

[INCH-POUND]
WW-H-191E
May 27, 1998
SUPERSEDING
WW-H-191D
February 1, 1990

FEDERAL SPECIFICATION

HEATER, FLUID, INDUSTRIAL (INSTANTANEOUS, STEAM, WATER CONVERTOR TYPE)

The General Services Administration has authorized the use of this specification by all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers shell and tube water heaters that use steam in the shell to raise the temperature of a continuous flow of water.

1.2 Classification.

1.2.1 Heaters. The heaters will be of the following types and classes, as specified (see 6.2):

- Type I - U tube.
- Type II - Straight tube, floating head.

- Class 2 - 2 pass unit.
- Class 4 - 4 pass unit.

1.2.2 Rear end heads. The rear end heads will be of the following styles, as specified (see 6.2):

- Style a - Integral shell cover.
- Style b - Externally sealed floating tubesheet.
- Style c - Outside-packed floating head.
- Style d - Floating head with backing device.
- Style e - Pull through floating head.

Beneficial comments, recommendations, additions, deletions, clarifications, etc. and any data which may improve this document should be sent to: Commanding Officer (Code 15E2), Naval Construction Battalion Center, 1000 23 rd Avenue, Port Hueneme, CA 93043-4301, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.
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2. APPLICABLE DOCUMENTS

2.1 Government documents. The following documents, of the issues in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

Federal Standard

FED-STD-595 - Colors Used in Government Procurement.

Military Standard

MIL-STD-209 - Slings and Tiedown Provisions for Lifting and Tying Down Military Equipment.

(Copies of federal and military standards required by contractors in connection with specific procurement functions are obtained from the Defense Automated Printing Services, Attn: DoDSSP, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z1.4 - Sampling Procedures and Tables for Inspection by Attributes.

(Private sector and civil agencies may purchase copies of this voluntary standards from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME Boiler and Pressure Vessel.
Section VIII, Division 1 - Pressure Vessels.

(Private sector and civil agencies may purchase copies of these voluntary standards from the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017-2392.)

ASTM

ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
ASTM A 516 - Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
ASTM A 278 - Gray Iron Castings for Pressure - Containing Parts for Temperatures Up to 650°F.

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- ASTM B 75 - Seamless Copper Tube.
- ASTM B 111 - Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock.
- ASTM B 395 - U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes.

(Private sector and civil agencies may purchase copies of these voluntary standards from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

TUBULAR EXCHANGER MANUFACTURERS ASSOCIATION, INC. (TEMA)

Standards for Tubular Exchanger Manufacturers Association, Class “C” Heat Exchangers.

(Private sector and civil agencies may purchase copies of these voluntary standards from the Tubular Exchanger Manufacturers Association, Inc. 25 North Broadway, Tarrytown, NY 10591.)

(DoD activities may obtain copies of those adopted voluntary standards listed in the DoD Index of Specifications and Standards free of charge from the Defense Automated Printing Services, Attn: DoDSSP, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Description. The heater, as referred to in this specification, is a horizontal unit, multi-pass shell and tube heat exchanger, with saturated steam flowing in the shell side and water flow in the tube side.

3.2 Codes and standards. Each heater shall conform to the applicable requirements of TEMA standards for class C exchanger and ASME Section VIII, Division 1, standards.

3.3 First article. When specified (see 6.2), a sample heater shall be subjected to first article inspection in accordance with 4.2.1.

3.4 Materials. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all equipment, material, and articles incorporated in the work covered by this specification are to be new and fabricated using materials produced from recovered materials to the maximum extent possible without jeopardizing the intended use. The

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term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. Unless otherwise specified, none of the above shall be interpreted to mean that the use of used or rebuilt products are allowed under this specification.

3.5 Interchangeability. All units of the same classification furnished with similar options under a specified contract shall be identical to the extent necessary to ensure interchangeability of component parts, assemblies, accessories, and spare parts.

3.6 System of measurement. The dimensions used in this specification are not intended to preclude the use of the metric system of measurement in the fabrication and production of the material, individual parts, and finished product, provided form, fit, and function requirements are satisfied.

