

INCH - POUND

MIL-PRF-32197

25 April 2006

PERFORMANCE SPECIFICATION

HEATER, SPACE - NON-POWERED, LIQUID FUEL, SMALL

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance and acceptance requirements for a non-powered, liquid fuel burning, 12,000 BTU, radiant space heater for use in the Soldier Crew Tent (SCT) and other 4 or 5 man tents.

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 documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation. (see 6.2).

<p>Comments, suggestions, or questions on this document should be addressed to U.S. Army Soldier Systems Center, Natick, MA 01760-5018 or emailed to Joseph.Mackoul@Natick.Army.Mil . Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil .</p>

AMSC N/A

FSC 4520

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STANDARDS
DEPARTMENT OF DEFENSE

MIL-STD-810 - Environmental Test Methods and Engineering Guidelines

(Copies of these documents are available online at <http://assist.daps.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094)

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to a first article inspection in accordance with 4.2.

3.2 Conformance. When specified (see 6.2), a sample shall be subjected to conformance inspection in accordance with 4.3.

3.3 Operating requirements. Each heater shall satisfy the following user-oriented requirements.

3.3.1 Operation. The heater shall operate safely with all specified fuels and under all specified conditions herein with no electrical power. There shall be no exposure of flame during any mode of operation. There shall be no pool of raw liquid fuel in the burner area during operation or in the case of accidental flame loss.

3.3.2 Ignition. The heaters shall not require any electrical power for ignition. Ignition shall be accomplished safely in ten minutes or less with the use of a match. If priming is required it shall be accomplished safely and cleanly with no fuel spillage. If a device is required to facilitate priming it shall be securely fastened to the heater during transport.

3.3.3 Monitoring. The heaters shall incorporate a sight glass or other means for viewing the entire combustion flame during operation.

3.3.4 Liquid fuel. The heaters shall be safely operated with all of the fuels listed in Table I.

TABLE I. Compatible Fuels

Ambient Temperature Range	Military Symbol CONUS
Above +25° F	DF-2
Above +10° F	DF-1

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Above -60° F	JP8, DFA
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3.3.5 Fuel supply. The heater shall have an integral fuel tank with sufficient capacity to provide 5 hours of operation when operated at 12,000 BTU/hr output, or higher. The tank shall be shielded from heat. At no time during operation shall fuel temperature exceed 100° F in the tank. The tank shall have a 2-1/4" diameter fill hole to allow refueling and emptying with the fuel spout (NSN 7240-00-177-6154) that goes with the standard military 5 gallon. A small vent to allow makeup air into the tank shall be located on the top of the tank. The vent shall be capable of being closed to prevent fuel spillage during transport of the heater. The heater shall also have the capability to connect to and operate from an external fuel supply. The external fuel supply will be the standard military 5 gallon fuel can elevated 4 feet above the ground with a gravity feed adapter and hose line with a Parker Hannifin female hose coupler part number B20-5BP.

3.3.6 Fuel control. The heaters shall have a fuel control that maintains a constant flow rate to the burner from the fuel tank with 10 settings. The heater settings shall be visible from a vantage point of two feet in front of the heater when the heater is in the operational configuration inside the SCT. The fuel control shall provide sufficient fuel flow to achieve the full range of required heat outputs corresponding to Table II utilizing no less than 60% of the full range of 10 settings. The settings shall be permanently labeled. The fuel control shall control fuel flow to the burner to eliminate any possibility of an unsafe over fire condition. The fuel control shall regulate the firing rate in conjunction with the heater, such that, for over 60% of the full range of settings, smoke levels shall not exceed a # 4 on the Bacharach smoke scale. The fuel control shall be located so that the heater is adjustable during operation while wearing cold weather gloves NSN 8415-00-227-1220, and it shall be sufficiently isolated from high heat so that it may be adjusted during operation without posing a burn hazard to the operator.

3.3.6.1 Fuel overflow. The heater shall incorporate a fuel overflow device. The device shall divert fuel from the burner to an overflow hose leading to outside the tent in the event of a failure in the fuel control. The hose shall have a minimum length of 3 feet.

3.3.7 On/Off Valve. An on/off valve shall be located in an easily accessible location and shall immediately stop fuel flow to the burner when turned to the off position. The on/off valve shall be located so that it can be manipulated while wearing cold weather gloves NSN 8415-00-227-1220 and it shall be sufficiently isolated from high heat so that it may be manipulated during operation without posing a burn hazard to the operator.

