inspectors are not allowed to conduct initial Boiler Acceptance and/or Certification Inspections unless approved by the EXWC Boiler & UPV Inspection Program Manager.

4-3 EXTERNAL INSPECTION OF BOILERS.

Perform external inspections of boilers in accordance with \3\ \4\ Part 2, Section 2, /3/ Inspection-Detailed Requirements for In-service Inspection of Pressure-Retaining Items, in the paragraph entitled, "External Inspection" (paragraph 2.2.5) /4/ of the National Board Inspection Code. Test safety devices as part of the external inspection. Perform final testing of safety valves of power boilers on the boiler to which the valve will be mounted. The operational tests and observations of Chapter 7 are considered to be part of the external inspection.

4-4 INTERNAL INSPECTIONS OF BOILERS.

Perform internal inspections of boilers in accordance with \3\ \4\ Part 2, Section 2, /3/ Inspection-Detailed Requirements for In-service Inspection of Pressure-Retaining Items, in the paragraph entitled, "Internal Inspection" (paragraph 2.2.6) /4/ of the National Board Inspection Code. Boiler inspectors have the authority to order that boiler metal samples and/or ultrasonic tests be taken for their examination to ascertain the actual condition of the pressure parts.

4-5 BOILERS IN WET OR DRY LAY-UP.

In addition to the external and internal inspections required above, review the lay-up procedures being used to ensure that they conform to the requirements of Appendix E.
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CHAPTER 5 UNFIRED PRESSURE VESSEL INSPECTIONS

5-1 GUIDANCE.

The activity operating and maintaining the pressure vessel provides all material and labor necessary to prepare the unfired pressure vessel for inspection in accordance with this UFC and the NBBI Code. The activity assists the inspector as required during the inspections. Exception to this policy occurs when the operation and maintenance of the pressure vessel is under the cognizance of a contractor. In this case, the contractor provides material, labor, and assistance. Inspections of pressure vessels located on Navy bases in foreign countries must comply with this UFC under the constraints of the Status Force Agreement in effect. Inspectors should not compromise safety issues, but should exercise restraint when interpreting the fine points of the ASME Code. Obtain further guidance on foreign inspections from the respective (East or West) NAVFAC Senior Boiler Inspector or the cognizant FEC serving the activity.

5-2 EXTERNAL INSPECTIONS OF UNFIRED PRESSURE VESSELS.

\5\ Perform external inspections of unfired pressure vessels in accordance with \3\ Part 2, Section 2, /3/ Inspection-Detailed Requirements for In-service Inspection of Pressure-Retaining Items, in the paragraph entitled, "External Inspections" (paragraph 2.3.3) of the National Board Inspection Code.

5-3 INTERNAL INSPECTIONS OF UNFIRED PRESSURE VESSELS.

Perform internal inspections of unfired pressure vessels in accordance with \3\ Part 2, Section 2, /3/ Inspection-Detailed Requirements for In-service Inspection of Pressure-Retaining Items, in the paragraph entitled, "Internal Inspections" (paragraph 2.3.4) of the National Board Inspection Code. Inspectors have the authority to order metal samples and/or ultrasonic tests for their examination to ascertain the actual condition of the vessel.

\3\

5-4 MILITARY SPECIFICATION (MILSPEC) PRESSURE VESSELS

/3/

5-4.1 Internal and External Inspections.

Examine vessels in accordance with the paragraphs in this chapter entitled, "External Inspections of Unfired Pressure Vessels" and "Internal Inspections of Unfired Pressure Vessels". View internal surfaces using \3\ remote viewing equipment (borescope/fiberscope), /3/ if necessary, supplied by inspector and/or activity or by another acceptable method. Record areas of wear, corrosion, abuse, and/or damage and attach to the inspection report. /5/

\4\

5-4.2 Ultrasonic Examination Military Specification.

/4/

(\4\ For /4/ vessels constructed per military specifications, the ultrasonic examination procedures in *Naval Ship's Technical Manual* S9086-SY-STM-010, Chapter 551, 1.14.1.2 "Testing" may be used in lieu of the following.) Subject vessels to an ultrasonic thickness measurement check. The activity performs the checks while the inspector observes. Make the checks at the point of tangency between the cylinder and the end heads. Take measurements at 2-inch (50.8 mm) intervals around the circumference of the vessel. Take measurements on a line along the head from the point of tangency, across the end of the head to the far point of tangency; take measurements along a similar line at right angles to the first at the end of the head. Take lines of measurement at each end of the vessel. Arrange the lines so that the vessels low point, where water may collect and corrosion may form, is measured. Take measurements every \2\ three /2/ years. Ultrasonic measurement points for vessel configurations other than spherical or cylindrical must be approved by the inspector. The lines and points of measurement will be identical at each inspection. The activity will maintain measurement records. The vessel will not be derated nor certified if the measured thickness is less than that prescribed by the standard by which it was constructed, for example, ASME Section VIII, Division I, ASME Section VIII, Division 2, or Military Specification \4\ MIL-DTL-22606 /4/, *Flask and End Plugs, Compressed Gas for Air, Oxygen, and Nitrogen* (SHIPS).

\3\ /3/

\4\

5-4.2.1 Ultrasonic Examination ASME Division I & Division II Vessels.

Use of ultrasonic thickness (UT) testing in addition to internal inspection is highly encouraged and should be performed by the inspector.

/4/

5-4.3 Variations.

\5\ Address requests for variations in the inspection and testing procedures for MILSPEC pressure vessels to the \4\ NAVFAC /4/ Boiler Inspection Certification Board with a copy to the NAVFAC EXWC Boiler & UPV Inspection Program Manager. /5\ \3\ /3/ Appendix B depicts the relative position of the Boiler Inspection Certification Board in the \4\ NAVFAC /4/ boiler and pressure vessel inspection quality assurance organization.

5-5 DEAERATORS.

The purpose of a deaerating heater (deaerator) is to remove non-condensable gases and dissolved oxygen from the feedwater. A properly operating deaerator will have no

more than 10 ppb (parts per billion) O₂ in the outlet water. Deaerators are subject to thermal cycling and corrosion. Proper operation of deaerators is extremely important because of their critical function in protecting the boiler system from corrosion. Catastrophic failure of deaerators is usually attributable to cracks forming longitudinally and transversely to the heat affected zones of the welds. Deaerators are potentially a great danger because of their location at the top of the heating or power plant. To ensure deaerators provide safe reliable service, they require periodic visual inspections of their internal and external surfaces. If visual inspection reveals cracking, then a company specializing in deaerator inspection must perform an ultrasonic examination of the entire vessel and wet fluorescent magnetic particle examinations of the heat affected zones of the welds, prior to certification, to determine if continued operation of the vessel is safe. Subject repairs to post-weld heat treatment and hydrostatic testing prior to certification.

\3\

5-6 LIQUIFIED PETROLEUM GAS (LPG) TANKS.

/3/

\5\ Non-mandatory guidelines may be found in the *National Board Inspection Code*, \4\ SUPPLEMENT 7, Page 285, "Inspection of Pressure Vessels in Liquefied Petroleum Gas (LPG) Service." /4/

5-6.1 External Inspection.

Examine LPG (propane, butane, etc.) tanks in accordance with paragraph \4\ S7.4, page 286 /4/. Record areas of wear, corrosion, abuse, and/or damage and attach to the inspection report. Check capacity rating on safety relief valve nameplate for proper valve discharge.

5-6.2 Internal Inspection.

These tanks contain a non-corrosive liquid, and have virtually no internal corrosion. Inspect vessels by means of an ultrasonic thickness measurement check. When there is a reason to suspect an unsafe condition, the suspect parts of the pressure vessel shall be inspected and evaluated in accordance with paragraph S7.5, page 286. /5/

5-6.3 Hydrostatic Test.

Perform hydrostatic tests after any repair or alteration of pressure parts (additional times are at the discretion of the inspector). Prior to performing a hydrostatic test, verify support structure is adequate to support the weight of the hydrostatic liquid. If a hydrostatic test is not possible, request approval for a pneumatic test from the NAVFAC Boiler Inspection Certification Board.

5-6.4 Safety Relief Valves.

Fit LPG tanks with ASME \4\ Section VIII, Division I /4/ certified, or Underwriters Laboratories UL 132 stamped, spring-loaded safety relief valves. Do not fit safety relief valves for LPG service with lifting devices. Replace or bench test safety relief valves every 6 years of service. This will be done by a company authorized to perform such tests on either ASME or UL safety valves.

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CHAPTER 6 PRESSURE TESTS

6-1 HYDROSTATIC TESTS.

/5/ Make hydrostatic tests in accordance with the paragraphs below and the National Board Inspection Code, Part /3/ /4/ 2, Section 4, /3/ Inspection-Examinations, Test Methods, and Evaluations, the paragraph entitled, "Pressure Testing" (paragraph 4.3.1). /4/

6-1.1 Strength Test Pressure.

Base strength tests on the maximum allowable working pressure (MAWP) of the boiler or pressure vessel as marked or as recalculated as a result of previous tests. All boilers and unfired pressure vessels covered by ASME Section I or Section VIII, Division 1 subjected to internal pressure will be tested hydrostatically at a pressure not greater than 1-1/2 times the highest safety valve popping pressure or 1-1/2 times the MAWP, whichever is less. /5/ Unfired pressure vessels constructed by the standards of ASME Section VIII, Division 2 subjected to internal pressure will be tested hydrostatically at a pressure of 1-1/4 times the highest safety valve popping pressure or 1-1/4 times the MAWP, whichever is less. Exceptions follow:

- Vessels not capable of supporting the weight of liquids (see Chapter 10, MAWP and the paragraph in Chapter 6 entitled, "Pneumatic Tests").
- Vessels not readily dried that are to be used in services where traces of the testing liquid cannot be tolerated (see the paragraph in Chapter 6 entitled, "Pneumatic Tests").
- The test pressure for enameled vessels will be at least equal to, but need not exceed, the maximum allowable working pressure marked on the vessel.
- The test pressure for glass-lined vessels will not exceed the maximum allowable working pressure.
- The test pressure for cast iron vessels will be 2 times the maximum allowable working pressure for maximum allowable working gage pressures greater than 30 psig (206.84 kPa) and 2-1/2 times the maximum allowable working pressure but not to exceed 60 psig (413.69 kPa) (gage pressure) for maximum allowable working gage pressures under 30 psig (206.84 kPa).
- The test gage pressure for vessels and piping in high-pressure air systems (3,000 psig (20684.27 kPa) and over) will not exceed 1-1/2 times the maximum allowable working pressure of the system.

6-1.1.1 Vacuum Vessels.

Single-wall vessels designed for a vacuum or partial vacuum only, and chambers of multi-chamber vessels designed for vacuum or partial vacuum only, need not be subjected to a hydrostatic test.

6-1.1.2 Special Combination Units.

Test special combination units so that each pressure chamber (vessel) receives the required hydrostatic test without pressure in the others.

6-1.1.3 Hydrostatic Tests with Fluids Other than Water.

Test procedures for fluids other than water must be approved by the \4\ NAVFAC /4/ Boiler Inspection Certification Board.

6-1.2 Tightness Test Pressure.

Perform the tightness test pressure at above the normal operating pressure, but not exceeding the lowest safety valve set pressure. Safety valves may be blocked or gagged for this test.

6-1.3 Precautions

- Direct connection of the boiler to the water system is prohibited, where an approved back-flow prevention device is not installed, to prevent contamination of the potable water system.
- Provide a power-driven or hand pump for application of the test pressure if the boiler feed pump will not deliver the test pressure. The test pump will be provided by the activity or its utilities contractor and operated and inspected to ensure that it is in proper working condition prior to connecting it to the boiler or the vessel.

6-1.4 Possible Deformation.

If any indications of probable permanent deformation are observed, cease the test until the weak parts have been properly strengthened. If necessary repairs are not practicable, apply a new test, progressing up to 20 psi (138 kPa)) less than the pressure at which the preceding test ceased. If the test is successful, make the new maximum allowable working pressure two-thirds of the test pressure, and reset or replace the safety valves in accordance with the new maximum allowable working pressure.

6-1.5 Hold Pressure.