3.7 Design. Design pressure for both the shell and tube sides shall be not less than 125 pounds per square inch gage (psig) (862 kilopascal (kPa (gage))). Pressure loss of the water flowing through clean tube shall be not greater than 6 psig (41 kPa (gage)), and the water velocity shall be not greater than 7.5 feet per second (2.3 metre per second (m/s)). The acceptable nozzle steam velocity shall be not greater than 6,000 feet per minute (30.48 m/s). The rated heater capacity in gallons per minute (GPM) (litre per second (L/s)), temperature of inlet water and temperature of outlet water in degrees Fahrenheit (°F) (degrees Celsius (°C)), and the pressure of steam available at the shell nozzle (psig (kPa (gage))) shall be as specified (see 6.2).

3.8 Construction.

3.8.1 Shell. The shell shall be fabricated from carbon steel pipe conforming to ASTM A 53 grade B. The shell front end shall be a bolted flanged joint. The shell rear end for type I heater shall be welded integral with the shell cover. The shell rear end for type II heater shall be a bolted flanged joint. Unless otherwise specified (see 6.2), the nominal shell diameter and shell length (rounded off to the nearest inch (millimetre (mm))) shall conform to the manufacturer's standard dimensions. The shell length for type I heater is the dimension from the face of the front end flange to the tangent line of the rear end shell cover. The shell length for type II heater is the dimension from the face of the front and rear flanges.

3.8.2 Tubes. Tubes shall be seamless copper or copper alloy conforming to ASTM B 75, ASTM B 111, or ASTM B 395.

3.8.3 Tubesheet. Tubesheet material shall be comparable for tubes specified in 3.8.2 used in commercial practice and designed that the tube bundle be removable from the shell. Tubes shall be rolled into a single tubesheet. When specified (see 6.2), tubes shall be seal welded or brazed to the tubesheet.

3.8.4 Heads. Heads shall be fabricated from carbon steel conforming to ASTM A 516, grade 70 or cast iron conforming to ASTM A 278, grade 30. The front head cover shall be a one-piece flanged bonnet. The rear head for type I heater shall be an integral bonnet cover. The rear head

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for type II heater shall be a floating head with a one-piece flanged bonnet or flanged shell cover, as applicable. All flanged joint(s) shall be provided with metal jacketed or nonasbestos composition gasket(s).

3.8.5 Saddle support. Unless otherwise specified (see 6.2), saddle support shall be provided.

3.8.6 Impingement protection. Impingement baffle shall be provided at the steam inlet nozzle.

3.8.7 Nozzles. Nozzles, 2 inches (50 mm) Iron Pipe Size (IPS) and smaller, shall be a female pipe thread connection. Nozzles, 2.5 inches (65 mm) IPS and larger, shall be flanged. Unless otherwise specified (see 6.2), nozzle orientation and location shall be in accordance with manufacturer's standard practice.

3.8.8 Vent and drain. A 0.75-inch (20 mm) IPS vent and drain shall be provided.

3.8.9 Instrument connections. A 0.75-inch (20 mm) IPS pressure gage and thermometer connection shall be provided on the pipe stub portion of the flanged nozzles.

3.9 Performance. When connected to the specified source of steam supply, the heater shall be capable of providing a continuous flow of hot water at the rated flow and temperature as specified herein (see 3.7).

3.10 Lifting and tiedown attachments. When specified (see 6.2), the heaters shall be equipped with lifting and tiedown attachments. Lifting and tiedown attachment shall conform to type II or type III of MIL-STD-209. A nonferrous transportation plate shall be provided and mechanically attached to the heaters. Transportation plates shall be inscribed with a diagram showing the lifting attachments and lifting slings, the capacity of each attachment, and the required length and size of each sling cable. A silhouette of the item furnished shown the center of gravity shall be provided on the transportation plate. Tiedown attachments may be identified by stenciling or other suitable marking. Tiedown marking shall clearly indicate that the attachments are intended for the tiedown of the heaters on the carrier when shipped.

