INCH-POUND
MIL-PRF-22594C(SH)
w/AMENDMENT 1
12 April 2016

SUPERSEDING
MIL-PRF-22594C(SH)
31 January 2012

PERFORMANCE SPECIFICATION

HEATERS, DUCT TYPE, ELECTRIC

This specification is approved for use by the Naval Sea Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers electric, duct type heaters used in heating, ventilating, and air conditioning systems.

1.2 Classification. Electric, duct type heaters are of the following sizes and types as specified in table I (see 6.2).

1.2.1 Sizes. The sizes of electric, duct type heaters are as follows:

19EH	-	3¼- by 6-inch housing	29EH	-	12¼- by 30-inch housing
20EH	-	3¼- by 6-inch housing	30EH	-	15¼- by 30-inch housing
21EH	-	3¼- by 6-inch housing	31EH	-	12¼- by 42-inch housing
22EH	-	3¼- by 9-inch housing	32EH	-	18¼- by 30-inch housing
23EH	-	3¼- by 14-inch housing	33EH	-	16¾- by 42-inch housing
24EH	-	6¼- by 9-inch housing	34EH	-	15¼- by 56-inch housing
25EH	-	6¼- by 14-inch housing	35EH	-	24¼- by 42-inch housing
26EH	-	6¼- by 22-inch housing	36EH	-	21¼- by 56-inch housing
27EH	-	9¼- by 22-inch housing	37EH	-	36¼- by 42-inch housing
28EH	-	9¼- by 30-inch housing	38EH	-	33¼- by 56-inch housing

1.2.2 Types. The types of electric, duct type heaters are as follows:

Type L - Low Heat Output

Type M - Medium Heat Output

Type H - High Heat Output

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

1.3 Part or identifying number (PIN). PINs to be used for electric, duct type heaters acquired to this specification are created as follows:

M	22594	-	XX	X
Prefix for Military Specification	Specification Number		Size (see code below)	Type (see code below)

Size Code		Type Code	
Size	**Code**	**Type**	**Code**
19EH	19	L	L
20EH	20	M	M
21EH	21	H	H
22EH	22		
23EH	23		
24EH	24		
25EH	25		
26EH	26		
27EH	27		
28EH	28		
29EH	29		
30EH	30		
31EH	31		
32EH	32		
33EH	33		
34EH	34		
35EH	35		
36EH	36		
37EH	37		
38EH	38		

Examples: M22594-19H
M22594-26L

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-S-901 - Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-108 - Definitions of and Basic Requirements for Enclosures for Electric and Electronic Equipment

MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I – Environmental and Type II – Internally Excited)

MIL-STD-889 - Dissimilar Metals

MIL-STD-1399-300 - Electric Power, Alternating Current (Metric)

MIL-STD-2142 - Magnetic Silencing Characteristics, Measurement of (Metric)

(Copies of these documents are available online at http://quicksearch.dla.mil.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S9074-AR-GIB-010/278 - Requirements for Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels

(Copies of this document are available online via Technical Data Management Information System (TDMIS) at https://mercury.tdmis.navy.mil/ by searching for the TMIN without the suffix. Refer questions, inquiries, or problems to: DSN 296-0669, Commercial (805) 228-0669. This document is available for ordering (hard copy) via the Naval Logistics Library https://nll.ahf nmci.navy.mil. For questions regarding the NLL, contact the NLL Customer Service at nllhelpdesk@navy mil, (866) 817-3130, or (215) 697-2626/DSN 442-2626.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY OF HEATING, REFRIGERATION, AND AIR CONDITIONING ENGINEERS (ASHRAE)

ASHRAE STD 33 - Methods of Testing Forced Circulation Air Cooling and Air Heating Coils

(Copies of this document are available online at www.ashrae.org.)

AMERICAN WELDING SOCIETY (AWS)

AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification

AWS B2.2/B2.2M - Specification for Brazing Procedure and Performance Qualification

(Copies of these documents are available online at www.aws.org.)

ASTM INTERNATIONAL

ASTM F1166 - Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities

(Copies of this document are available online at www.astm.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, 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 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.2.