For all boilers, UPVs and heat exchangers, pressure should not drop more than 10 percent within 15 minutes. If the pressure drop exceeds 10 percent, repair leaks and repeat the test. If the pressure drop is within 10 percent and inspection does not reveal

leaks in the pressure parts, assume that the leaks are through the isolation valves, manholes, and handholes.

6-1.6 Inspection Under Pressure.

Inspect all joints and connections for leaks or other defects while the vessel is under pressure. The pressure held during this inspection need not necessarily be equal to the hydrostatic test pressure, but will not be less than two-thirds of the hydrostatic pressure. Where the test pressure exceeds the MAWP of the item, the test pressure must be reduced to the MAWP for close examination by the inspector.

6-1.7 Permanent Deformation.

Where permanent deformation of the unfired pressure vessel shell or heads, or of the boiler shell or drum has occurred, whether as a result of hydrostatic pressure tests or from normal operating pressures, make repairs only after it has first been definitely determined that such repairs are practicable and economical. After approved repairs of this nature have been completed, recalculate the maximum allowable working pressure of the vessel or boiler according to the requirements of Chapter 10. Prior to returning the vessel or boiler to service, perform a hydrostatic test, based on the recalculated maximum allowable working pressure.

6-1.8 Gaskets.

Replace manhole and handhole gaskets after performing the hydrostatic strength test unless a non-compressible metal gasket is used.

6-2 PNEUMATIC TESTS.

Perform a pneumatic test only in extreme cases, when a hydrostatic test is not permissible. \5\ Do not perform pneumatic tests without the written approval of the \4\ NAVFAC /4/ Boiler Inspection Certification Board (NBICB). This approval can be granted by submitting a request in writing to \4\ NAVFAC /4/ via the NAVFAC EXWC Boiler & UPV Inspection Program Manager. Include the proposed pneumatic test procedures for each particular test in the request. Pneumatic test procedures for each particular test are in UG-100 for Section VIII Division 1 vessels, and in Article T-4 for Section VIII Division 2 vessels. The pneumatic test pressure will be 1.25 times the MAWP for Division 1 vessels and 1.15 times the MAWP for Division 2 vessels. A pneumatic test may be used in lieu of the hydrostatic test prescribed in the paragraph in Chapter 6, entitled, "Hydrostatic Tests", with \4\ a NAVFAC EXWC Boiler & UPV Inspection Program Manager /4/ /5/ approval as follows:

- For vessels that are so designed and/or supported that they cannot safely be filled with water.
- For vessels not readily dried that are to be used in services where traces of the testing liquid cannot be tolerated and the parts of which have, where possible, been previously tested by hydrostatic test pressure.

6-3 PRESSURE TEST RESULTS

6-3.1 Yielding During Test.

If yielding occurs, and examination shows the vessel is in satisfactory condition, establish the MAWP as 50 percent of the pressure at yielding.

6-3.2 No Yielding During Test.

If yielding does not occur, increase the pressure step by step until the required test pressure has been reached. Then hold the pressure for a sufficient time to permit inspection of the vessel for leaks or signs of failure.

6-3.3 Inspection Under Pressure.

If permanent deformation occurs, replace or repair the vessel. If permanent deformation occurs in a vessel not constructed to the ASME *Boiler and Pressure Vessel Code*, drill and discard the vessel.

CHAPTER 7 OPERATIONAL TESTS

7-1 GUIDANCE.

Following internal inspection, as part of the external inspection, bring the boiler or unfired pressure vessel up to operating pressure and temperature. Inspect, and cause to function under operating conditions, all automatically and manually operated control devices provided for controlling the operation of the vessel, steam or water pressure, hot water temperature, combustion, and boiler water level. Inspect under operating conditions all associated valves and piping, pressure and temperature indicating devices, metering and recording devices, and all boiler auxiliaries. Boilers firing oil or gas without fully automatic or semiautomatic controls must have a NAVFAC waiver to be certified. All combustion controls attached to the boiler regardless of the fuel being fired must be in good working order or the inspection certificate will be withheld. Inspections and tests of boilers may be made with the main steam or hot water distribution valves closed or open, as necessary, to fire the boiler and operate it under normal operating conditions. Testing the function of automatically or manually controlled devices and apparatus that may interfere with the distribution requirements should be done with the main steam or hot water distribution valves closed, as applicable.

7-1.1 Purpose.

These additional inspections and tests allow the inspector to discover any inefficient or unsafe operation or maintenance of the vessel or of the boiler or its auxiliaries that may be evidenced under operating conditions.

7-1.2 Conditions to be Reported.

Report all deficiencies requiring adjustment, repair, or replacement, and all conditions indicating excessive operating and maintenance cost. **Withhold certificates until the deficiencies are corrected.**

7-2 FIRING EQUIPMENT.

Inspect, for any deficiency that may be evidenced under operating conditions, the operation of all firing equipment including oil burners, gas burners, fuel injectors, fuel igniters, coal stokers, and feeders, burner safety controls and other such equipment provided to introduce fuel into the boiler furnace and to ignite the fuel. Inspect the flame pattern to ensure that it is consistent with manufacturer specifications. All fuel leaks must be repaired before the certificate is issued.

7-3 CONTROLS.

Inspect the operation of all controls directly associated with the operation and safety of the boiler for any defects preventing proper operation. These controls include such items as unloading valves, high-pressure cutout devices, high temperature cutout devices, low-pressure cut-in devices, and burner safety controls. Inspect the operation

of combustion controls, steam pressure controls, water temperature controls, and feedwater controls. Make sure that the ability of the combustion control and steam pressure control to maintain proper steam pressure (or water temperature in high temperature water installations) and air-fuel ratio is demonstrated throughout the capacity range of the boiler and the load swings encountered in the operation of larger boilers. \4\ Ensure that the air-fuel ratio is checked \3\ during the inspection /3/ \3\ using either CO₂ or O₂ /3/ measuring devices and that the results are consistent with manufacturer recommendations or appropriate industry or Navy guidelines. CO \3\ and stack temperature /3/ will also be checked. Ensure that the boiler is properly tuned for efficient operation and that CO emissions are optimized consistent with manufacturer specifications or appropriate industry or Navy guidelines. /4/ Check fully-automatic boiler controls for the proper programming sequence and timing with respect to pre-purge, ignition, pilot proving, flame proving, and post-purge periods. Check the operation of flame failure and combustion air failure devices to ensure that they properly shut off the supply of fuel; this should be done by simulating a flame failure (by manually shutting off the fuel or by other means) and by observing the operation of the controls, solenoid valves, diaphragm operated valves and so forth, which are to operate during a flame failure. The installation of the boiler and controls including the fuel train and the operation of automatic burner management systems must comply with the *National Fire Codes* (NFC), including NFPA 85, *Boiler and Combustible Systems Hazards Code*; and ASME CSD-1 in effect at the time of installation of the boiler. Inspect feedwater controls, and check the ability of the controls to maintain proper water level throughout the range of capacity with load swings. Check the operation of the low-water fuel cutoff and automatic water feeding devices by draining the float bowl, lowering the boiler water level, and performing the necessary steps to cause these devices to function to ensure that they operate properly.

7-4 PIPING AND PIPING CONNECTIONS.

While the boiler (or vessel) is operating \4\ at full operational pressure /4/, examine all steam and water pipes, including connections to the water columns and all associated piping, for leaks. If any leaks are found, determine whether they are the result of excessive strains due to expansion, contraction, water hammer, or other causes. Look for undue vibration, particularly in piping connections to the boiler and the vessel. Where excessive vibration is found, examine connections and parts for a tendency to crystallize.

7-5 DEVICES

7-5.1 Temperature Indicating Devices.

Observe all temperature indicating devices for indications of excessive temperatures, particularly during and immediately following the time when high load demands are made on the boiler and the vessel.

7-5.2 Metering and Recording Devices.

While the boiler is operating under normal conditions, observe the operation of all metering and recording devices. When there is evidence that any such device is not functioning properly, it must be adjusted, repaired, or replaced as necessary.

7-6 VALVES

7-6.1 Blow-Down Valves.

Test the freedom of each blow-down valve and its connections by opening the valve and blowing down the boiler for a few seconds. Determine whether the valve is excessively worn or otherwise defective, and whether there is evidence of restrictions in the valve or connected piping preventing proper blow-down of the boiler.

7-6.2 Stop and Check Valves.

While the boiler (or vessel) is operating, inspect the operating condition of each stop and check valve where possible. Serious defects of externally controlled stop valves may be detected by operating the valve when it is under pressure. Similarly, defects in check valves may be detected by listening to the operation of the valve or by observing any excessive vibration of the valve as it operates under pressure.

7-6.3 Pressure Reducing Valves.

While there is pressure on the system, open and then close the by-pass valve, as safety and operating conditions permit, and observe the fluctuation of the pressure gage pointer as an aid in determining possible defects in the operation of the pressure reducing valve or the pressure gage. Look for evidence that may indicate improper condition of the relief or safety valves provided for pressure reducing valves.

7-6.4 Safety and Safety Relief Valves.

Inspect the valves for evidence of leaks and proper operation. Check the popping pressure and blow-down of safety valves by allowing the pressure of the boiler to rise so that the valves lift. Inspect the valve drains and discharge to ensure that they are free from obstructions and installed according to the ASME Code. For multiple valve operations, where an accumulation test cannot be accomplished, check the freedom of the valve to lift using the lifting lever provided the pressure is within 10 percent of the valve set pressure. Similarly, check safety relief valves by using the lifting lever. Proper installation and operation is necessary prior to issuing an inspection certificate.

7-7 BOILER AUXILIARIES.

While the boiler is operating under normal conditions, observe the operation of all boiler auxiliaries for any defects that may prevent the proper functioning of the boiler or which may indicate a lack of proper maintenance. \5\ Inspectors shall check for proper combustion air supply, fuel supply, air water separators, expansion tanks, distribution

pipng supports, guides and anchors. /5/ Discourage the unnecessary use of multiple auxiliaries or the use of a large auxiliary during a light load period (when a smaller auxiliary could be substituted.) Steam leaks, wastage to atmosphere, and so forth, should be called to the attention of the operating personnel. Particular attention should be given to deaerator venting practice. Venting should be held to the minimum required to preclude oxygen entrainment in the feedwater. When intermittently operating condensate pumps are used, look for any tendency toward the creation of a vacuum when a pump starts. If this happens, the installation of a small continuously operating, float throttled, condensate pump (in parallel with intermittently operating pumps) will ensure a condensate flow at all times. If there are a number of intermittently operating condensate pumps, it may be possible to convert one of them (if of small enough capacity) to continuous throttled operation.

7-8 BOILER AND FEEDWATER TREATMENT.

Observe the operation of equipment provided for boiler and feedwater treatment, and check the materials and procedures used for boiler and feedwater treatment to ensure adequate protection against scale and corrosion in the boiler, plant, equipment, and distribution system. The internal condition of the boilers, as evidenced from inspections required under Chapter 4, the paragraph entitled, "Internal Inspections of Boilers," is the determining factor regarding the adequacy of materials, and procedures used in boiler and feedwater treatment. Withhold the certificate if an effective boiler water treatment program is not being implemented.

7-9 FUEL HANDLING PRACTICES.

Check the fuel handling practices and make recommendations toward the elimination of multiple handling, heating of tanks not in use, and the simultaneous use of heaters in a duplex fuel oil pump and heater set where load conditions do not require this procedure. Avoid heating entire tanks. Limit heating within a tank to heating at the suction point only. With respect to residual fuel oil tanks, frequent tank changes (utilizing the full capacity of the tank, from max full to max drawdown, extending to the tank bottom) should be encouraged as a means of precluding sludge buildup.

CHAPTER 8 REPAIRS AND ALTERATIONS

8-1 GUIDANCE.