3.3.8 Fuel filtering. A means to eliminate foreign particles from obstructing fuel flow shall be included. The device shall be located within a protected area on the heater and shall be located to allow for 15 minute removal, cleaning and installation using only common hand tools without the need for supplemental sealers to prevent leaks.

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3.3.9 Combustion efficiency. The heater shall have a combustion efficiency greater than 50% when operated 10,000 BTU/hr or higher.

3.3.10 Smoke readings. The smoke reading of the heater shall not be greater than a No. 4 on the Bacharach smoke scale when the heater is operated between 9,000 BTU/Hr and 12,000 BTU/Hr.

3.3.11 Heat output. The heater shall provide the BTU outputs listed in Table II.

TABLE II. Heat Output Requirements (6500 BTU)

Ambient (°F)	Fuel	Output (low)	Output (high)
40	DF2/DF1	9,000 BTU/Hr	10,000 BTU/Hr
-25	JP8/DFA	10,000 BTU/Hr	12,000 BTU/Hr
-60	JP8/DFA	10,000 BTU/Hr	12,000 BTU/Hr

3.3.12 Fuel flow. Fuel flow shall stop entering the combustion area during accidental flame loss. At no time shall there be a puddle of raw fuel inside the burner area.

3.3.13 Fuel lines and fittings. Fuel lines and controls shall be sufficiently isolated from the combustion chamber and high heat areas to prevent being adversely affected from heat. Fittings shall not leak and shall be compatible with all fuels specified herein. Any fuel lines within 3 inches of the burner shall be capable of withstanding sustained contact with direct flame without melting or rupturing.

3.3.14 Exhaust pipe assembly. The heater shall be supplied with an exhaust pipe assembly. The exhaust pipe shall be compatible for use with the Soldier Crew Tent (SCT) (see 3.6.1). The exhaust pipe assembly shall be storable within the heater envelope dimensions in a secure location to prevent damage or loss during transport. A rain cap and guy lines to secure the exhaust pipe assembly shall be supplied.

3.3.15 Tilt. The heater shall operate at five degrees tilted in any direction without causing a safety hazard or performance degradation.

3.3.16 Safety. The heater and its components shall perform in all modes of operation in a safe manner. All equipment shall include fail safe features for safety of personnel during installation, operation, maintenance, and repair activities. The heater shall be designed to confine any fuel spillage from possible fuel leakage sources (i.e. hoses, fittings, plumbing, tank, etc) in a location at least 3 inches away from the burner.

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3.3.16.1 Exhaust. Products of combustion shall remain separated from the breathable heated air and shall be directed outside the tent via the exhaust pipe

3.3.16.2 Sharp edges. Non-functional sharp edges and projections shall be eliminated.

3.3.16.3 Noise. Noise levels, as measured from 3 feet from the heater, shall not exceed 60 dB.

3.4 Support or ownership requirements. Each heater shall meet the following logistical requirements.

3.4.1 Weight. The weight of the heater, empty of fuel, including all accessories, shall be less than 34 pounds.

3.4.2 Volume. The outside dimensions of the heater in its packed configuration for transport shall not exceed 1.9 cubic foot.

3.4.3 Bottom surface. The bottom surface of the heater in contact with the floor shall remain at 1508 F or less during all modes of operation.

3.4.4 Accessories. The heater shall include all components and tools necessary to facilitate starting and operating the heater.

3.4.5 Mean Time Between Essential Function Failure (MTBEFF)/Maintenance Ratio(MR). The heaters shall meet a quantitative reliability requirement MTBEFF of 615 hours. An essential function failure (EFF) shall be scored when an incident results in the loss or significant degradation of an essential function that can not be quickly (within 15 minutes) corrected by the crew using only on board tools, spares and repair parts. An incident that causes catastrophic or critical hazards shall also be scored as an EFF. The heater maintainability requirement is a total unit, direct support (DS), general support (GS) MR which shall not to exceed 0.0016 maintenance man-hour per operating hour, not including preventive maintenance checks and services (PMCS).

3.4.6 Preventive maintenance checks and services (PMCS). The heater fuel lines and burner shall be designed in such a manner to allow for operator inspection. PMCS shall not exceed 10 minutes time to accomplish. The minimum PMCS items to be checked shall be secure connections of lines, fuel leaks, exhaust obstructions, burner, and general condition to permit operation.