3.2 Materials. Materials shall be corrosion-resisting. Materials degraded during the fabrication process shall be normalized to restore those properties before assembly in any heater. Selected materials shall be capable of meeting all of the operational and environmental requirements specified herein.

3.2.1 Hazardous materials. Materials for use in the construction of heaters shall have no effect on the health of personnel when the materials are used for their intended purpose. Regardless of other requirements, materials and parts containing asbestos, cadmium, lithium, mercury, or radioactive material shall not be used.

3.2.2 Fasteners. Material for all bolts, nuts, studs, screws, and similar fasteners shall be corrosion-resistant passivated or of a material rendered resistant to corrosion. Self-tapping sheet metal screws shall not be used. Galling shall be prevented. Tapped holes shall be reinforced where shearing of thread can occur.

3.2.3 Dissimilar metals. Heaters and components shall not be degraded by electrolysis as specified in MIL-STD-889.

3.2.4 Nonmagnetic material. When nonmagnetic heater assemblies are specified (see 6.2), parts shall be fabricated of nonmagnetic material which has a relative permeability of less than 2.0 after fabrication.

3.2.5 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3 Painting. Interior and exterior surfaces of the heater, except the heating elements and those surfaces constructed of brass, copper, or corrosion-resisting steel, shall be painted as specified (see 6.2). If not specified, the heater shall be unpainted.

3.4 Welding and allied processes. Welding and allied processes shall be performed by personnel certified to AWS B2.1/B2.1M and AWS B2.2/B2.2M. S9074-AR-GIB-010/278 shall be used for guidance.

3.5 Identification plates. Each heater shall be provided with a permanently attached corrosion-resistant identification plate. Attachment method for the identification plate shall also be corrosion-resistant. The plate shall contain the following information:

a. National stock number (NSN)

b. Manufacturer's name, commercial and government entity (CAGE) code, and part number

c. PIN code

d. Contract or order number

3.6 Interchangeability. In no case shall parts be physically interchangeable or reversible unless such parts are also interchangeable or reversible with regard to function, performance, and strength.

3.7 Operating life. The heater shall have an operating life of at least 126,000 hours. The basis for design of replaceable parts shall be an equivalent of 5 years of ship operation (approximately 21,000 hours) before replacement is necessary (see 3.12.1.e).

3.8 Workmanship. The heater assembly shall be free from defects that affect appearance and operation. Fin edges of the heating elements shall be free of burrs and shall not be bent. Support sheets shall not crack due to punching or forming. Sharp edges, burrs, and other imperfections shall be removed from all parts subject to contact with personnel to prevent cuts during repair and maintenance. Cabinet corners shall be square and fasteners shall be in place and secured.

3.9 Human engineering. The heater shall be arranged so as to achieve safe, reliable, and effective performance by the operator and maintenance personnel and to optimize personnel skill requirements. ASTM F1166 shall be utilized as a guideline in applying human engineering design criteria for the heater assembly.

3.10 Maintainability. The heater assembly shall be constructed so that the capability to maintain, disassemble, and repair the unit may be demonstrated (see 4.5.7).

3.11 General design. The heater shall consist of three or more electrical elements (see 3.11.8). Standard wiring shall be for single-stage operations with terminals marked for acceptance of shipboard cable. Up to four three-phase stages may be provided by the contractor using the configuration of the standard single-stage heater. The terminals and shipboard wiring shall be mounted and enclosed in a metal housing. This housing shall be provided with a spraytight enclosure on one side for the electrical connection and a manual reset high limit cutout switch. The heater shall be designed for overhead mounting and shall be provided with flanges on both the inlet and outlet sides for connection to ductwork and shall be ready for installation and connection to a power source.

3.11.1 General shipboard design conditions. General shipboard design characteristics shall be as follows:

a. Power source: In accordance with MIL-STD-1399-300:

(1) 440 volts, three-phase, 60-Hertz for Size 22EH, Types M and H, and Sizes 23EH through 38EH.

(2) 115 volts, three-phase, 60-Hertz for Sizes 19EH through 21EH and Size 22EH, Type L.

b. Shall operate in accordance with requirements herein under a design entering dry bulb (DB) temperatures of 0 °F minimum to 70 °F maximum.

c. Shall operate satisfactorily at airflows between 80 to 125 percent of rated airflow (see table I).

d. Where “standard air” conditions are referenced herein, they shall be defined as: dry air having a density of 0.075 pound per cubic foot, which corresponds to a temperature of approximately 69.4 °F dry bulb at a pressure of 14.696 pounds per square inch absolute.