Repairs to the equipment may be necessary before certification. The activity may already be aware of necessary repairs prior to any inspections and tests. Prior to issuing a certificate, all deficiencies that cause an unsafe condition must be corrected. The repairs must be completed in accordance with the applicable code. For pressure parts, repairs must be performed in accordance with the NBBI and ASME Codes. For combustion control safeguards (burner safety controls), the equipment must be repaired to meet the requirements of the NFPA 85 or ASME CSD-1, as applicable. When deficiencies are found in the pressure parts of MIL-SPEC pressure vessels or pressure vessels of undetermined code origin, the vessels must be rendered inoperable in such a way as to prevent further use. To ensure safe operating conditions, repairs to flame safeguard equipment should only be made by the manufacturer or his authorized representative.

8-2 CONTRACTOR REPAIRS.

NAVFAC \3\ activities are allowed /3/ the option of using Navy welders qualified in accordance with the applicable Military Standards to make repairs and alterations to boilers and unfired pressure vessels, or a contractor holding a NBBI (R) stamp in accordance with \4\ Part 3, Section 1, Repairs and Alterations – General and Administrative Requirements of the *National Board Inspection Code*. For welding repairs or alterations, the contractor, or Navy organization furnishing the qualified welder, must complete a Navy documentation equivalent to the /4/ National Board Form R-1 and stamping and nameplate attachment is required.

\4\ /4/

8-3 SETTING SAFETY AND RELIEF VALVES.

The setting of safety valves of power boilers and relief valves of UPVs within the limits of ASME Section I and VIII are adjustments. Other changes in settings, welding, or machining are repairs. Repairs and adjustments of these valves are not valid unless performed by the manufacturer or a valve repair company. **Repairs by the Government are prohibited.** The contractor is required to affix a National Board VR nameplate to the repaired valve. Whether the valve is repaired or adjusted; document the breaking of the seal, the setting of the valve, and resealing of the valve. Power boilers and UPVs are not certifiable unless all safety and relief valves are sealed and tagged. Bench testing the valve with no adjustments may be performed by a non-ASME shop/Government. It is required that documentation be provided including the valve's nameplate data, pressure at which it opened, date and time of test and the signature of the tester.

8-4 RECORDS.

ANSI/NB-23, National Board Inspection Code, \4\ Part 3, Section 5, Repairs and Alterations – Certification/Documentation and Stamping gives the formats for the various /4/ forms: Form R-1 Report of Welded Repair, Form R-2 Report of Alteration, Form R-3 Report of Parts Fabricated by Welding, Form R-4 Report Supplementary Sheet. If the information in these forms is acceptable to the inspector, the repairs or alterations can proceed and be inspected. Upon inspector approval of the work, the activity must make a permanent record of the repairs or alterations.

CHAPTER 9 INSPECTION CERTIFICATES AND REPORTS

9-1 PROCEDURES FOR SUBMITTING REPORTS AND FORMS.

The following hard copy reports and forms, or NAVFAC approved computer reports, are for use in the inspection and testing of boilers and unfired pressure vessels. An example of each is contained in Appendix E.

9-1.1 Inspection Reports - Boilers and Unfired Pressure Vessels.

The applicable report is to be completed by the inspector to record the condition of the boiler or unfired pressure vessel, the tests performed, and the issuance of the certificate. \5\ \4\ Figure F-1 inspection reports for boilers and unfired pressure vessels, respectively, must be used when filling out the inspection report. Figures F-2 and F-3 are example field checklists for boilers and unfired pressure vessels used by some regional inspectors. /4/ One copy is to be forwarded to the Public Works Department and retained in the activity files for a period of at least \2\ three /2/ years and one copy forwarded to the Region FEC Boiler & UPV LCO \2\ \4\ /4/ /2/ within 30 days of the inspection. The inspector must promptly notify the Public Works Officer of the activity whenever inspection reports indicate \4\ code deficiencies, environmental compliance deficiencies, /4/ pressure reductions, or unserviceability.

9-1.2 Inspection Certificate for Boilers - Unfired Pressure Vessels; NAVFAC Form 9-11014/32(09/15).

A current and valid NAVFAC certificate \4\ /4/ must be used and must be posted on, or near, the equipment, \3\” BY **THE CERTIFYING INSPECTOR**” /3/ under an activity provided clear protective covering. \4\ Figure F-4 certificate form must be used when filling out the inspection certificate. /4/ Operation of the equipment without the certificate is not authorized. The certificate will be issued or withheld under the following conditions:

- No Deficiencies: The inspector will complete and sign after the test inspection.
- Deficiencies Not Affecting Operating Safety: May be issued, but correction must be recorded on the Inspection Report.
- Deficiencies Affecting Operating Safety: Withheld until corrected and re-inspected. The activity Public Works Officer must be notified in writing listing the specific deficiencies.
- Pressure Reduction: Issued for the reduced working pressure. Oral notification, confirmed in writing, must be made by the inspector to the activity Public Works Officer.
- Unserviceable: No certificate may be issued. The inspector must notify the activity Public Works Officer in writing of the deficiencies.

- Vessels of Unknown Origin: Certificate may be issued provided it is accompanied by a plan of action with milestones to replace the vessel prior to the next inspection cycle. /5/

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CHAPTER 10 MAXIMUM ALLOWABLE WORKING PRESSURE

10-1 GUIDANCE.

The MAWP will be determined as described in the *National Board Inspection Code*. The following paragraphs provide further guidance on MAWP. Defects or damage discovered during the inspection must be repaired in accordance with Chapter 8. If, in the judgment of the inspector, a steam or hot water boiler or vessel is unsafe for operation at the pressure previously approved, reduce the pressure, make proper repair, or condemn the boiler or vessel.

10-2 STANDARD BOILERS.

Including expansion drums on high temperature water installations. The maximum allowable working pressure of a boiler built in accordance with the ASME BPVC Code must not, in any case, exceed the pressure indicated by the manufacturer's identification stamped or cast upon the boiler or upon a plate secured to it. Specific requirements governing the maximum allowable working pressure on the following standard boilers must be followed.

10-2.1 Standard Watertube Boilers.

The maximum allowable working gage pressure on a standard watertube boiler, the tubes of which are secured to cast iron or malleable iron headers, or which have cast iron mud drums, must not exceed 1103.16 kPa (160 psig).

10-2.2 Standard Cast Iron Steam Boilers.

The maximum allowable working gage pressure for a standard cast iron steam boiler must not exceed 15 psig (103.42 kPa). Standard cast iron hot water boilers operating at temperatures not to exceed 250 degrees F (121.1 degrees C) may be operated at gage pressures up to 160 psig (1103.61 kPa).

10-3 NONSTANDARD BOILERS

10-3.1 Nonstandard Riveted Boilers.

The maximum allowable working pressure on the shell of a nonstandard riveted heating boiler must be determined in accordance with the Code, except that in no case can the maximum allowable working gage pressure of a steam heating boiler exceed 103.42 kPa (15 psig,) or a hot water boiler exceed 160 psig (1103.16 kPa) at a temperature not exceeding 250 degrees F (121.1 degrees C).

10-3.2 Nonstandard Welded Boilers.

The maximum allowable working gage pressure of a nonstandard steel or wrought iron heating boiler of welded construction must not exceed 15 psig (103.42 kPa) for steam.

For other than steam service, calculate the maximum allowable working pressure in accordance with the Code.

10-3.3 Nonstandard Cast Iron Boilers.

The maximum allowable working gage pressure of a nonstandard boiler composed principally of cast iron must not exceed 15 psig (103.42 kPa) for steam service, or 30 psig (206.84 kPa) for hot water service. The maximum allowable working gage pressure of a nonstandard boiler having cast iron shell or heads and steel or wrought iron tubes must not exceed 15 psig (103.42 kPa) for steam service or 30 psig (206.84 kPa) for hot water service.

10-4 CALCULATIONS OF MAXIMUM ALLOWABLE WORKING PRESSURE.

When inspection indicates that the thickness of the plate or the strength of any joint is less than that on which the current maximum allowable working pressure is based, or when it is impracticable to apply the required hydrostatic test, calculate a new maximum allowable working pressure in accordance with the rules of the Code. The following factors of safety must be used and increased by the inspector if the condition of the boiler demands it:

- The lowest factor of safety permissible on existing installations is be 4.5 except for horizontal return tubular boilers having continuous longitudinal lap seams more than 12 feet (3.7 m) in length where the factor of safety is 8, and when this latter type of boiler is removed from its existing setting, it must not be reinstalled for gage pressures in excess of 15 psig (103.42 kPa).
- Reinstalled or secondhand boilers have a minimum factor of safety of 6 when the longitudinal seams are of lap riveted construction, and a minimum factor of safety of 5 when the longitudinal seams are of butt and double strap construction.
- The maximum allowable working pressure for a vessel in operation must be computed with the appropriate formulas in the Code, using dimensions actually determined by the inspection for the thickness and twice the estimated corrosion allowance before the next inspection, and making suitable allowance for the other loadings enumerated in the Code to be considered in the design of a vessel. The maximum allowable working pressure of vessels designed and built with one or more openings, for which the closures are auxiliary equipment not part of the pressure vessels, must be determined only after due consideration of the auxiliary equipment to be used as closures. The minimum factor of safety must not be less than 4 and must be increased by the inspector if the condition and safety of the vessel demand it. The condition of the vessel and the particular service to which it is subject are the determining factors.

10-5 FACTOR OF SAFETY.

The factor of safety is "built in" to the ASME Code formulas of Section I. For reference, the original formula is:

EQUATION: $P = (TS \times t \times E) / (R \times FS)$

Where:

P = pressure in psi
TS = tensile strength, psi
t = thickness, inches
E = efficiency of the longitudinal seam
R = inside radius, inches
FS = factor of safety

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CHAPTER 11 MISHAP OR PROPERTY DAMAGE REPORTING

11-1 REPORTING REQUIREMENTS.

OPNAVINST 5102.1C, *Mishap Investigation and Reporting*, requires that incidents which satisfy the following criteria be reported to the activity Safety Office for investigation and reporting to the Naval Safety Center:

- \5\ Damage to property involving a repair or replacement cost equal to or exceeding \$50,000. /5/
or
- Any incident involving a lost time employee mishap.

This instruction also encourages reporting of incidents where serious injury to Navy personnel was possible or if there was a "lesson to be learned."

11-2 INFORMATION COPIES.

\5\ A copy of the required report for all incidents relating to the construction, repair, operation and maintenance of the boilers and unfired pressure vessels covered by this UFC must be forwarded to the NAVFAC EXWC Boiler & UPV Inspection Program Manager for information. /5/

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APPENDIX A REFERENCES

ASME INTERNATIONAL

<http://www.asme.org/>

Boiler and Pressure Vessel Code

ASME CSD-1, Control and Safety Devices for Automatically Fired Boilers

COMPRESSED GAS ASSOCIATION (CGA)

<http://www.cganet.com/>

G-6.1, Standard for Insulated Liquid Carbon Dioxide Systems at Consumer Sites

G-6.7, Safe Handling of Liquid Carbon Dioxide Containers That Have Lost Pressure

DEFENSE LOGISTICS AGENCY (DLA)

DLAI 4145.25/ AR 700-68/ NAVSUPINSTR 4440.128D/ AFJMAN 23-227(I)/ MCO 10330.2D, *Storage and Handling of Liquefied and Gaseous Compressed Gasses and their Full and Empty Containers*, 16 June 2000,
<http://www.dla.mil/issuances/Documents/i4145.25.pdf>

\4\

DEPARTMENT OF THE AIR FORCE

\5\ AFMAN 32-1068, *Heating Systems and Unfired Pressure Vessels* /5/

DEPARTMENT OF THE ARMY

<http://armypubs.army.mil/eng/>

TM 5-650, *Central Heating Plants*

TM 5-642, *Small Heating Systems*

\5\ AR 420-1, *Army Regulations* /5/

/4/

DEPARTMENT OF DEFENSE

MIL-DTL-22606, *Flask and End Plugs, Compressed Gas - Air, Oxygen, and Nitrogen*,
<http://quicksearch.dla.mil/>

UFC 3-240-13FN, *Industrial Water Treatment Operation and Maintenance*,
<http://dod.wbdg.org/>

DEPARTMENT OF THE NAVY

<http://doni.daps.dla.mil>

CNO Letter, Inspection of Boilers, Unfired Pressure Vessels, Elevators, Dumbwaiters and Escalators, 22 October 1970