3.4.7 Transportability. The heaters shall be transportable in the High Mobility Multipurpose Wheeled Vehicle (HMMWV), heavy-HMMWV, the Commercial Utility

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Cargo Vehicle (CUCV), and standard Army cargo trucks (2 to 5 ton) and all standard Army cargo trailers having a 3 to 12 ton capacity.

3.4.7.1 Loose cargo. The heaters shall be of sufficient durability to be transported as loose cargo in any of the required transport vehicles.

3.4.7.2 Drop. The heaters shall be of sufficient durability to survive an accidental drop from any of the required transport vehicles.

3.4.8 Labels/tags. The heaters shall have an instruction plate permanently attached in an immediately obvious location which provides warnings, start up and shut down procedures, operating procedures, and safety cautions. The fuel control and heater lettering shall be permanent for the life of the item. Controls shall not obscure labels. Labels shall be located in a consistent manner throughout the system. Labels shall be printed in capitals. All letters shall be black except for when using a black background the letters shall be white. Letter size and width shall be sufficient to be easily read from a distance of four feet in daylight or with the aid of a flashlight.

3.4.9 Set up. The heater shall be capable of being assembled for operation in 20 minutes or less, and disassembled and repacked for storage by two people in 15 minutes or less in any climatic category specified herein.

3.4.10 Food/beverage warming. The heater shall have the capability of heating food and water with the standard 8 inch diameter mess kit pan NSN 7350-00-153-5661.

3.5 Environmental requirements. The heater shall operate as specified under the following environmental conditions.

3.5.1 Storage. The heater and accessories shall remain operable and show no signs of impairment due to storage at 155° F for 4 hours daily.

3.5.2 Basic climate operation. The heater and accessories shall be operable in temperatures of +60° F to 0° F. Heat outputs shall be in accordance with Table II.

3.5.3 Basic cold operation. The heater and accessories shall be operable in temperatures of -5° F to -25° F. Heat outputs shall be in accordance with Table II.

3.5.4 Severe cold operation. The heater and accessories shall be operable in temperatures of -25° F to -60°F. Heat outputs shall be in accordance with Table II.

3.5.5 Severe cold manipulation. The heater shall be compatible with temperatures of -60° F allowing unpacking, set up for operation, and stowage of all accessories. Fuel hose and hose couplers shall remain flexible and operational.

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3.5.6 High altitude. The heaters shall operate safely at a minimum of 85% rated capacity when operated at altitudes of 4,000 feet above sea level. The heater shall display no signs of backfiring, sputtering or pulsing at high altitude.

3.6 Interface requirements. The heater shall meet the following interface and interoperability requirements.

3.6.1 Tent interface. The heater shall be safely operated inside the Soldier Crew Tent (SCT) (NSN 8340-01-359-1481). When the heater is configured for operation inside the SCT, controls shall be readily accessible and the hot surfaces of the heater shall be sufficiently isolated from tent walls.

3.6.2 Fuel interface. During test of 4.5.2 the heater shall operate on DF-2 conforming to commercial item description A-A-52557. During tests of 4.5.3 and 4.5.4, the heater shall operate on JP8 NSN 9130-01-031-5816.

4. VERIFICATION

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

- a. First article inspection (see 4.1.1).
- b. Conformance inspection (see 4.1.2).
- c. End item inspection (see 4.1.3).

4.1.1 First article inspection. When a first article inspection is required (see 3.1 and 6.2), the heater shall undergo the tests and examinations outlined in table III. Sampling for first article inspection shall be as specified in the contract or purchase order.

4.1.2 Conformance inspection. Conformance inspections shall be conducted according to the tests specified in table III. Sampling for conformance inspection shall be as specified in the contract or purchase order (see 3.3 and 6.2).

4.1.3 End item examination. Each heater shall be examined for the requirements specified in table III. Any redesign or modification of the contractor's product to comply with specified requirements, or any necessary redesign or modification following failure to meet the specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examination and dimensional measurements. Non-compliance with any specified requirement, absence of components, or presence of one or more defects shall constitute cause for rejection.

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4.2 Verification methods. Verification methods can include visual examination, measurement, testing, simulation, modeling, engineering evaluation, component properties analysis, certification, and similarity to previously approved or previously qualified designs.