3.11.2 Sizes. Sizes and types of heaters shall be limited to those specified (see 1.2).

3.11.3 Physical dimensions. To satisfy interface requirements and permit replacement, physical dimensions of the heater shall be in accordance with the dimensions provided on figure 1.

3.11.4 Heater casing material. The casing shall be manufactured from corrosion-resisting materials and be equal or greater in yield strength (tensile and compressive) to 0.045-inch thick 304 stainless steel when the heater face area is 0.750 square foot or less and shall be equal or greater in yield strength (tensile and compressive) to 0.056-inch thick 304 stainless steel when the heater face area exceeds 0.750 square foot. Casing shall be of watertight construction.

3.11.5 Enclosure for electrical connections. The enclosure for electrical connections shall be on the side of the heater casing and shall be of spraytight construction, except the enclosure where the heating elements enter, which shall be watertight as specified in MIL-STD-108. Provisions shall be made for the drainage of condensed moisture. A removable cover plate shall be provided to permit access to the electrical connections, parts, and mounting of heating elements. A separate removable cover plate shall be provided in the bottom of the enclosure to permit installation of a cable terminal tube by the installing activity. Surfaces which mate with the removable cover plates shall be gasketed or otherwise made suitable to provide a spraytight seal.

3.11.6 Connections (flanges) for ductwork and mounting flanges. To permit replacement, connecting flanges for ductwork shall be provided with $^{13}/_{32}$-inch diameter holes (or optional ⅜-inch 16 UNC 2B threaded holes), as shown on figure 1, and shall be on 3-inch centers, working from the flange corners towards the air inlet and air outlet center lines. When the space between the centerline and the adjacent hole exceeds 2 inches, there shall be a hole on the centerline. Tolerance for the distance between hole centers and the location of the corner holes shall be $\pm^{1}/_{64}$ inch. Mounting flanges shall be provided with ½-inch diameter holes (or optional ½-inch 13 UNC 2B threaded holes), as shown on figure 1. Optional mounting flange center connections are shown for Size 33EH heaters and larger; these locations are given if additional mounting connections are required to pass shock testing.

3.11.7 Intermediate supports. Spacing of intermediate supports, where required, shall not exceed 23 inches between supports.

3.11.8 Heating element. Heating elements shall consist of a helical coiled resistance wire centered in a densely packed insulating material enclosed in a hermetically sealed finned metal sheath. Heating elements shall be provided with a terminal at each end of the element and a means of attaching the element to the casing such that the casing is watertight.

3.11.9 Gaskets. Gaskets shall be of heat- and moisture-resistant material.

3.11.10 Marking of terminal board. Terminal boards shall be clearly and permanently marked.

3.11.11 Wiring diagram. A reduced size copy of the heater wiring diagram shall be permanently printed on a material not degraded by high temperature or moisture and shall be permanently attached to the inside of the enclosure access cover for the electrical connections.

3.12 Performance. Performance of the heater for a rated kilowatt at specified airflows and delta temperature rise (ΔT equals leaving air DB temperature minus entering air DB temperature (10 °F)) shall be as specified in table I. Tolerances for airflow shall be within ±5 percent and for ΔT within ±1 °F of that specified in table I. For test purposes, heaters are tested in accordance with table I.

3.12.1 Heating element. Heating elements shall also be in accordance with the following:

a. Fins and hermetic seals shall be positively bonded to the metal sheath.

b. Maximum surface temperature of sheath shall not exceed 750 °F at minimum airflow rating as specified in table I.

c. Moisture-resistant.

d. Capable of continuous operation at rated kilowatt with rated airflow.

e. 21,000-hour shipboard operating life expectancy. Shipboard life expectancy of less than 21,000 hours is defined as a test result of fusion prior to 85 watts per square inch of sheath heating surface area (WSIA) when tested in accordance with 4.5.1.4. A shipboard life expectancy of less than 21,000 hours shall be cause for rejection. The element does not pass if it fails by fusion prior to 85 WSIA.