3.11 Cleaning, treatment, and painting. Surfaces normally painted in good commercial practice shall be cleaned, treated, and painted as specified herein. The color of the finish coat, conforming to FED-STD-595, shall be as specified (see 6.2). Surfaces to be painted shall be cleaned and dried to ensure that they are free from contaminants such as oil, grease, welding slag and spatter, loose mill scale, water, dirt, corrosion product, or any other contaminating substances. As soon as practicable after cleaning and before any corrosion product or other contamination can result the surfaces shall be prepared or treated to ensure the adhesion of the coating system. The painting shall consist of at least one coat of primer and one finish coat. The primer shall be applied to a clean, dry surface as soon as practicable after cleaning and treating. Painting shall be with manufacturer's current materials according to manufacturer's current processes and the total dry film thickness than be not less than 2.5 mils (64 mm) over the entire surface. The paint shall be free from runs, sags, orange peel, or other defects.

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3.12 Identification plate. The contracting officer will furnish to the Government inspector the required identification plates. The contractor will be required to stamp the necessary data in the blank spaces thereon and securely affix said plates in a conspicuous place on each unit, assembly or subassembly, and parts as directed by the Government inspector. Nonferrous screws, rivets, or bolts of not less than 0.125-inch (3.175 mm) in diameter shall be used to affix the plates.

3.13 Technical publication. The technical manual, normally provided in the commercial marketplace, shall be furnished with each heater.

3.14 Repair parts and maintenance tools. When specified (see 6.2), repair parts and maintenance tools shall be furnished. The repair parts required and the quantity thereof shall be as specified in the contract, or when applicable, shall be determined in accordance with the provisioning procedures of the contract.

3.15 Workmanship.

3.15.1 Steel fabrication. The steel used in fabrication shall be free from kinks, sharp bends, and other conditions which would be deleterious to the finished product. Manufacturing processes shall not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes shall be done neatly and accurately. All bends shall be made by controlled means to ensure uniformity of size and shape.

3.15.2 Bolted connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. Washers or lockwashers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.15.3 Welding. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by weld are subjected to proof and service loadings.

3.15.4 Castings. All castings shall be sound and free from patching, misplaced coring, warping, or any other defect which reduces the casting's ability to perform its intended function.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification, where such inspections are deemed necessary to ensure that supplies and services conform to prescribed requirements.

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4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this document shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in this document shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Component and material inspection. Components and materials shall be inspected in accordance with all requirements specified herein and in applicable referenced documents.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.2.1).
- b. Quality conformance inspection (see 4.2.2).

4.2.1 First article inspection. The first article inspection shall be performed on one heater when a first article is required (see 3.3, 6.2 and 6.3). This inspection shall include the examination of 4.5 and the tests of 4.6. The first article may be either a first production item or a standard production item from the supplier's current inventory provided the item meets the requirements of the specification and is representative of the design, construction, and manufacturing technique applicable to the remaining items to be furnished under the contract.

4.2.2 Quality conformance inspection. The quality conformance inspection shall include the examination of 4.5 and the test of 4.6.1. This inspection shall be performed on the samples selected in accordance with 4.4.

4.3 Inspection lot. All units of the same type, style, class, arrangement, and mounting offered to the Government at one time shall be considered a lot for purposes of inspection. The sample unit shall be one complete heater.

4.4 Sampling. Sampling and inspection procedures shall be in accordance with ANSI - Z1.4. The unit of product shall be one heater. All heaters offered for delivery at one time shall be considered a lot for the purpose of inspection. If an inspection lot is rejected, the contractor may rework it to correct the defects, or screen out the defective units, and resubmit for a complete reinspection. Resubmitted lots shall be reinspected using tightened inspection. If the rejected lot was screened, reinspection shall be limited to the defect causing rejection. If the lot was reprocessed, reinspection shall be performed for all defects. Rejected lots shall be separated from new lots, and shall be clearly identified as reinspected lots.

4.4.1 Sampling for examination. Guidance for inspection level and an Acceptable Quality Level (AQL) is provided in 6.4.1.

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4.4.2 Sampling for tests. Guidance for inspection level and an AQL is provided in 6.4.2.

4.5 Examination. Each heater selected shall be examined for compliance with the requirements specified in section 3 of this document. Any redesign or modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following failure to meet specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Noncompliance with any specified requirements or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection.