4.2.1 Verification alternatives. The contractor may propose alternative test methods, techniques, or equipment, including application of statistical process control, tool control, or cost-effective sampling procedures to verify performance.

TABLE III. Requirement and Verification Outline

Requirement	Requirement Paragraph	Verification Paragraph	First article inspection	Conformance inspection	End item Examination
Operating Requirements	3.3	4.3			
Operation	3.3.1	4.3.1	X	X	
Ignition	3.3.2	4.3.2	X	X	
Monitoring	3.3.3	4.3.3	X	X	
Liquid fuel	3.3.4	4.3.4	X	X	
Fuel supply	3.3.5	4.3.5	X		
Fuel control	3.3.6	4.3.6	X	X	
Fuel overflow	3.3.6.1	4.3.6.1	X	X	
On/off valve	3.3.7	4.3.7	X	X	
Fuel filtering	3.3.8	4.3.8	X	X	
Combustion efficiency	3.3.9	4.3.9	X		
Smoke readings	3.3.10	4.3.10	X		
Heat output	3.3.11	4.3.11	X		
Fuel flow	3.3.12	4.3.12	X		
Fuel lines and fittings	3.3.13	4.3.13	X		
Exhaust pipe assembly	3.3.14	4.3.14	X	X	
Tilt	3.3.15	4.3.15	X		
Safety	3.3.16	4.3.16			
Exhaust	3.3.16.1	4.3.16.1			
Sharp edges	3.3.16.2	4.3.16.2			X
Noise	3.3.16.3	4.3.16.3			
Support or ownership requirements	3.4	4.4			
Weight	3.4.1	4.4.1	X	X	X

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Volume	3.4.2	4.4.2	X	X	X
Bottom surface	3.4.3	4.4.3	X	X	
Accessories	3.4.4	4.4.4	X	X	X
MTBEFF/MR	3.4.5	4.4.5	X		
PMCS	3.4.6	4.4.6	X		
Transportability	3.4.7	4.4.7	X		
Loose cargo	3.4.7.1	4.4.7.1	X		
Drop	3.4.7.2	4.4.7.2	X		
Labels/tags	3.4.8	4.4.8	X	X	
Set up	3.4.9	4.4.9	X	X	
Food/beverage warming	3.4.10	4.4.10	X		
Environmental requirements	3.5	4.5			
Storage	3.5.1	4.5.1	X		
Basic climate operation	3.5.2	4.5.2	X		
Basic cold operation	3.5.3	4.5.3	X	X	
Severe cold operation	3.5.4	4.5.4	X	X	
Severe cold manipulation	3.5.5	4.5.5	X		
High Altitude	3.5.6	4.5.6	X		
Interface requirements	3.6	4.6			
Tent interface	3.6.1	4.6.1			
Fuel interface	3.6.2	4.6.2			

4.3 Operating requirements verification. All operating requirements shall be verified as follows.

4.3.1 Operation inspection. Any use of electrical power, failure to operate with specified fuels, exposure of flame or exposure of raw fuel shall constitute a failure.

4.3.2 Ignition inspection. Observe heater on start. Failure to start using a match as an ignition source, and failure of the heater to be operating within specified smoke and efficiency readings within 20 minutes after lighting under any environmental condition specified herein, shall constitute a failure. Verify priming procedure is accomplished cleanly and safely and any devices required to facilitate priming can be secured to the heater.

4.3.3 Monitoring inspection. Observe the heater during operation. Inability to view entire flame through a sight glass shall constitute a failure.

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4.3.4 Liquid fuel inspection. Verify fuel compatibility during environmental climate testing of 4.5.2, 4.5.3, and 4.5.4.

4.3.5 Fuel supply inspection. During environmental and reliability testing determine adequacy of integral fuel tank for safe usage and observe for safe fuel temperature at all times. Verify the heater can operate a minimum of 5 hours with a heater output of 12,000 BTU/hr or greater. Verify the tank can be sealed for transport and can be refilled using the standard military 5 gallon can with fuel spout. Verify adequacy of tank venting device. Verify that the heater can connect to and operate safely from the standard military 5 gallon can and gravity feed adapter.