OPNAVINST 5102.1D, Navy and Marine Corps Mishap and Safety Investigation, Reporting, and Record Keeping

\5\ NAVFAC Headquarters Technical Letter of Authority, Boiler & UPV Inspection (9/18/15) /5/

NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

<http://www.nationalboard.org>

\5\ ANSI/NB-23, National Board Inspection Code Part 1, 2, 3 /5/

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

<http://www.nfpa.org>

National Fire Codes

NFPA 85, Boiler and Combustion Systems Hazards Code

\5\ NFPA 31, Standard for the Installation of Oil-Burning Equipment

NFPA 54, National Fuel Gas Code

NFPA 58, Liquefied Petroleum Gas Code /5/

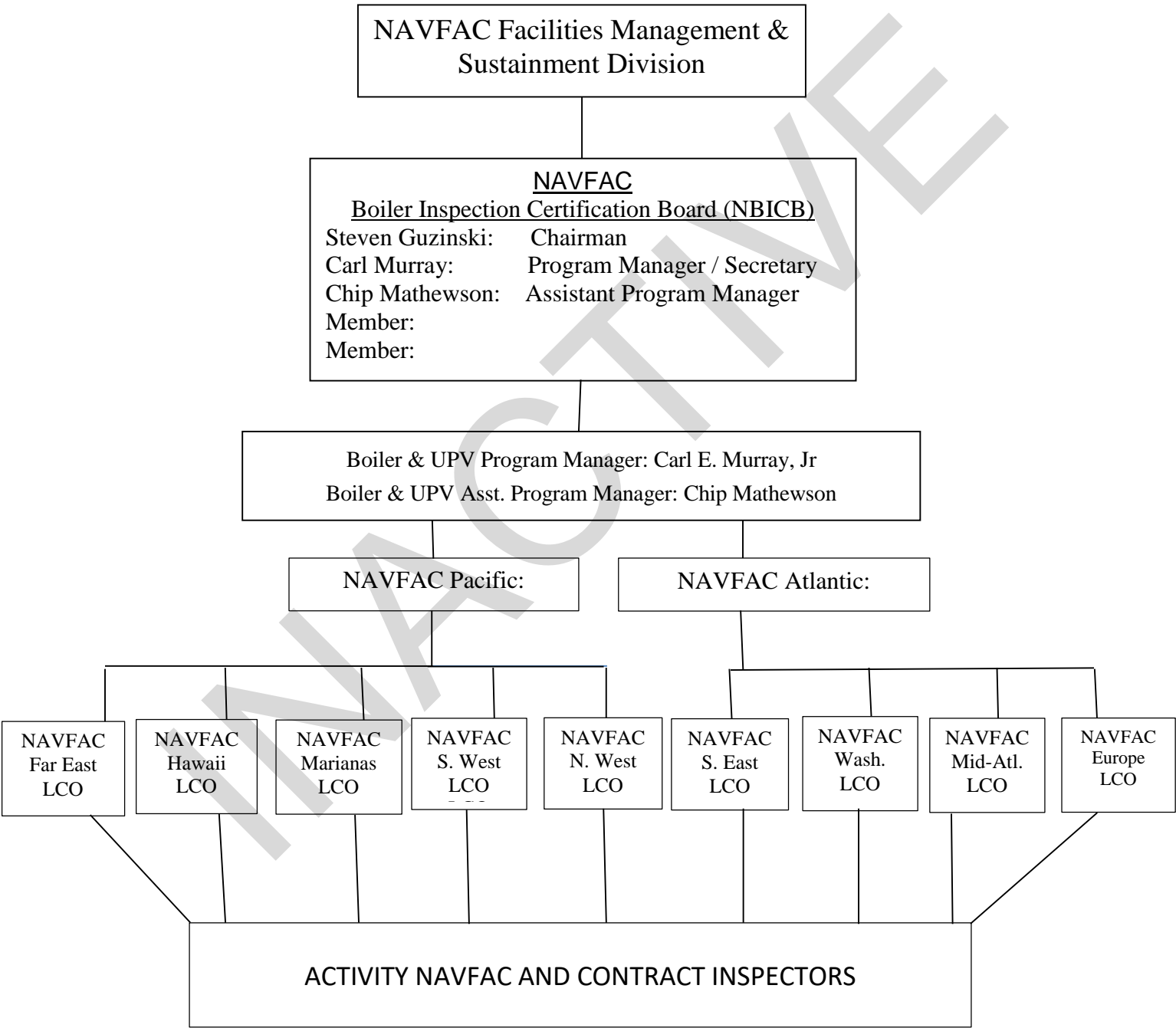
NAVAL SUPPLY SYSTEMS COMMAND

Navy Ship's Technical Manual, S9086-SY-STM-010, Chapter 551, Compressed Air Plants and Systems

\4\ /4/ \5\

APPENDIX B NAVFAC BOILER AND UNFIRED PRESSURE VESSEL INSPECTION PROGRAM

Figure B-1 Quality Assurance Organization



NAVFAC Facilities Engineering Command (FEC) PW Core Boiler & UPV Lead Certifying Official (LCO):

- Compile and update inventory and certification status of all Boilers & UPVs for all Navy and Marine Corps Installations in the FEC AOR.
- Provide annual report to NAVFAC Boiler & UPV Program Manager, carl.murray@navy.mil, located at NAVFAC EXWC
- Arrange for the performance of inspection services by a Navy or contract inspector located near the requesting activity. When assistance is required, such assistance will be rendered on a reimbursable basis. The requesting activity is responsible for providing the funds to accomplish the inspections. Inspector performing inspections needs to coordinate with local PWD shops or BOS contractor for proper support. /5/

\5\

APPENDIX C DUTIES OF THE NAVFAC EXWC BOILER & UPV INSPECTION PROGRAM MANAGER

The duties of the NAVFAC EXWC Boiler & UPV Inspection Program Manager are:

- Monitoring inspectors by endorsing the credentials of inspector candidates, licensing, and reissuing licenses to NAVFAC certified inspectors every two years.
- Verifying and endorsing the credentials, experience, and qualifications of Navy employed inspector candidates prior to forwarding this information to the NBICB.
- Monitoring inspections to ensure compliance with UFC 3-430-07. The EXWC Boiler & UPV Inspection Program Manager along with FEC Boiler & UPV LCO should perform the actual monitoring.
- Acting as Secretary of the NBICB, maintains a record of all boiler and pressure vessel inspection matters brought to the Licensing Board's attention.
- Maintaining an active liaison with the NBICB and notifying the NBICB of non-renewal or revocation of licenses to inspect boiler and pressure vessel failures and their causes and other inspection difficulties of a technical or administrative nature as they occur.
- Notifying major claimants of situations where a boiler or pressure vessel fails to meet inspection certification requirements or where they are delinquent by three or more months in their inspection schedule. The Public Works Officer and Commanding Officer of the owning activity should be made aware of the deficiency prior to notifying the major claimant. Major claimants need not be notified if the activity is in the process of repairing the boiler or pressure vessel or has removed it from service.
- Assisting in providing training to FECs and activity employed inspectors.
- Reviewing all inspection contracts.
- Providing inspection services on a reimbursable basis either by Navy employed inspectors or by contract.
- Providing consultation services concerning the installation and repair of boilers and pressure vessels.
- Ensuring that boilers and pressure vessels procured by FEC administered contracts are designed, constructed and installed according to the ASME Boiler and Pressure Vessel Code and other applicable Codes as referenced in UFC 3-430-07.

- Ensuring that all newly constructed or installed boilers and pressure vessels have been inspected and that the vessel is certified. A NAVFAC certified inspector should perform the final inspection.
- Perform random performance checks of Navy and Contractor inspections.
- At their discretion, accompany Contractor and/or Navy inspectors on inspections.
- Provide consultation services, technical support, and guidance to Navy and Contract Inspectors.
- Conduct NAVFAC Boiler Inspector Workshop every 2 years.
- Void/Revoke boiler and UPV inspection certificates and inspector licenses when appropriate.

APPENDIX D DUTIES OF THE FEC BOILER & UPV LCO

The duties of the FEC Boiler & UPV LCO are:

- Compiling and updating inventory and certification status of all Boilers and UPVs for all Navy and Marine Corps Installations in the FEC AOR.
- Providing annual report to NAVFAC EXWC Boiler & UPV Inspection Program Managers Carl E. Murray, Jr., carl.murray@navy.mil and Chip Mathewson, chip.mathewson@navy.mil.
- Coordinate with PWO's for the Design & SOW Reviews, Contractor Submittal Reviews and Acceptance Inspections for all contracts involving boiler or UPV installations. The requesting activity is responsible for providing the funds to accomplish the reviews and inspections.
- Scheduling and coordinating Safety Code Certification inspection and testing of boiler and UPVs in accordance with UFC 3-430-07. Arranging for the performance of those inspection services by a Navy or contract inspector located near the requesting activity. When assistance is required, such assistance will be rendered on a reimbursable basis. The requesting activity is responsible for providing the funds to accomplish the inspections. Inspector performing inspections needs to coordinate with local PWD shops or BOS contractor for proper support.
- Conducting or administering studies for the purpose of improving operations and maintenance efficiency.
- Providing information on boiler monitoring and other information technology to better manage boiler plants.
- Ensuring that all newly installed boilers and UPV's are inspected by a NAVFAC certified inspector. Contract inspectors shall not be utilized to perform initial boiler and UPV inspections unless approved by the NAVFAC EXWC Boiler & UPV Inspection Program Managers, Carl E. Murray, Jr., carl.murray@navy.mil or Chip Mathewson, chip.mathewson@navy.mil, located at NAVFAC EXWC. /5/

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APPENDIX E PROCEDURES FOR LAY-UP OF BOILERS

E-1 GUIDANCE.

When a boiler is taken out of service, the boiler should be cooled until the water is below the atmospheric boiling point, but not below 180 degrees F (82.2 degrees C); the boiler should be emptied and flushed out. An inspection should be made to determine what repair work is necessary and what mechanical and chemical cleaning should be done. A decision should then be made on whether to employ dry storage or wet storage. Since freshly cleaned metal surfaces are much more vulnerable to corrosion than surfaces that have operational oxides on them, prefer delay of chemical cleaning until the boiler is ready to be returned to service.

E-2 DRY STORAGE.

This procedure is preferred for boilers out of service for extended periods of time or in locations where freezing temperatures may be expected during standby.

- The boiler should be thoroughly dried, since any moisture left on the metal surface would cause corrosion to occur on long standby. After drying, precautions should be taken to preclude entry of moisture in any form from steam lines, feed lines, or air.
- Moisture absorbing material, such as quicklime at the rate of 2 lbs (0.9 kg), or silica gel at the rate of 5 lbs (2.3 kg), for 30 cu. Feet (0.85 cu. meters) of boiler volume, is placed on trays inside the drums to absorb moisture from the air. The manholes should then be closed and all connections on the boiler should be tightly blanked. The effectiveness of materials for such purposes and need for their renewal may be determined through regular internal boiler inspections.
- Alternatively, air dried externally to the boiler may be circulated through it. The distribution should be carefully checked to be sure the air flows over all areas.
- It is usually desirable in the case of large utility boilers (particularly the once-through type) to simply drain the boiler while feeding nitrogen to the boiler vents and maintaining a 5-psig (34.47 kPa) nitrogen gage pressure during the storage period.

E-3 WET STORAGE.

A wet procedure may be used for a boiler to be placed in a standby condition. Wet storage is particularly useful if the standby boiler may be required for service at short notice or it is impractical to employ a dry storage procedure. The method is not generally employed for reheaters or for boilers that may be subject to freezing temperatures. Several procedures have been employed.

- The empty boiler should be closed and filled to the top with water conditioned chemically to minimize corrosion during standby. Water pressure greater than atmospheric should be maintained within the boiler during the storage period. A head tank may be connected to the highest vent of the boiler to maintain a pressure above atmospheric.
- For a short storage period, condensate or feedwater containing approximately 100 to 200 ppm of sodium sulfite may be used. If the superheater is drainable, it can also be filled with the same treated water by overflow from the boiler.
- If the superheater is not drainable, refer to the plant operating manual or request assistance from your respective FEC.