4.6 Tests.

4.6.1 Hydrostatic test. The hydrostatic test shall be conducted in accordance with ASME standards. Failure of any heater to pass the test shall be cause for rejection.

4.6.2 Performance test. The first article sample shall be tested to verify compliance with the requirements of 3.7 and 3.9. The heater shall be mounted in the test piping with necessary controls and safety devices. When a continuous flow of water at the rated capacity is discharged from the heater outlet, saturated steam shall be gradually admitted to the heater shell until the steam pressure specified for the heater selected is obtained. Outlet water temperature shall be recorded after stabilization of water temperature is achieved. Failure of the heater to meet the required flow and outlet temperature specified shall be cause for rejection.

5. PACKAGING

5.1 Packaging requirements. The preservation, packing, and marking shall be as specified in the contractor or order.

6. NOTES

(This section contains information of a general explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The heaters covered by this specification are intended for hot water heating systems, as supplements to storage tanks or as converters for steam-hot water systems.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this document.
- b. Type and class of heater required (see 1.2.1).
- c. Style of rear end head required (see 1.2.2).
- d. When first article inspection is required (see 3.3, 4.2.1, and 6.3).
- e. Heater capacity (GPM (L/s)), inlet water temperature (°F (°C)), outlet water temperature (°F (°C)), and steam supply pressure (psig (kPa (gage))) as required (see 3.7).

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- f. Nominal shell diameter and shell length if other than manufacturer's standard dimensions (see 3.8.1).
- g. When tubes should be seal welded or brazed to tube sheet (see 3.8.3).
- h. When saddle support should not be provided (see 3.8.5).
- i. Orientation and location of nozzles, if other than manufacturer's standard (see 3.8.7).
- j. When lifting and tiedown attachments are required (see 3.10).
- k. Color of finish coat (see 3.11).
- l. When repair parts and maintenance tools are required and the parts and quantities to be furnished (see 3.14).

6.3 First article. When a first article inspection is required, the item will be tested and should be a first article sample or it may be a standard production item from the contractor's current inventory as specified in 4.2.1. The first article should consist of one unit. The contracting officer should include specific instruction in acquisition documents regarding arrangements for examination, test, and approval of the first article.

6.4 Sampling procedures.

6.4.1 Sampling for examination. Recommended inspection level is II and AQL is 2.5 percent defective (see 4.4.1).

6.4.2 Sampling for tests. Recommended inspection level is S-3 and AQL is 4.0 percent defective (see 4.4.2).

6.5 Standards compliance. Prior to approval of the first shipment, the contractor shall submit for the approval of the contracting officer, or his authorized representative, satisfactory evidence that the heater he proposed to furnish under this specification meets the requirements of ASME and TEMA standards.

6.5.1 ASME standard. Acceptable evidence of meeting the requirements of ASME Section VIII, Division 1, shall be the ASME certification stamp or label, or a certified test report from a recognized independent testing laboratory indicating the heater has been tested and conforms to ASME Section VIII, Division 1. Such evidence must be acceptable to the contracting officer.

6.5.2 TEMA standard. Acceptable evidence of meeting the requirements of TEMA shall be the TEMA Registration Plate attached to the heat exchanger, or a certified test report from a recognized independent testing laboratory indicating the heater has been tested and conforms to TEMA standard. Such evidence must be acceptable to the contracting officer.

6.6 Selection guideline. Selection guidelines shown in tables I and II were requirements in WW-H-191D and were reprinted in this section for information only.

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TABLE I. Design A heater capacity.
Inlet water - 40 °F (4 °C); Outlet water - 180 °F (82 °C)