3.12.1.1 Dielectric strength. The element shall withstand, for a period of 1 minute, a voltage of twice the rated line voltage plus 1,000 volts applied between the terminal and the sheath. The voltage wave shall approximate a sine wave, and frequency shall be 60 Hertz or greater (see 4.5.1.2).

3.12.1.2 Insulation resistance. Insulation resistance of the element after 10 minutes of operation or at an operating temperature of 450 °F shall be not less than 25 megohms. Insulation resistance when each heating element (excluding wiring) is at ambient room temperature shall be not less than 200 megohms (see 4.5.1.3).

TABLE I. Heater performance.

Type	L			M			H		
	ΔT °F			**ΔT °F**			**ΔT °F**		
Size	**29**	**24**	**20**	**44**	**35**	**29**	**48**	**39**	**32**
EH	**Airflow, cubic feet per minute (ft^3/min)**			**Airflow, (ft^3/min)**			**Airflow, (ft^3/min)**		
21	70	85	100	90	115	140	125	155	185
22	105	130	155	140	175	210	190	235	280
23	160	200	240	220	275	330	290	365	440
24	200	250	300	270	340	410	360	450	540
25	305	380	455	415	520	625	550	690	830
26	485	605	725	660	825	990	880	1100	1320
27	710	890	1070	970	1215	1460	1295	1620	1945
28	975	1220	1465	1330	1665	2000	1775	2220	2665
29	1295	1620	1945	1770	2210	2650	2355	2945	3535
30	1610	2015	2420	2195	2745	3295	2930	3660	4390
31	1810	2260	2710	2465	3080	3695	3285	4105	4925
32	1925	2405	2885	2625	3280	3935	3495	4370	5245
33	2475	3095	3715	3375	4220	5065	4500	5625	6750
34	3000	3750	4500	4090	5115	6140	5455	6820	8185
35	3575	4470	5365	4880	6100	7320	6505	8130	9755
36	4180	5225	6270	5700	7125	8550	7600	9500	11,400
37	5365	6705	8045	7315	9145	10,975	9750	12,190	14,630
38	6530	8160	9790	8900	11,125	13,350	11,870	14,835	17,800
19							**ΔT °F**		
							13	10	8
							Airflow, (ft^3/min)		
							125	155	185
20				**ΔT °F**			**ΔT °F**		
				20	16	13	26	21	17
				Airflow, (ft^3/min)			**Airflow, (ft^3/min)**		
				90	115	140	125	155	185

3.12.2 Protection for heater. Each heater shall be provided with a manual reset high limit cutout switch that will limit the surface temperature of the heating elements to 750 °F or less with no airflow. Cutout switch shall be suitable for pilot duty at 115 volts alternating current. The high limit switch shall have a provision for manual reset from the exterior of the enclosure for the electrical connections.

3.12.3 Kilowatt rating. The kilowatt rating of a specific size and type heater shall be equal to that specified in table II ±5 percent, based on 10 °F DB temperature air entering the heater air inlet at rated airflow.

3.12.4 Resistance to airflow. The maximum resistance to airflow through a heater shall be 0.35 inch of water at rated airflow at standard conditions as defined in 3.11.1.

TABLE II. Kilowatt rating.

Size	Capacity in kilowatts (kW)		
	Type L	Type M	Type H
19EH	-	-	0.5
20EH	-	0.58	1.0
21EH	0.65	1.26	1.9
22EH	1.0	1.93	2.9
23EH	1.52	3.0	4.5
24EH	1.90	3.74	5.5
25EH	2.90	5.72	8.5
26EH	4.59	9.1	13.5
27EH	6.76	13.4	20.0
28EH	9.26	18.3	27.3
29EH	12.3	24.3	36.2
30EH	15.3	30.2	45.0
31EH	17.2	33.9	50.5
32EH	18.2	36.0	53.8
33EH	23.5	46.4	69.2
34EH	28.5	56.3	84.0
35EH	33.9	67.1	100.0
36EH	39.7	78.4	117.0
37EH	50.9	100.6	150.0
38EH	61.9	122.4	183.0

3.12.5 Heater electrical circuits.

3.12.5.1 Circuit strength. Heater electrical circuits shall be subjected to and shall withstand, for a period of 1 minute, a dielectric test voltage of twice the rated line voltage plus 1,000 volts applied between each electrical circuit and the frame with all other electrical conductor and metal parts grounded. The voltage wave shall approximate a sine wave, and frequency shall be 60 Hertz or greater (see 4.5.5.4).