E-4 ALTERNATIVE WET LAY-UP METHODS.

The boiler may be stored with water at a normal operating level in the drum and nitrogen maintained at greater than atmospheric pressure in all vapor spaces. To prevent in-leakage of air, it is necessary to supply nitrogen at the vents before the boiler pressure falls to zero as the boiler is coming off line. If boiler pressure falls to zero, the boiler should be fired to reestablish pressure and the superheater and reheater thoroughly vented to remove air before nitrogen is admitted. All partly filled steam drums and superheater and reheater headers should be connected in parallel to the nitrogen supply. If nitrogen is supplied only to the steam drum, nitrogen pressure should be greater than the hydrostatic head of the longest vertical column of condensate that could be produced in the superheater. Rather than maintain the water in the boiler at normal operating level with a nitrogen cap, it is sometimes preferable to drain the boiler completely, applying nitrogen continuously during the draining operation and maintaining a pressure of nitrogen greater than atmospheric throughout the draining and subsequent storage.

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APPENDIX F INSPECTION REPORTS, CHECKLISTS, AND FORMS

Figure F-1 Boiler and UPV Report Form

NAVFAC INSPECTION REPORT													
From:					To:								
EQUIPMENT <input type="checkbox"/> Steam Boiler <input type="checkbox"/> Heating Boiler <input type="checkbox"/> Unfired Pressure Vessel			TYPE OF INSPECTION <input type="checkbox"/> Type A (Internal/External) <input type="checkbox"/> Type C (Operational Safety) <input type="checkbox"/> Pressure Test			INSPECTION DATE Started: Completed:							
CERTIFICATE ISSUED			EXPIRATION DATE:			DATE OF LAST INSPECTION							
BOILER INSPECTOR			NAVFAC No.			LICENSE No.							
MILITARY INSTALLATION			REPAIRS MADE SINCE LAST INSPECTION/CURRENT STATUS:										
BOILER/UPV EQUIPMENT IDENTIFICATION													
BUILDING NO:		BUILDING DESCRIPTION:		BOILER/UPV MFG:									
NATIONAL BOARD #:		VESSEL TYPE: (FT, WT, VT, ETC.)		PROPERTY NUMBER:			MFG. SERIAL #:						
ASME Symbol:		MFG MODEL #:		MFG DATE:		MAWP:		OP. PSI: TEST PSI:					
CAPACITY: (LBS/HR-CU/FT)		ECONOMIZER		<input type="checkbox"/> YES <input type="checkbox"/> NO		SUPERHEATER		<input type="checkbox"/> YES <input type="checkbox"/> NO					
BURNER MFG:		FLAME SAFEGUARD MFG:		PRIMARY FUEL:		SECONDARY FUEL:							
TYPE C - OPERATIONAL SAFETY INSPECTION													
Safety Checks		Combustion Analysis			Condition Status and Inspector Remarks								
<input type="checkbox"/> Flame Detection/Failure <input type="checkbox"/> Ignition <input type="checkbox"/> Loss of Pilot <input type="checkbox"/> Primary LWCO <input type="checkbox"/> Secondary LW/Lock-Out <input type="checkbox"/> High Water CO/Lock-Out <input type="checkbox"/> OP. Limit PSI <input type="checkbox"/> HI. Limit/Lock-Out PSI <input type="checkbox"/> OP. Temp. <input type="checkbox"/> HI. Temp./Lock-Out <input type="checkbox"/> Fuel PSI <input type="checkbox"/> Low Gas/Lock-Out PSI <input type="checkbox"/> High Gas/Lock-Out PSI <input type="checkbox"/> Draft/Air Flow <input type="checkbox"/> Emergency Stop <input type="checkbox"/> Electrical Disconnect		As Found		Corrected		CSD-1 Compliant		<input type="checkbox"/> YES <input type="checkbox"/> NO		Proper Purging		<input type="checkbox"/> YES <input type="checkbox"/> NO	
		%O2		%O2									
		%CO		%CO									
		% CO2		% CO2									
		NOx		NOx									
		% Air		% Air									
		Stack		Stack									
		Amb.		Amb.									
% EFF		% EFF											
SAFETY / RELIEF VALVES													
MANUFACTURER:		PSI/TEMP:		Inlet/Outlet Size:		CAPACITY:		MFG. SERIAL #:		CONDITION:			
TOTAL CAPACITY OF SAFETY / RELIEF VALVES						LBS/HR - CU/FT							
OTHER COMPONENTS, REGULATORS, AND CONTROL DEVICES													
Pressure Gauges:		Sight Glasses:		Thermometers:		Gas Valves:							
Fuel Valves:		Steam Valves:		Control Dampers/Linkage:		Other Metering Valves:							
Isolation Valves:		Vent Piping:		External Conduit/Cables:		Flow Meters/Regulators:							

TYPE A – INTERNAL - EXTERNAL INSPECTION					
Date:	Bldg. #:	Equipment #:	Lock-Out/Tag-Out:		
			<input type="radio"/> YES	<input type="radio"/> NO	
Shell Thickness:	Head Thickness:	Confined Space Entry:	Gas Free Tested:		
		<input type="radio"/> YES <input type="radio"/> NO	<input type="radio"/> YES	<input type="radio"/> NO	
Discrepancies:		Condition Assessment/Corrective Action:			
<ul style="list-style-type: none"> <input type="radio"/> Scale Deposits, Sludge <input type="radio"/> Corrosion/Rust <input type="radio"/> Oxygen Pitting <input type="radio"/> Leaks (Water, Air, Gas) <input type="radio"/> Overheating Damage <input type="radio"/> Metal Thickness/Damage/Loss 					
CHEMICAL AND PRETREATMENT SYSTEM					
Describe type Chemical Treatment Program, Pre-treatment Equipment Used, Boiler Water Sampling/Results:					
CONDITION OF BOILER / UNFIRED PRESSURE VESSEL (UPV)					
INSPECTOR COMMENTS:		STATUS			
		Not Inspected or not Applicable	Fully Acceptable	Needs Minor Repair	Requires Major Repair or Replacement
Boiler Room Ventilation, Egress, Housekeeping, OSHA Compliance, Eye Wash Stations					
Boiler Operating Logs, Maintenance Records, Water Treatment Testing, Chemicals					
Burner Safety Operation & Ignition System, Panel Boxes, Conduit & Cables, Lights					
Safety / Relief Valves and Vent Piping, High Point Vents, Low Point Drains, Hangers					
Water Column Site Glass and Tri-Cock Valves, Level Controllers, Wiring Harness					
Fuel System/ Vent Piping and Hangers, Inline Strainers/Filters, Isolation Valves					
Solid Fuel System (Feed, Grates, Ash, Conveyers, Belts, Pulleys)					
Steam / Hot Water Piping, Control and Isolation Valves, Gauges, Insulation, Hangers					
Blow Down Piping, Valves, Tanks, Gages, Insulation, Gauges, Hangers					
Steam / Hot Water Pressure/Temperature Gauges, Siphon Loops, Fittings					
Water side Heat Transfer Surfaces, Tubes, Ligaments, Access Covers, Baffles, Gaskets					
Fire side Heat Transfer Metal Surfaces, Tubes, Tube Sheet, Ligaments, Internals					
Furnace Refractory Mortar, Fire Brick, Baffle Plates, Gasket Rope, Sight Glass					
Boiler Foundation, UPV Saddles and Supports, Vibration Insulation & Snubbers					
Boiler Skin, Insulation, Exhaust Stack & Cover, Thermometer, Mounting Brackets					
Feedwater System, Control and Isolation Valves, Pot Feeder, Gauges, Insulation					
Electrical Disconnects, Boxes, Terminations & Connections, and Wiring Insulation					
UPV Shell/Head Thickness, DATA Plate, Inspection Plugs, Piping, Coating Thickness					
QUALITY ASSURANCE					
TYPE A – INTERNAL - EXTERNAL INSPECTION RESULTS		<input type="checkbox"/> SATISFACTORY		<input type="checkbox"/> UNSATISFACTORY	
TYPE C - OPERATIONAL SAFETY INSPECTION RESULTS		<input type="checkbox"/> SATISFACTORY		<input type="checkbox"/> UNSATISFACTORY	
PRESSURE TEST	<input type="checkbox"/> STRENGTH	<input type="checkbox"/> TIGHTNESS	<input type="checkbox"/> SATISFACTORY	<input type="checkbox"/> UNSATISFACTORY	
Print Name of Inspector		Signature of Inspector & Date (Digital Option)			
Contact Information					

Figure F-2 Field Checklist for Boilers

BOILER

Field Checklist for Boilers

Used as a Pre/Final Inspection for Boilers Prior to Issuance of Certification Certificate.

Insp. Date _____ Command _____ Building No. _____
 National Board # _____ Boiler Serial # _____ MAWP _____
 Boiler Name _____ Manufacturer _____ Date of MFG _____
 Boiler Function _____ Boiler Type _____ Boiler Capacity _____

BOILER INSPECTION

INTERNAL INSPECTION	Sat	Unsat	OPERATIONAL	Sat	Unsat
Combustion Chamber			Gas Boilers:		
Brick Work			Start in low Fire		
Insulation			Loss of Combustion Air		
Fire/ Water Tubes			Low Gas Pressure		
Burner Nozzle			High Gas Pressure		
Steam Drum			Fuel Oil Boilers:		
Stack/ Flue			Start in Low Fire		
Blow off Valve			Loss of Combustion Air		
			Loss of Atomizing Air		
EXTERNAL INSPECTION			Low Oil Pressure		
Programmer-()			Burner Draw Switch (if applicable)		
Safety/ Relief Valve			Proximity Switch (if applicable)		
Low Water/ Fuel Cutouts			All Boilers:		
Water Column			Flame Sensor		
Pressure Gage			LWCO (left/ Right)		
Review Record Logs (weekly/monthly)			Feed Pump/ Recirculating Pump		
Condensing Neutralizer Installed			Normal Trip		
			Flame Pattern Inspection		
Hydrostatic Test			Water Treatment		
Backflow Preventer			High Trip		
			Emergency Stop		
Date of last Combustion Tuning			Combustion Tuning		
Date of last waterside inspection			Combustion (Air/Fuel) Control System		
Date of last 150% Strength Hydro			Test Relief Valve under Pressure		

Boiler Efficiency

	Oxygen %	CO ppm	CO2%	SO2 ppm	NO ppm	Stack Temp.
Gas Fired						
Oil Fired						

BURNER ASSY	MODEL	BTU RANGE	S/N	PROGRAMMER

Safety/Relief Valve _____
 _____ Manufacturer _____ Size _____ PSI _____ BTU/Hr
Gage _____
 _____ Manufacturer _____ PSI



Comments _____

Inspector _____ Certification Expires _____

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Figure F-4 Inspection Certificate for Boiler-Unfired Pressure Vessel

Form, NAVFAC 9-11014/32(09/15)

		DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND			
INSPECTION CERTIFICATE FOR: <input type="checkbox"/> BOILER <input type="checkbox"/> UNFIRED PRESSURE VESSEL					
ACTIVITY		LOCATION		NATIONAL BOARD #	
SERIAL #		MANUFACTURER		PRESSURE ALLOWED psi	
THIS CERTIFICATE EXPIRES:			INSPECTOR COMMENTS ON BACK		
<input type="checkbox"/> YES			<input type="checkbox"/> NO		
This Boiler or Vessel has been Inspected and Approved for Operation at a Pressure Shown Above:					
<input type="checkbox"/> EXTERNAL		<input type="checkbox"/> INTERNAL		<input type="checkbox"/> PRESSURE	
<input type="checkbox"/> OPERATIONS					
Printed NAME:		Inspection DATE:		NAVFAC #	
Signature:				LICENSE #	
THIS CERTIFICATE MUST BE POSTED UNDER GLASS NEAR THE BOILER OR VESSEL (Refer to UFC-03-430-07)					

NAVFAC 9-11014/32 (09/15) Supersedes NAVDOCKS 1910 & 2507 S/N 0105-LF-003-0000 *U.S. GPO: 1988-505-007/67081 2-1 B-31105