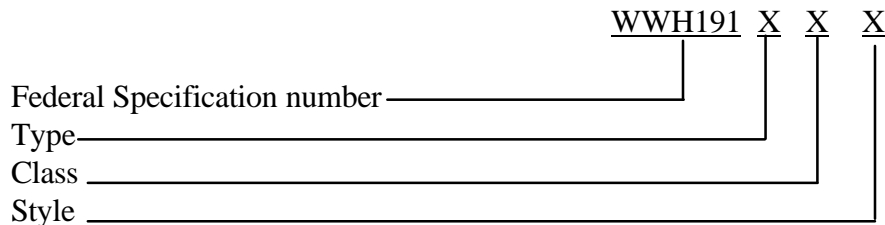
Heater size	Length inches (mm)	Diameter inches (mm)	Minimum required water flow rate, GPM (L/s)					
			(2 pass design)			(4 pass design)		
			5 psig (34 kPa (gage)) steam	10 psig (69 kPa (gage)) steam	25 psig (172 kPa (gage)) steam	5 psig (34 kPa (gage)) steam	10 psig (69 kPa (gage)) steam	25 psig (172 kPa (gage)) steam
1	41 (1 041)	6.625 (168)				360 (2482)	460 (3 171)	660 (4 550)
2	53 (1 346)	6.625 (168)				560 (3861)	620 (4 274)	1,200 (8 273)
3	65 (1 651)	6.625 (168)			800 (5 515)	860 (5929)	1,060 (7 308)	1,800 (12 409)
4	43 (1 092)	8.625 (219)				700 (4826)	900 (6 205)	1,300 (8 962)
5	55 (1 397)	8.625 (219)				1,000 (6894)	1,400 (9 652)	2,000 (13 788)
6	67 (1 702)	8.625 (219)			1,600 (11 030)	360 (2482)	2,000 (13 788)	3,000 (20 682)

TABLE II. Design B heater capacity.
Inlet water - 180 °F (82 °C); Outlet water - 200 °F (93 °C)

Heater size	Length inches (mm)	Diameter inches (mm)	Minimum required water flow rate, GPM (L/s)	
			5 psig (34 kPa (gage)) steam	10 psig (69 kPa (gage)) steam
1	41 (1 041)	6.625 (168)	1,200 (8 273)	2,300 (15 856)
2	53 (1 346)	6.625 (168)	2,100 (14 477)	4,100 (28 265)
3	65 (1 651)	6.625 (168)	3,600 (24 818)	5,000 (34 470)
4	43 (1 092)	8.625 (219)	2,800 (19 303)	5,000 (34 470)
5	55 (1 397)	8.625 (219)	4,800 (33 091)	8,400 (57 910)
6	67 (1 702)	8.625 (219)	7,800 (53 773)	10,000 (68 940)

6.7 Classification cross reference. Classifications used in this specification (see 1.2) are identical to those found in the superseded Federal Specification WW-H-191D.

6.8 Part or Identifying Number (PIN). The specification number, type, class and style are combined to form PINs for heaters covered by this document (see 1.2). PINs for the heaters are established as follows:



6.8.1 Cataloging data. For cataloging data purposes, PIN code numbers for styles are assigned as follows:

- A = Type I
- B = Type II

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2 = Class 2

4 = Class 4

A = Style a

B = Style b

C = Style c

D = Style d

E = Style e

6.9 Subject term (key word) listing.

Converters for steam-hot water systems

Hot water heating systems

Shell and tube water heaters

6.10 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to previous issue due to the extensiveness of the changes.

MILITARY INTERESTS:

Custodians:

Navy - YD1

Air Force - 99

Review Activities:

Navy - MS

Air Force - 84

DLA - CC

CIVIL AGENCY COORDINATING ACTIVITY:

GSA-FSS

Preparing Activity:

Navy - YD1

(Project 4520-0411)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
WW-H-191E

2. DOCUMENT DATE (YYMMDD)
980527

3. DOCUMENT TITLE

HEATER, FLUID, INDUSTRIAL (INSTANTANEOUS, STEAM, WATER CONVERTER TYPE)

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*
5. REASON FOR RECOMMENDATION
6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*

b. ORGANIZATION

c. ADDRESS *(Include Zip Code)*

d. TELEPHONE *(Include Area Code)*
(1) Commercial
(2) AUTOVON
(if applicable)

7. DATE SUBMITTED
(YYMMDD)

8. PREPARING ACTIVITY

a. NAME

D. C. MUI

b. TELEPHONE *Include Area Code)*

(1) Commercial 805-982-5666 (2) AUTOVON 551-5666

c. ADDRESS *(Include Zip Code)*
COMMANDING OFFICER, NCBC CODE 15E2G
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PORT HUENEME, CA 93043-4301

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