3.12.5.2 Insulation resistance. The insulation resistance of the assembled heater at operating temperature shall be not less than 5 megohms (see 4.5.5.5).

3.12.6 Heater creepage and clearance. Creepage shall be equal to or greater than ¼ inch and clearance shall be equal to or greater than ⅛ inch.

3.13 Environmental conditions.

3.13.1 Vibration. Heaters shall be designed such that no damage will occur or malfunction be caused by environmental vibrations in accordance with MIL-STD-167-l.

3.13.2 Shock. Unless otherwise specified (see 6.2), the heater assembly shall pass the high-impact shock tests specified in MIL-S-901 for Grade A, Class I equipment.

3.13.3 Atmospheric spray. Heaters/heater assembly shall be capable of operating satisfactorily when exposed to soaking atmospheric spray (rain or seawater).

4. VERIFICATION

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

a. First article inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 First article inspection. First article inspection shall be performed on each size and type heater assembly when a first article sample is required (see 3.1). This inspection shall include the examination of 4.4 and the tests of 4.5 (see table III).

TABLE III. Test agenda.

Applicability of test to heater type				
Tests	**Requirement**	**Verification**	**First article**	**Conformance**
Heater elements				
Moisture resistance	3.12.1	4.5.1.1	ALL	ALL
Dielectric strength	3.12.1.1	4.5.1.2	ALL	ALL
Insulation resistance	3.12.1.2	4.5.1.3	ALL	ALL
Accelerated life test	3.12.1	4.5.1.4	1/	-
High limit cutout switch	3.12.2	4.5.2	ALL	ALL 2/
Vibration	3.13.1	4.5.3	3/ and 4/	-
Shock	3.13.2	4.5.4		-
Heater performance	3.12	4.5.5	ALL	-
Kilowatt rating	3.12.3	4.5.5.1	ALL	-
Airflow resistance	3.12.4	4.5.5.2	ALL	-
Over-temperature protection	3.12.2	4.5.5.3	ALL	-
Circuit strength	3.12.5.1	4.5.5.4	ALL	ALL
Insulation resistance	3.12.5.2	4.5.5.5	ALL	ALL
Creepage and clearance	3.12.6	4.5.5.6	ALL	-
Nonmagnetic	3.2.4	4.5.6	5/	5/
Maintainability	3.10	4.5.7	6/	6/

NOTES:

1/ First production unit of each watt density.

2/ Can be omitted if the cutout switch manufacturer supplies a Certificate of Conformance certifying that the switch trips within 15 °F of its specified temperature set point.

3/ Test of Size 32EH includes all sizes below Size 32EH. Test of any size heater below Size 32EH includes only those sizes below that size heater.

4/ Test of Size 38EH includes heater Sizes 33EH through 38EH. Test of any size heater below Size 38EH includes only those heaters below that size heater through Size 33EH.

5/ Only test those units to be designated nonmagnetic.

6/ Demonstrate maintainability only on first production unit of each size.

4.3 Conformance inspection. Conformance inspection shall include the examination of 4.4 and the tests of table III.

4.4 Examination. Heaters shall be examined and measured to verify compliance with the requirements of this specification not involving tests. Examination shall be conducted as specified in 4.4.1, 4.4.2, and table IV. Any heater in the sample containing one or more defects shall be rejected.

4.4.1 Lot. All heaters of the same size and type offered for delivery at one time shall be considered a lot.

4.4.2 Sampling for examination. A random sample of heaters shall be selected from each lot in accordance with table V for the examination specified in 4.4, with the following exception: regardless of lot size, the entire lot shall be examined for the proper installation of high limit cut-out switches (Major Defect 102 under table IV).

TABLE IV. Classification of defects.