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APPENDIX G PREVENTIVE MAINTENANCE INSPECTION (PMI) CHECKLISTS FOR SMALL BOILERS

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Table G-1 Steam Boilers PMI Checklist

(Capacities of 400,000 BTU (117124.2 W) per Hour Input or Less)

1. Observe condition of flame. Correct if flame is smoky or if burner starts with a puff. Flame should not impinge on furnace walls. \4\ Adjust if necessary to ensure that flame pattern is consistent with manufacturer specifications, established industry best practices, or Navy guidance. /4/	Weekly
2. Test the low water fuel cutoffs for proper sequencing and operation. Blow down boiler.	Weekly
3. Test water column or gage glass. Glass must be clean and free of obstructions. Clean dirty glass and replace defective column or glass at once. Defects include leaking gage cocks and glass, excessive corrosion, inability to discern water level, and improper operation.	Weekly
4. Observe operation of condensate or vacuum pumps. Replace or repair defective or leaking pumps.	Weekly
5. Check operation of chemical feed pots and feed pumps. Repair or replace defective equipment.	Weekly
6. Test flame detection devices and associated automatic fuel cutoff valves. Loss of flame should shut off flow of fuel to the burner(s). Repair or replace if devices or valves are defective.	Monthly
7. Inspect steam supply and condensate return piping, valves, radiators, and traps for leaks, excessive rust, and damage or lack of insulation. Blow down strainers. Repair or replace individual items as needed.	Monthly
8. Inspect fuel supply systems and piping in boilers for leaks, loss of insulation, etc. Repair or replace as needed. Replace cartridges for in-line oil filters. Adjust oil pressure as prescribed by the manufacturer. Ensure both oil supply and return lines have a fusible in-line valve.	Monthly
9. Check condition of safety valves. Test valve with tri-lever. Valves should preferably be the pressure type. Leaking safety valves must be replaced. No obstruction such as another valve, long pipe length, or constriction is permissible between the boiler and the safety valve. The overflow from the valve should be free of obstructions and piped to within 4 inches of the floor or to a floor drain.	Monthly

10. Check boiler room drains for proper functioning.	Monthly
11. Inspect burner assembly. Evidence of improper fuel nozzle wear, plugging, or carbon buildup on the nozzle is cause for replacement. Adjust equipment for proper combustion after replacing the old nozzle with a new one.	Monthly
12. Inspect burner assembly. Replace nozzle and filters on oil burning equipment. Clean, check, and adjust electrodes.	Annually
13. Inspect internal and external heating surfaces after cleaning. Fireside surfaces should be free of soot. Cracked surfaces will require repair or replacement of the furnace (firing chamber). Repair to pressure parts requires a certified welder. Evidence of bulges or other deformities indicate defective controls and safety devices or improperly sized and adjusted burner. Consult a boiler water treatment specialist if there is evidence of hard scale on the waterside surfaces.	Annually
14. Inspect gas piping and valves regularly for proper support and tightness. Test for tightness with a soap solution. If a leak is detected, then secure the piping to the boiler and contact the gas company.	Annually
15. Check the transformer. Do not interchange transformers of different capacities when replacing defective transformers.	Annually
16. Inspect area around boiler for cleanliness, combustibles, etc. Remove trash and any combustibles from the boiler room. Assure proper ventilation to the boiler.	Annually
17. Check draft, manifold pressure, and combustion. \4\ Conduct boiler combustion efficiency test and optimize boiler combustion efficiency (tune-up boiler) consistent with manufacturer specifications, established industry best practices, or Navy guidance. Adjust combustion characteristics if necessary for efficient and safe operation. Adjust boiler combustion to optimize (minimize) Carbon Monoxide (CO) emissions and smoke consistent with manufacturer specifications, established industry best practices, or Navy guidance. Minimum combustion measurements required are: CO (ppmv), CO ₂ %, \3\ O ₂ %, /3/ stack temperature, and boiler room temperature. Overfire draft should be at least +0.02 inches (+5 Pa) water gage (W.G.) for oil burners. Adjust manifold pressure as specified by the manufacturer. Record and retain documentation of pre and post boiler tune-up combustion results for CO (ppm), CO ₂ %, O ₂ %, stack temperature, and boiler room temperature. /4/	Annually
18. Inspect control equipment for proper sequence and operation. \4\ If boiler is equipped with an air-to-fuel ratio control system, ensure that the control system is operating in accordance with manufacturer specifications. /4/ Covers on controllers should be in place. Dust and dirt on control equipment must be removed. Electric contacts that are fouled require cleaning. All wiring should be properly grounded.	Annually

19. Calibrate and check operation of gages and meters. Repair or replace all defective gages and meters. Defects include cracked, broken, or dirty glass, illegible markings, and bent pointers. Place date and initials of tester on the face of the calibrated gages.	Annually
20. Check breaching and stack for integrity and tightness. Breaching and stack should be firmly attached to the boiler in forced draft systems. The breaching and stack should be properly supported and either vertical or sloped upward.	Annually
21. Check shell for cleanliness, excessive rust, corrosion streaks, or any deformations and cracks. Clean and repair as necessary. Repaint to cover bare metal. Assure access doors are in place and in working order.	Annually
22. Check fuel oil supply. Note level of oil tank. Leaking tanks must be repaired or replaced immediately.	Annually
23. \4\ Compile and retain compliance records and documentation required by federal, state, and/or local environmental regulations and permits. Many regulatory agencies require boiler owners to compile annual compliance documentation. If unsure of the environmental compliance requirements for this particular boiler, consult the installation environmental office. /4/	Annually

Table G-2 Hot Water Boilers PMI Checklist

1. Observe condition of flame. Correct if flame is smoky or if burner starts with a puff. Flame should not impinge on the furnace walls. \4\ Adjust if necessary to ensure that flame pattern is consistent with manufacturer specifications, established industry best practices, or Navy guidance. /4/	Weekly
2. Check fuel supply (oil). Note level of oil in tank. Leaking tanks must be repaired or replaced immediately.	Weekly
3. Observe operation of circulating pumps. Lubricate pump motor, bearing assembly, and flex coupling. Noisy pump motors require repair or replacement.	Weekly
4. Test flame detection devices and associated automatic fuel cutoff valves. Loss of flame should shut off flow of fuel to the burner(s). Replace or repair if devices or valves are found defective.	Monthly
5. Inspect fuel supply systems and piping in boilers for leaks, loss of insulation, etc. Repair or replace as needed. Replace cartridges for in-line oil filters. Adjust oil pressure as prescribed by the manufacturer. Ensure both oil supply and return lines have a fusible in-line valve.	Monthly
6. Check boiler room drains for proper functioning.	Monthly
7. Check condition of safety relief valves. Test valve with tri-lever. Valves should preferably be the pressure and temperature type. Leaking safety valves must be replaced. No obstructions such as another valve, long pipe length, or constriction are permissible between the boiler and the safety valve. The overflow from the valve should be free of obstructions and piped to within 4 inches of the floor or to a floor drain.	Monthly
8. Inspect burner assembly. Evidence of improper fuel nozzle wear, plugging, or carbon buildup on the nozzle is cause for replacement. Adjust equipment for proper combustion after replacing the old nozzle with a new one.	Monthly
9. Inspect burner assembly. Replace nozzle and filters on oil burning equipment. Clean, check, and adjust electrodes.	Annually
10. Inspect internal and external heating surfaces after cleaning. Fireside surfaces should be free of soot. Cracked surfaces will require repair or replacement of the furnace (firing chamber). Repair to pressure parts requires a certified welder. Evidence of bulges or other deformities indicates defective controls and safety devices or improperly sized and adjusted burner. Consult a boiler water treatment specialist if there is evidence of hard scale on the waterside surfaces.	Annually
11. Inspect gas piping and valves regularly for proper support and tightness. Test for tightness with a soap solution, never a flame. If a leak is detected, then secure piping to the boiler and contact the gas company.	Annually

12. Check transformer. Do not interchange transformers of different capacities when replacing defective transformers.	Annually
13. Inspect area around boiler for cleanliness, combustibles, etc. Remove trash and any combustibles from the boiler room. Assure proper ventilation to the boiler.	Annually
14. Inspect hot water supply and return piping, valves for leaks, excessive rust, and damaged or missing insulation. Repair or replace as needed.	Annually
15. Check draft, manifold pressure, and combustion. \4\ Conduct boiler combustion efficiency test and optimize boiler combustion efficiency (tune boiler) consistent with manufacturer specifications, established industry best practices, or Navy guidance. Adjust combustion characteristics if necessary for efficient and safe operation. Adjust boiler combustion to optimize (minimize) Carbon Monoxide (CO) emissions and smoke consistent with manufacturer specifications, established industry best practices, or Navy guidance. Minimum combustion measurements required are: CO (ppm), CO ₂ %, O ₂ %, stack temperature, and boiler room temperature. Overfire draft should be at least +0.02 inches (+ 5 PA) water gage (W.G.) for oil burners. Adjust manifold pressure as specified by the manufacturer. Record and retain documentation of pre and post boiler tune-up combustion results for CO (ppm), CO ₂ %, O ₂ %, stack temperature, and boiler room temperature. /4/	Annually
16. Check expansion tank and air eliminator equipment for leaks, corrosion, etc. Repair or replace defective equipment.	Annually
17. Inspect control equipment for proper sequence and operation. \4\ If boiler is equipped with an air-to-fuel ratio control system, ensure that the air-to-fuel ratio control system is operating in accordance with manufacturer specifications. /4/ Covers on controllers should be in place. Dust and dirt on control equipment must be removed. Electric contacts that are fouled require cleaning. All wiring should be properly grounded.	Annually
18. Calibrate and check operation of gages and meters. Repair or replace all defective gages and meters. Defects include cracked, broken, or dirty glass, illegible markings, and bent pointers. Place date and initials of tester on the face of the calibrated gages.	Annually
19. Check breaching and stack for integrity and tightness. Breaching and stack should be firmly attached to the boiler in forced draft systems. The breaching and stack should be properly supported and either vertical or sloped upward.	Annually
20. Check shell for cleanliness, excessive rust, corrosion streaks, deformations, and cracks. Clean and repair as necessary. Repaint to cover bare metal. Assure access doors are in place and in working order.	Annually
21. \4\ Compile and retain compliance records and documentation required by federal, state, and/or local environmental regulations and permits. Many regulatory agencies require boiler owners to compile annual compliance	Annually

documentation. If unsure of the environmental compliance requirements for this particular boiler, consult the installation environmental office. /4/	
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INACTIVE

APPENDIX H WHAT TO EXPECT WHEN THE BOILER INSPECTOR CALLS

The following article is reprinted unabridged with the permission of HEATING, PIPING, and AIR CONDITIONING. The author is John G. Gillissie, a field representative of the National Board of Boiler and Pressure Vessel Inspectors.

The article is provided as a general guide for use by activities when preparing boilers for inspection. The text of this UFC contains further guidance.

WHAT TO EXPECT WHEN THE BOILER INSPECTOR CALLS

Here's what you can and should do to help him to ensure the safety and integrity of your boiler plant.

Boilers are so common and essential that their safe and effective operation can easily be taken for granted. With boiler safety laws widely adopted and enforced, boiler accidents have become relatively rare. Yet the potential for injury and destruction still exists with any boiler or pressure vessel. A careful, consistent program of maintenance and third-party inspection is fundamental to boiler safety.

That's why you, as a boiler owner or user, can count on periodic visits from an inspector commissioned by the National Board of Boiler and Pressure Vessel Inspectors and authorized by the legal jurisdiction in which you operate. His visit is mandated by the police powers of that jurisdiction to maintain public safety.

Here is what to expect-and what you can and should do to help-when the authorized inspector visits you, based on the National Board Inspection Code.

Boilers bearing the ASME and National Board stamps are inspected during manufacture by a National Board commissioned inspector to assure conformance to the ASME Boiler and Pressure Vessel Code. They are then inspected at installation and at designated periods thereafter, depending on the regulations that govern your area. Because thorough boiler inspections are essential, the following directions for them have been carefully drawn up. In some cases, these instructions appear as recommendations in the National Board Inspection Code although your local regulations probably make them mandatory.