4.3.6 Fuel control inspection. Determine adequacy of the fuel control during environmental climate testing of 4.5.2, 4.5.3, and 4.5.4. Operate the heaters over the full range of settings. Measure heat output as outline in Appendix A for each setting. Failure of the flow rate and heat output to incrementally increase shall constitute a test failure. Measure the smoke level per Appendix A over the range of settings during the climatic tests of 4.5.2, 4.5.3, and 4.5.4. Any smoke readings greater than #4 for over 40% of the range of settings shall constitute a failure. Presence of an unsafe over fire condition during testing as evidenced by black smoke exiting the exhaust stack, pulsing, sputtering or backfiring of the heater or excessive sooting shall constitute a failure. Absence of labeling shall constitute a failure. During test of 4.5.2, measure flow rate to the heater at setting 4 after 1 hour of operation and record. After one more hour of operation at a constant ambient temperature with the tent doors closed and at a fuel control setting 4, measure the flow rate to the heater. An increase greater than 10% over the previous reading shall constitute a failure.

4.3.6.1 Fuel overflow test. Temporarily disable or bypass fuel control to simulate a failure. Verify fuel exits overflow device, and no fuel enters the burner area.

4.3.7 On/Off Valve inspection. After the heater has been operating for a minimum of 10 minutes, turn the on/off valve to the off position and observe the flame. Failure of the flame to diminish after 1 minute prior to activation of the off valve shall constitute a failure. Verify on/off valve is in a readily accessible location and isolated from high heat.

4.3.8 Fuel filtering inspection. Verify the presence of a fuel filtering device. Observe filter condition after reliability testing. Any rusting of filter or heater shut downs related to particles bypassing the fuel filter shall constitute a failure. Verify 15-minute removal, cleaning and replacement.

4.3.9 Combustion efficiency test. During environmental testing of 4.5.2, 4.5.3, and 4.5.4, after durability testing, every 24 hours during reliability testing, and as required, measure efficiency per procedure outlined in Appendix A. Any readings lower than 50% while the heater is operating at 10,000 BTU/Hr or higher shall constitute a test failure.

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4.3.10 Smoke reading test. During environmental testing of 4.5.2, 4.5.3, and 4.5.4, after durability testing, and every 24 hours during reliability testing, measure smoke readings per procedure outlined in Appendix A. Any readings greater than a #4 when heater is operated between 9,000 and 12,000 BTU/Hr shall constitute a failure.

4.3.11 Heat output test. See 4.5.2, 4.5.3, 4.5.4.

4.3.12 Fuel flow test. Configure the heater for operation with a fuel tank and operate for a minimum of 30 minutes. Turn the fuel control to the off position until heater is off. Let heater cool then turn the fuel control to the on position. Any fuel flow entering the combustion area or any puddling of fuel in the burner area shall constitute a failure.

4.3.13 Fuel lines and fittings inspection. During reliability testing per 4.4.5, visually inspect fuel lines every 100 hours and at the end of the test. Any signs of heat damage or degradation shall constitute a test failure. Inability of any fuel lines or fittings to provide positive connections with no fuel leakage during any environmental condition specified herein shall constitute a failure.

4.3.14 Exhaust pipe assembly inspection. Inspect for presence exhaust pipe assembly, rain cap, and, guy-lines and that they are nestable within the heater envelope dimensions. Verify proper interface with SCT.

4.3.15 Tilt test. Operate the heater. After the heater has stabilized tilt the heater 2 degrees and operate for a minimum of 15 minutes. Failure of the heater to continue normal safe operation shall constitute a failure. Perform this test on all four sides.

4.3.16 Safety inspection. Observe test records and performance of all test and inspections within this performance specification. Inspect heater system documentation for adequacy of safety information. Presence of any hazards, injury to personnel or damage to equipment or property resulting from testing shall constitute a failure. Simulate a fuel leakage from hose fittings or tank and ensure that the fuel spillage is confined in a location at least 3 inches away from the burner.

4.3.16.1 Exhaust test. Test for, at a minimum, sulfur dioxide, carbon monoxide, ammonia, nitrogen dioxide and formaldehyde while the heater is set up and operated in a SCT in an ambient temperature of 40° F. The heaters shall operate for a minimum of 6 hours and all doors shall be closed during testing with no one entering the tent during the test. Any readings above the TLV-TWA as established by the ACGIH shall constitute a failure. The test shall be conducted using JP-8 fuel.

4.3.16.2 Sharp edges inspection. Visually inspect the heater. Presence of any non-functional sharp edges shall constitute a failure.