Categories	Defects
Critical	
1	None defined.
Major	
101	Size not as specified.
102	Incomplete, component parts missing (heating elements, high limit cut-out switch).
103	Materials defective or not as specified.
104	Limited dimensions exceeded.
105	Flange holes and mounting dimensions not as specified.
106	Welding incomplete, not free of cracks, non-fusion, heavy porosity, heavy undercut, slag inclusions.
107	Corner of flanges not smooth, square, or airtight.
108	Access cover plates, missing.
109	Cable entrance plate, missing.
110	Gaskets, missing or defective.
111	Fins not brazed to sheath at least 90 percent.
112	Fins bent back against the sheath or burrs not removed.
113	Splices in wire.
114	Electrical connections, not at terminal of components or terminal blocks.
115	Wiring not neat, tied, or clamped.
116	Cut-out switch cannot be reset without the removal of the cover plate.
117	Bolts, nuts, and screws not tight, missing.
118	Sharp edges and burrs not removed from parts subject to personnel contact.
119	Drawings not followed, or wiring diagram missing.
120	Painting (as applicable), nonconforming.
121	Marking, identification plate not complete, missing, not permanent, illegible, or not as specified.

TABLE V. Sampling for examination.

Lot size number of heaters	Sample size number of heaters [1/]
1 to 6	All [1/]
7 to 15	7 [1/]
16 to 25	10 [1/]
26 to 40	13 [1/]
41 to 65	17 [1/]
66 to 110	22 [1/]
111 to 180	28 [1/]
181 to 300	35 [1/]
301 to 500	45 [1/]

NOTE:
[1/] All production heaters shall be examined for complete installation of high limit cut-out switch.

4.5 Tests. Tests shall be conducted in accordance with 4.5.1 through 4.5.6.

4.5.1 Heating elements. Heating elements of each watt density shall be subjected to the tests specified in 4.5.1.1 through 4.5.1.4 and shall be conducted in the order shown.

4.5.1.1 Moisture resistance. The element shall be completely immersed in water and, while immersed, subjected to a hydrostatic gage pressure of at least 60 pounds per square inch for a period of at least 20 minutes. Terminals of the element shall be wiped dry and subjected to the dielectric test of 4.5.1.2 and the insulation resistance test of 4.5.1.3.

4.5.1.2 Dielectric strength. The element shall be subjected to and shall withstand, for a period of 1 minute, a dielectric test voltage of twice the rated line voltage plus 1,000 volts applied between the terminal and the sheath. The voltage wave shall be in accordance with 3.12.1.1.

4.5.1.3 Insulation resistance. Insulation resistance shall be measured to determine conformance with 3.12.1.2 as follows:

a. Insulation resistance (cold) – at ambient room temperature.

b. Insulation resistance (hot) – after heating element has been energized for at least 10 minutes or has reached a temperature of 450 °F, deenergize the heater and take hot insulation resistance within 60 seconds of removing electrical power.

4.5.1.4 Accelerated life test. Accelerated life test by fusion shall be conducted as follows:

a. Support element in still air.

b. Apply voltage so that element is operating at rated wattage.

c. When operating temperature is stabilized, operate at this condition for at least 30 minutes, cycling on/off at 5-minute intervals.

d. Increase voltage to the next higher increment of 5 WSIA, excluding the fins.

e. Read and record voltage and wattage, and operate the element at this level for at least 30 minutes, cycling on/off at 5-minute intervals.

f. Repeat steps d and e until element fails by fusion or 90 WSIA is reached, whichever occurs first.

4.5.2 High limit cutout switch. Each high limit cutout switch shall be tested to show that the switch opens within 15 °F of the design temperature set point as specified in 3.12.2.

4.5.3 Vibration tests. Vibration tests on the heater assembly shall be conducted prior to the shock test specified in 4.5.4 and performance tests specified in 4.5.5. The heater assembly shall be subjected to the Type I environmental tests specified in MIL-STD-167-1.

4.5.4 High-impact shock tests. Size 32EH and smaller heaters shall be shock tested on the lightweight machine as prescribed for Grade A shock of MIL-S-901. Size 33EH and larger heaters shall be shock tested on the medium weight machine as prescribed for Grade A shock of MIL-S-901. The heater shall be operated at rated voltage and current during the shock tests. Correction of damage which may have occurred during the shock test shall not be performed prior to conducting the tests specified in 4.5.5. Evidence of fragmentation or missile effect of parts or failure to operate shall be cause for rejection.