The commissioned inspector visiting you will know these regulations and will understand what causes boiler deterioration and accidents. He will be conscientious and careful in his observations, taking sufficient time to make his examination thorough in every way and making no final statement about conditions not personally observed. He will not accept testimony of others. If he cannot make a thorough inspection, he will note that in his report.

The inspector will request that you, as the owner, or your representative be present during the inspection. He may request you or your representative to aid in any physical tests necessary to evaluate the boiler's physical condition.

The inspector will begin by observing the condition of your entire boiler installation, forming an opinion of the care the equipment receives. On entering the boiler area, he

will first inspect the boiler externally. The general cleanliness and accessibility of the boiler and its auxiliary apparatus will be noted.

Boiler fittings, valves, and piping will be checked. Any steam or water leak-such as leakage coming from behind insulation, coverings, supports, or settings-or any evidence of leakage will be thoroughly investigated and any necessary corrective action pointed out. You may be asked to remove insulation to locate the source of leakage or to determine the extent of suspected corrosion.

POWER BOILER INSPECTION

External inspection of power boilers (operating pressures greater than 15 psig) is slightly different from that of heating boilers. For power boilers, the inspector will compare the pressure indicated on the pressure gauge with readings on other gauges in the same system or, if necessary, with a standard test gauge. He will observe the readings during tests, such as the reduction in pressure when testing the low water fuel cutoff control. Defective gauges must be replaced.

Next, the inspector will observe the blowdown of the water gauge in the normal manner and how promptly the water returns. A sluggish response may indicate an obstruction in the pipe connection to the boiler, which must be corrected. During the water level gauge test, water and steam connections will be blown separately to ensure both are clear. The inspector will also determine that the boiler water level indication is accurate.

Safety valves come next. The inspector will check the nameplate data of the safety valves to assure that they are ASME/National Board certified and that their relieving capacity is sufficient to safeguard the boiler under full firing conditions. He will also assure that factory seals have not been broken. If the set pressure does not exceed 400 psi, safety valves are tested by allowing the boiler pressure to rise to the popping pressure and subsequently fall.

If checking the actual popping pressure and blowdown is not practical, the boiler operator, while being observed by the inspector, will test the valve for free operation by using the lifting lever, provided the boiler pressure is 75 percent or more of the set pressure. This method is the only practical way to test multiple safety valves unless an accumulation test is made.

At pressures above 400 psi (2.76 MPa), evidence must be shown that the valves were tested under pressure or dismantled, overhauled, and tested and their popping pressures and blowdown adjusted where necessary within a reasonable period of time acceptable to the inspector. Your best assurance that the safety valves have been properly repaired or refurbished is to have this work carried out by an organization that holds a National Board "VR" (safety valve repair) certificate of authorization.

Alternatively, the owner or user may elect to make the actual popping test just described. If the valve has a discharge pipe, the inspector will determine whether the drain opening in the pipe is free to an atmospheric exhaust area.

When inspection reveals that a safety valve is leaking, sticking, or not opening and closing properly, the boiler will be taken out of service. The valve must then be replaced or repaired.

The inspector will next observe how the low water fuel cutoff or feed controls respond when the drain is opened; he will check how promptly the system returns to normal, as when the alarm or the feed pump stops. A sluggish response may indicate an obstruction in the pipe connections to the boiler. If the controls, where provided, are inoperative or the correct water level is not indicated, the boiler will be taken out of service until the unsafe condition has been corrected.

Piping, connections, and fittings will also be carefully examined by the inspector to ensure that there is provision for expansion and adequate support. Steam and water piping and fittings will be examined for leakage. Any leakage or other defects must be corrected. (To avoid water hammer, the locations of the various stop and drain valves should not allow water to accumulate when the valves are closed.) Excessive vibration will be noted and corrective action required.

Connections between individual boilers and the main steam header will be checked for strain caused by the boilers' changing position due to settling or other causes. The inspector will verify that all pipe connections and fittings are properly rated for the service conditions they encounter. He will also observe the blowdown of the boiler in the normal manner, check for freedom of the piping to expand and contract, and ensure that there is no excessive vibration.

During all tests, the inspector will determine whether the actual operating and maintenance practices he observes are acceptable. He will discuss any defects or deficiencies in the boiler or in operating and maintenance practices with the owner or user at this time and recommend corrections.

INTERNAL INSPECTIONS

Since most internal conditions to be observed by the inspector are common to both power and heating boilers, the internal inspection procedures are essentially the same for both types. (Remember, when a boiler is to be prepared for internal inspection, the water must not be withdrawn until the setting has been sufficiently cooled at a rate to avoid damage to the boiler.)

The owner or user should follow these steps to prepare a boiler for internal inspection:

- 1) Draw off all water and thoroughly wash out the waterside.
- 2) Remove manhole and handhole plates, washout plugs, and inspection plugs in water column connections as required by the inspector. Cool and thoroughly clean the furnace and combustion chambers.
- 3) Remove all grates from internally fired boilers.
- 4) Remove insulation and brickwork as designated by the inspector to determine the condition of the boiler, headers, furnace, supports, or other parts.
- 5) Remove the pressure gauge for testing when required by the inspector.

6) Steam or hot water leakage into the boiler can be prevented by disconnecting the pipe or chain locking the valves at the most convenient point or by other means approved by the inspector.

7) Before the manhole or manholes are opened and the inspector enters any part of a boiler connected to a common header with other boilers, close, tag, and preferably padlock the required steam or water system stop valves and open the free blow drain valves or cocks between the two closed stop valves. Disconnect blow off lines, where practical, between pressure parts and valves. Open all drains and vent lines.

8) Before internal inspection is begun, the owner or user must determine that the boiler is safe to enter, is adequately ventilated, and contains no harmful vapors. Applicable safety rules and local regulations must be followed. A person should also stand by the boiler all the time the inspector is inside.

With preparations complete, internal inspection begins with insulation and brickwork. Removing boiler insulation material, masonry, or fixed parts for inspection is not normally necessary unless defects or deterioration are suspected or are commonly found in the particular type of boiler being inspected. If evidence of leakage shows on the covering, the insulating material, masonry, or a fixed part of the boiler may require removal to ensure a thorough inspection. Even drilling or cutting away parts may be necessary.

The boiler temperature must be low enough to ensure that inspecting personnel will not be exposed to excessive heat. If a boiler has not been properly prepared for an internal inspection, the inspector will decline to proceed. The inspector begins the detailed internal inspection by first examining all exposed metal surfaces on the waterside of the boiler for deposits caused by water treatment, scale, oil, or other substances. Oil or scale in the tubes of watertube boilers or on the plates over the fire in any boiler is particularly detrimental. It can have an insulating effect that can lead to overheating, weakening, and possible metal failure by bulging or rupture. Since even the smallest amount of oil is dangerous, immediate steps must be taken to clean the affected surfaces and prevent further contamination, using chemical or mechanical means as appropriate.

The inspector will examine all stays to determine whether or not they are in even tension. All fastened ends will be examined for cracks. Stays or stay bolts not in tension or adjustment must be repaired. Broken stays must be replaced. He will test firebox stay bolts by tapping one end of each bolt with a hammer. Stay bolts with holes will be examined for evidence of leaks, which indicate a broken or cracked stay bolt. Broken stay bolts must be replaced.

Manholes and reinforcing plates, as well as nozzles or other connections flanged or screwed into the boiler, will be examined both internally and externally. Whenever possible, observation will be made from the inside to determine whether connections to the boiler are properly made.

All openings leading to external attachments-such as water column connections, low water fuel cut-off devices, openings in dry pipes, and openings to safety valves-will be examined to ensure they are free from obstruction.

The inspector will also check fire surfaces for bulging or blistering. Bulges often result from overheating of the entire thickness of the metal, lowering the strength of the metal and allowing it to be deformed by the pressure in the boiler. Bulges may also be caused by creep or temperature gradients.

Blisters may be caused by metal defects, such as lamination in which the side exposed to the fire overheats but the opposite side retains its strength due to the cooling effect of the boiler water. Overheating can cause serious boiler deterioration. Metal parts can oxidize, and pressure parts can deform and even rupture. Tubes can also be damaged by poor circulation, steam binding, or deposition of scale.

The inspector will pay particular attention to the plate or tube surfaces exposed to the fire, looking for any deformation such as bulging or blistering. If a bulge or blister shows evidence of leakage or is large enough to weaken the plate or tubes seriously, the boiler will be put out of service for repair. The blister area must be removed, the remaining thickness determined, and repairs made as required. Although a bulge on a water tube must always be repaired, a bulge on a plate, if not extensive, can be driven back into place. Otherwise the affected area must be patched.

Another type of flaw noted by the inspector is cracking. Cracks can result from flaws originating in the material from which the boiler was made, the boiler's basic design and operating conditions, or metal fatigue. They can be accelerated by corrosion. Fire cracks are caused by the thermal differential when the cooling effect of the water is not adequate to transfer the heat from the metal surfaces exposed to the fire. Cracks can result from a combination of these causes. Cracks noted in shell plates usually are dangerous.

The inspector will examine areas where cracks are most likely to appear, such as the ligaments between the tube holes on watertube boiler drums, between the tube holes on the tube sheet of firetube boilers, areas of stay bolts, at any flange where there may be repeated flexing of the plate during operation, and around welded pipe and tube connections.

If cracks are suspected, a hydrostatic test to determine their location may be necessary. A suitable nondestructive examination method may also locate such cracks.

The inspector will also look for corrosion, which causes metal surface deterioration. Corrosion can affect large areas or be localized as pitting. Isolated, shallow pitting is not considered serious if it is not active.

Boiler corrosion is usually caused by free oxygen and dissolved salts. If the inspector finds active corrosion, he will advise the owner or user to obtain competent remedial action. To estimate what effect severe corrosion over large areas has on the safe working pressure, the thickness of the remaining sound metal will be determined by ultrasonic examination or by drilling.

Grooving, yet another type of flaw, is a metal deterioration caused by localized corrosion and stress concentration. The inspector will examine all flanged surfaces, particularly the flanges of unstayed heads, as thoroughly as their construction permits. Grooving in the knuckles of such heads is fairly common since they have a slight natural movement that causes a stress concentration.

Boilers with ogee or reversed flanged construction are also prone to grooving but may not be readily accessible for examination. The inspector will insert a mirror through an examination opening to examine as much area as possible. \5\ Other examination methods, such as ultrasonic thickness testing, may be employed. /5/ Since grooving is usually progressive, its effect must be carefully evaluated and corrective action taken when it is detected.

Firetubes, watertubes, and piping are examined next. The fireside surfaces of tubes in horizontal firetube boilers usually deteriorate more rapidly at the ends nearest the fire. The inspector will check the tube ends for serious reductions in thickness. The surfaces of tubes of vertical tubular boilers are more susceptible to deterioration at the ends exposed to combustion. These exposed tube ends in the combustion space will also be checked for serious reductions in thickness.

The inspector will thoroughly examine the waterside surface of all tubes for pitting and corrosion. In vertical firetube boilers, excessive corrosion and pitting often occur at and above the water level. Excessive scale on water surfaces must be removed before the boiler is placed back in service.

Watertube surfaces will be carefully examined for corrosion, erosion, bulges, cracks, or any evidence of defective welds. Tubes can become thinned by erosion produced by the impingement of particles of fuel and ash at high velocity or by improperly installed or operated soot blowers. Tube leaks frequently cause serious corrosion or erosion on adjacent tubes.

Fuel and ash also tend to lodge in restricted fireside spaces, as where short tubes or nipples join drums or headers. Such deposits usually cause corrosion if moisture is present. Coal and fuel oils contain sulfur, which is present in ash or soot deposits. Dampness adds hydrogen and exposure to air adds oxygen. The result is H_2SO_4 , not helpful to metal surfaces. Clean this area thoroughly for the inspector's examination.

The inspector will thoroughly examine piping, connections, and fittings for leaks and to ensure adequate provision for expansion and supports. Any leaks or other defects must be corrected. To avoid water hammer, stop and drain valves must be located so that water will not accumulate when the valves are closed. Excessive vibration and its effects must be corrected.