4.5.5 Heater performance tests. Performance tests shall be conducted in accordance with 4.5.5.1 through 4.5.5.6.

4.5.5.1 Kilowatt rating tests. The kilowatt rating of each size and type heater shall be determined at ambient temperature and corrected for the conditions specified in 3.12 and 3.12.3. The temperature rise through the heaters shall be as specified in table I, and the tolerances for airflow and ΔT shall be in accordance with 3.12. The kilowatt rating shall be as specified in 3.12.3. The test shall be conducted in accordance with ASHRAE STD 33, except as follows:

a. The type of heating shall be electric and the power source shall be 115 volts ±5 percent, three-phase, 60-Hertz for heater Sizes 19EH through 22EH (Type L), and 440 volts ±5 percent, three-phase, 60-Hertz for heater Sizes 22EH (Types M and H) through 38EH.

b. Readings of line volts, amperes, and watts input shall be recorded. Heater shall be operated for at least 30 minutes before commencing test.

c. Use: 3412 British thermal units per hour (Btu/h) = 1 kilowatt.

4.5.5.2 Airflow resistance. The resistance to airflow of the heater shall be determined in accordance with ASHRAE STD 33 at rated airflow ±5 percent at standard conditions as described in 3.11.1. The resistance to airflow shall not exceed that specified in 3.12.4.

4.5.5.3 Over-temperature protection. Heater shall be operated at rated airflow and voltage for at least 30 minutes with an entering air temperature of at least 70 °F. The fan providing the air supply shall be shut off and the surface temperature of the heating elements measured at five points selected at random. The mean measured surface temperature at which the high limit cutout switch contacts open shall not exceed 750 °F.

4.5.5.4 Circuit strength test. Heater electrical circuits shall be subjected to and shall withstand, for a period of 1 minute, a dielectric test voltage of twice the rated line voltage plus 1,000 volts applied between each electrical conductor circuit and the frame with all other electrical conductor and metal parts grounded. The voltage wave shall be in accordance with 3.12.5.1.

4.5.5.5 Insulation resistance test. Insulation resistance of the heater assembly at the normal operating sheath temperature shall be measured within 60 seconds after the heater has been deenergized after being energized for at least 10 minutes or elements have reached a temperature of 450 °F, to determine conformance with 3.12.5.2.

4.5.5.6 Creepage and clearance. Heater shall have the creepage and clearance distances measured to determine whether the distances are in accordance with 3.12.6. Any heater where there is evidence that the creepage or clearance distances, when measured, are not in accordance with 3.12.6 shall be grounds for rejection.

4.5.6 Permeability tests. A permeability test of nonmagnetic material used in construction of the heater assembly shall be conducted in accordance with MIL-STD-2142, Test 501.

4.5.7 Maintainability demonstration. The heater shall be examined after testing, and the capability to maintain, disassemble, and repair the unit shall be demonstrated. The demonstration shall be conducted utilizing commonly available tools and with other-than-expert mechanics. The maintainability demonstration shall include, but not be limited to, the following:

a. Wiring, terminals, and electrical connections are accessible for servicing and testing by removing terminal enclosure cover but without requiring the removal of a subassembly or complete heater casing.

b. Heating elements are replaceable without removing the adjoining ductwork.

c. Fins of the heating elements may be cleaned with a nonmetallic stiff bristle brush without being damaged.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

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

6.1 Intended use. The heater assembly is intended to be used in a ventilation system or an air conditioning system to heat air for ships' compartments or as a preheater for weather air for a ventilation system. It is designed for ready connection to a ventilation or air conditioning distribution system and a power source.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Size, type, and capacities required (see 1.2).

c. Whether first article inspection or first article inspection report is required (see 3.1).

d. Whether nonmagnetic heaters are required (see 3.2.4).

e. Paint requirements (see 3.3).

f. Shock requirements (see 3.13.2).

g. Packaging required (see 5.1).

h. That verification tests should be conducted after award of contract.