All automatic low water fuel cutoff and water feeding devices will be examined for proper installation. Operating instructions for the devices must be readily available. The inspector will examine the float chamber type control devices for wear. Necessary repairs must be made before the devices are placed back into service.

He will further check that fireside baffles in watertube boilers are in place. If proper baffling is absent, high temperature concentrations often result, causing overheating in portions of the boiler. The location and condition of combustion arches will be checked to ensure flame impingement will not cause overheating. Any localized heat buildup caused by defective or improperly installed or operated firing equipment must be corrected before the boiler is returned to service.

The inspector will examine the supports and setting of suspended boilers, especially where a boiler is near the setting walls or floor, to ensure ash or soot does not bind or produce excessive strains on the boiler by restricting its movement when operating.

The National Board recommends that under normal operating conditions, safety valves installed on power boilers operating at 400 psi (2.76 MPa) or less be manually tested once a month by the operator and pressure tested once a year. (Under certain operating conditions, these recommendations may not apply.) Actual operating experience will determine how frequently safety valves on power boilers operating at more than 400 psi should be tested.

The inspector will check safety and safety relief valves on heating boilers for the correct set pressure and adequate relieving capacity. Any leaking or deteriorated valve must be repaired by the manufacturer or an authorized safety valve repair facility or be replaced. Discharge pipes must be adequately supported, and valves must be properly sealed unless they are nonadjustable.

A common unsafe condition found in both safety and safety relief valves is the failure to open at the set pressure due to buildup of corrosive deposits between the disc and seat.

The National Board recommends that under normal operating conditions, the safety or safety relief valve on a steam or hot water heating boiler should be tested manually once a week and pressure tested once a year. Again, under certain operating conditions, these recommendations may not apply.

The inspector will next determine that where required, all pressure gauges have been removed and tested and their readings compared to the readings of standard test gauge or a dead weight tester. He will determine whether any steam pressure gauge is exposed either to high temperature from an external source or to internal heat due to lack of protection by a proper siphon or trap. He will also check that provision is made for blowing out the pipe leading to the steam gauge.

If tubes have been replaced or re-rolled, the inspector will check for proper workmanship. If tubes are readily accessible, they may have been over-rolled. Conversely, if it is difficult to reach the tube ends, they may have been under-rolled.

If the inspector requires additional information regarding a leak in a boiler or the extent of a possible defect, he may require that a hydrostatic test be performed. To determine tightness, the hydrostatic test pressure need be no greater than the set pressure of the safety valve having the lowest setting.

The hydrostatic test pressure may not exceed 1.5 times the maximum allowable working pressure. The safety spring may not be compressed to prevent the valve from opening. The safety valve or valves will be removed and each disc held down by means of a gag or testing clamp. A plug device designed for this purpose may be used. Water used in the hydrostatic test should be at least 70 degrees F (20 degrees C) but may not exceed 120 degrees F (49 degrees C) during the inspection. If a test is conducted at 1.5 times the maximum allowable working pressure and the owner specifies a temperature higher than 120°F for this test, the pressure must be reduced to

the maximum allowable working pressure and the temperature to 120 degrees F (49 degrees C) for close examination.

Finally, the inspector will review the boiler log and the records of maintenance and feedwater treatment to determine what regular tests have been made on the boiler and controls. He will consult the owner or user regarding any repairs made since the last inspection and will review such repairs for compliance with Chapter III of the National Board Inspection Code.

The inspector will discuss any defects or deficiencies in the condition or the operating and maintenance practices of the boiler and auxiliary equipment with the owner or user at this time and recommend any necessary corrective actions.

A National Board commissioned inspector is a well-trained, experienced individual, who may be in the employ of your insurance carrier, a state of the U.S. or a province or Canada, or a large municipality. He offers you an independent evaluation of your boiler's physical condition. He will recommend only repairs or maintenance necessary to safeguard the integrity of your boiler. His prime interest is public safety. Listen to him and follow his advice.

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**APPENDIX I CHARTER FOR THE NAVAL FACILITIES ENGINEERING AND
EXPEDITIONARY WARFARE CENTER (NAVFAC EXWC) BOILER INSPECTION
CERTIFICATION BOARD (NBICB)**

1. The purpose of this appendix is to establish procedures and to assign responsibility for the administration of the Navy Shore Boiler Safety Inspection Program and to establish a NAVFAC Boiler Inspection Certification Board (NBICB).

2. UFC 3-430-07 established the administrative procedures for the Navy Shore Boiler Safety Inspection program. The Chief of Naval Operations (CNO) established Navy shore boiler and unfired pressure vessel (UPV) inspections as the responsibility of the owning activity. Naval Facilities Engineering and Expeditionary Warfare Center (EXWC) is tasked with oversight responsibility, monitoring inspections, providing training to inspectors, and reporting to the Chief of Naval Operations (CNO) and commands those boilers and UPVs which have not been properly inspected. The lack of proper inspection is sometimes an inspector ignoring the requirements and criteria for inspection of boilers or UPVs or activities ignoring the requirements for the inspection of Boilers and UPV's. Supplementary training in specific control and flame safeguard systems, which the inspector must know how to test, sometimes have not been provided. Serious boiler explosions have occurred because control systems have failed to operate. In some cases, investigations disclosed that these systems were deficient at the time the boilers were inspected and certified as safe.

a. In order to curb these dangerous violations to inspection rules, it is necessary to establish procedures for monitoring inspections more closely, thus resulting in decisive action to rectify situations where improper inspections are being conducted. An integral part of this effort is to define, in more explicit terms, the roles each level of command should fill in the boiler safety inspection effort.

3. Responsibilities and Procedures.

a. Naval Facilities Engineering and Expeditionary Warfare Center will:

(1) Establish and maintain a Board that shall act on boiler inspection matters and maintain a record of such actions.

(2) Monitor boiler and UPV inspections to establish that the proper internal, external, hydrostatic and operational tests are being performed in accordance with reference (a), and inform the NAVFAC EXWC Boiler Inspection Certification Board (NBICB) of units delinquent by three or more months in their inspection schedules.

(3) License inspectors biennially who have been certified by the NBICB provided they:

(a) Have a regular inspection workload (inspection of 10 or more boilers or UPVs per year).

(b) Are full time employees of a naval shore establishment component.

(c) Are administratively located in a position that does not constitute a conflict of interest as defined by reference (a).

(d) Continue to conduct and report inspections in a proper manner.

(4) Suspend or revoke licenses in accordance with UFC 3 430-07 and Appendix I.

(5) Assist activities in contractual arrangements for boiler inspections and repairs.

(6) Assist activities in providing supplementary training for Boiler Inspectors and, on request, review and approve flame safeguard and control system inspection techniques incorporated in the operation tests conducted on specific units.

(7) Maintain an active liaison with the Secretary of the NBICB. Problem areas, regardless of whether they are administrative or technical, should be brought to the attention of the NBICB as they are discovered.

b. Activities shall comply with Chief of Naval Operations (CNO) directed Boiler Safety Inspection Program and UFC 3 430-07, Inspection and Certification of Boilers and Unfired Pressure Vessels by:

(1) Insuring that boilers and unfired pressure vessels meet the construction, maintenance and operating criteria and requirements of the American Society of Mechanical Engineers (ASME) Pressure Vessel Code, the ASME CSD-1 designed-based standard for Controls and Safety Devices for Automatically Fired Boilers, the National Fire Protection Code, and Occupational Safety and Health Administrative Standards.

(2) Insuring that boilers and pressure vessels are inspected in accordance with UFC 3 430-07.

(3) Forwarding such information so that NAVFAC EXWC may effectively discharge the boiler and UPV safety inspection responsibilities they are assigned.

(4) Insuring that Navy inspectors employed within their organization receive supplementary training as required to understand the specific flame safeguard and control systems on the units they inspect.

(5) Submitting requests to NAVFAC EXWC for waivers of minimum attendance for systems not conforming to the requirements of reference (a) for fully automatic or semi-automatic boilers. Requests should state the condition of the system,

corrective action planned, and time frame necessary to comply with the provisions of the safety criteria and any special operating precautions planned for the interim period.

CHARTER FOR THE NAVAL FACILITIES ENGINEERING SERVICE CENTER
BOARD OF BOILER INSPECTORS

There is hereby created within Naval Facilities Engineering and Expeditionary Warfare Center (EXWC) a Board of Boiler Inspectors, which shall be hereafter referred to as the Board, consisting of five members, four of whom shall be appointed by the NAVFAC EXWC Boiler & UPV Inspection Program Manager. The NAVFAC EXWC Boiler & UPV Inspection Program Manager may, at any time, remove any member for inefficiency or neglect of duty in office. The NAVFAC EXWC Boiler & UPV Inspection Program Manager shall appoint new members to the Board as vacancies are created. These members shall be employees of Naval Facilities Engineering Command and shall be Professional Engineers employed in the design, construction, operation or maintenance of boilers and unfired pressure vessels (UPVs) or shall be Engineering Technicians that are certified and licensed inspectors of boilers and UPVs.

Article I – Selection of Board Executives

The NAVFAC EXWC Division Director, PLM FM&S, PW50, the fifth member, will serve as Chairman of the Board. The NAVFAC EXWC Boiler & UPV Inspection Program Manager shall act as Secretary of the Board. At the call of the Chairman, the Board shall meet at least once a year. No approval, decision or ruling of the Board will be effective unless supported by at least three Board members.

Article II – Responsibilities of the Chairman

A. The Chairman of the Board will call and preside over the meetings, and delegate committees or individuals to investigate and prepare reports for submission to the Board on technical aspects of the business before the Board.

B. The Chairman shall sign all correspondence relative to Board action.

Article III – Responsibilities of the Secretary

A. The Secretary of the Board shall be responsible for administering all correspondence relative to the activities of the Board and keeping the minutes of the meetings. He or she shall receive all correspondence from the field involving or requiring Board action, assume responsibility for preparing all correspondence to the field and, where other Board members assist in the preparation of such correspondence, edit such correspondence to assure that it conforms to the will of the Board and the policies of the Naval Facilities Engineering and Expeditionary Warfare Center.

B. The Secretary shall initiate all correspondence relative to the qualifications, training, and testing of candidate inspectors for certification or license.

C. With the concurrence of the Chairman, the Secretary may call a Board meeting whenever correspondence received renders such action necessary.

D. The Secretary shall maintain a record of certified and licensed inspectors. Approximately six months before each inspector's license expires, the Secretary shall require each inspector to complete and submit an updated boiler inspector's questionnaire to ascertain continued competency by the inspector.

Article IV – Responsibilities of the Board

A. The Board shall disseminate NAVFAC EXWC policy relating to the safety inspections and certifications of boilers and UPVs.

B. The Board shall administer the licensing of NAVFACENGCOM certified inspectors in accordance with procedures specified herein and criteria established by UFC 3-430-07, Inspection and Certification of Boilers and Unfired Pressure Vessels.

Article V – Modification of Charter

Articles of this Charter may be changed in writing by the Chairman, with the majority vote of the Board. The Secretary will maintain a full record of the transaction and modify the Charter accordingly.

Article VI – Suspension or Revocation of an Inspector's License

A. An inspector's license may be suspended and/or revoked by the Board after due investigation of the falsification of any matter or statement contained in his or her application for certification or in any report made by him or her. At such time, the Board may make the recommendation that the inspector's certification be revoked. An inspector's license may also be suspended and/or revoked for lack of boiler and/or UPV inspection work requirements or for any reasons listed in UFC 3 430-07, paragraph 2-1.4. If the Board has reason to believe that a licensed inspector is no longer qualified to hold his or her license, the Board shall, within ten working days, notify the inspector and his or her Commanding Officer in writing and hold a hearing at which time the inspector shall have an opportunity to be heard. An inspector whose license has been suspended shall be entitled to be present and/or to be represented by counsel at the hearing. Upon conclusion of the hearing the NBICB will decide by majority vote on whether to revoke the inspector's license.

B. An inspector's license becomes void upon leaving the full-time employment of the Department of the Navy or upon the completion of twelve consecutive months without completing the minimum specified boiler or UPV inspection workload, as determined by the Board. /5/