6.3 Waiving of requirement for first article testing. Invitations for bids should provide that the Government reserves the right to waive the requirement for first article testing to those bidders offering a product that has been previously approved to MIL-H-22594A or MIL-PRF-22594B.

6.4 Subject term (key word) listing.

Air conditioning

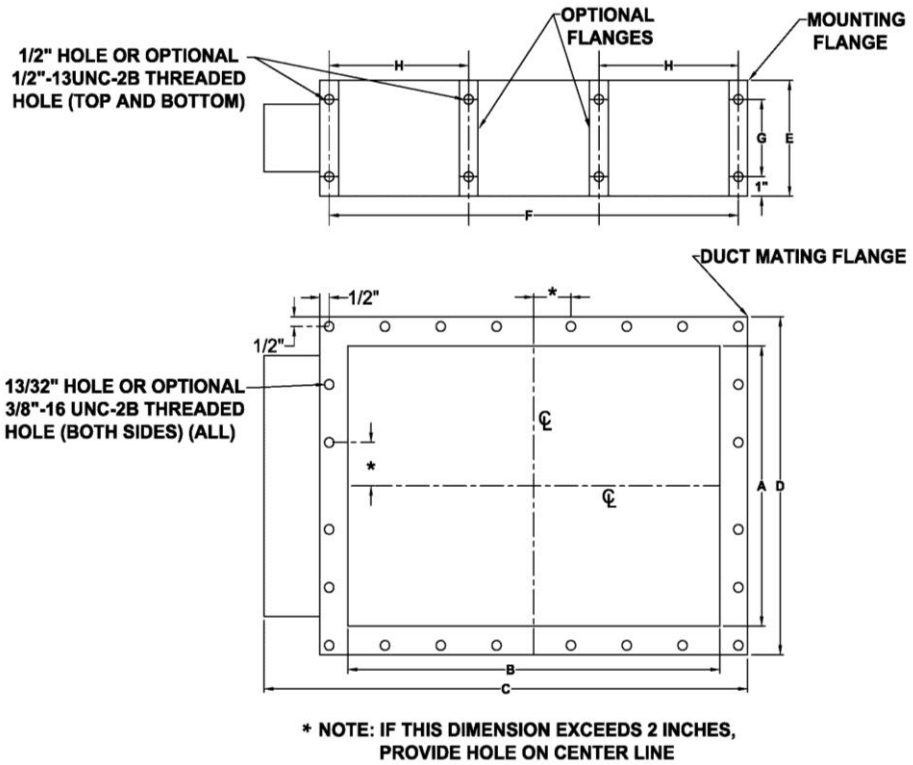
Electric heater

Heating element

Ventilation

6.5 Changes from previous issue. DELETED.

6.6 Amendment notations. The margins of this specification are marked with vertical lines to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.



+

SIZE	A ±1/16"	B ±1/16"	C ±⅛"	D ±1/16"	E ±1/16"	F ±1/16"	G ±1/32"	H ±1/32"
19	3¼	6	13	6¼	6	8	4	-
20	3¼	6	13	6¼	6	8	4	-
21	3¼	6	13	6¼	6	8	4	-
22	3¼	9	16	6¼	6	11	4	-
23	3¼	14	20	6¼	6	16	4	-
24	6¼	9	15	9¼	6	11	4	-
25	6¼	14	20	9¼	6	16	4	-
26	6¼	22	29	9¼	8	24	6	-
27	9¼	22	29	12¼	8	24	6	-
28	9¼	30	38	12¼	8	32	6	-
29	12¼	30	38	15¼	8	32	6	-
30	15¼	30	39	18¼	8	32	6	-
31	12¼	42	51	15¼	8	44	6	-
32	18¼	30	39	21¼	8	32	6	-
33	16¾	42	51	19¾	8	44	6	13½
34	15¼	56	66	18¼	8	58	6	16½
35	24¼	42	52	27¼	8	44	6	13½
36	21¼	56	66	24¼	8	58	6	19½
37	36¼	42	52	39¼	8	44	6	13½
38	33¼	56	66	36¼	8	58	6	19½

FIGURE 1. Heater dimensions.

Preparing activity:
Navy – SH
(Project 4520-2016-001)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.