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4.3.16.3 Noise test. Operate the heater at the high fire rate. Measure sound levels at a 3-foot distance around the outside of the heater on four sides and the top. Any readings in excess of 60 dB shall constitute a failure.

4.4 Support or ownership requirements. All support or ownership requirements shall be verified as follows.

4.4.1 Weight inspection. Weigh the heater. Any weight readings exceeding the requirements of 3.4.1 shall constitute a failure.

4.4.2 Volume inspection. Measure the outside envelope dimensions of the heater. Any measurements greater than the requirements listed in 3.4.2 shall constitute a failure.

4.4.3 Bottom surface inspection. During test of 4.5.2, after 1 hour of operation at 10,000 BTU/hr, measure surface temperature at bottom of the heater. Any readings in excess of 1508 F shall constitute a failure.

4.4.4 Accessories inspection. Inspect for the exhaust pipe assembly, overflow hose, burner cleaning / lighting device, and technical manual. Absence of any items required for operation shall constitute a failure.

4.4.5 Mean Time Between Essential Function Failure (MTBEFF)/Maintenance Ratio (MR) test. Four heaters shall each be placed on a reliability test for a minimum of 461 hours each for a total of 1844 hours collective. Testing shall be conducted at 30° F or colder and the heaters shall be at a setting to maintain 10,000 BTU/Hr. There shall be no more than one chargeable essential function failure (cumulative). Fuel type used for test shall be divided equally among DF-2 and JP-8. Perform burner smoke spot, during the start and each 100 hour interval (\pm 10 hours) and once during the last start cycle at the conclusion of this test for each unit operated. A maintenance ratio greater than .0016 maintenance man-hour per operating hour for any maintenance other than PMCS shall constitute a test failure.

4.4.6 Preventive maintenance checks and services (PMCS) inspection. Configure the heater for operation. Perform a walk around inspection of the heater and tent, verify a secure fuel control connection, the fuel supply for proper connection, fuel leaks, and general operating condition. A thorough examination shall not exceed 10 minutes.

4.4.7 Transportability inspection. Assess the ability to be carried by the required vehicles by inspection of the maximum dimensions of the heater and accessories with vehicle cargo storage area dimensions. Inability to transport the heaters and accessories with any of the vehicles listed in 3.4.7 shall constitute a failure.

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4.4.7.1 Loose cargo test. The heater shall be subject to loose cargo testing IAW the requirements and conditions set forth in MIL-STD-810, Method 514.4, Category 3, Procedure III.

- (1) Visually check all contents and functionally check the heater.
- (2) Place the heater, outside of it's original packaging box, on a tester using fences and a plywood bed configured IAW MIL-STD-810. The package tester speed shall be 300 ± 2 RPM. Total test time of 45 minutes shall be divided into the four major loading configurations by stopping the test and rotating the heater 90 degrees and continuing the test as needed.
- (3) Upon completion of the 45 minutes of testing, perform a visual and a functional check of the heater and components.

Any component damage, which prevents the heater from operating after loose cargo testing, or any damage on the heater or accessories which may lead to unsafe operation shall constitute a test failure.

4.4.7.2 Drop test. The heater shall be subject to drop testing as follows:

- (1) Visually check all contents and functionally check the heater.
- (2) Suspend the heater, outside of it's original packaging box, by a drop hook such that the desired edge, corner or face is 24 inches from the impact surface. The drop hook shall be triggered allowing the heater to free fall to the drop surface.
- (3) The drop surface shall be a packed dirt surface.
- (4) Perform a total of 4 drops on the bottom edge, at four different impact surfaces located 90 degrees apart.
- (5) Upon completion of the drop testing, perform a visual and operational check.

Any component damage which prevents the heater from operating after drop testing or any damage on the heater or accessories which may lead to unsafe operation shall constitute a test failure.

4.4.8 Labels/tags inspection. Any signs of labels wearing out from normal usage during reliability testing of 4.4.5 shall constitute a test failure. Omission of any of the required labels shall constitute a failure.

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4.4.9 Set up inspection. Configure the heater for operation. Set up shall be conducted by no more than two people. Average set up times greater than 20 minutes for each heater shall constitute a failure. Repack each heater for storage. Disassembly times greater than 15 minutes for each heater shall constitute a failure.

4.4.10 Food/beverage warming inspection. Verify a location on a hot surface of the heater capable of supporting the standard the mess kit pan (NSN 7350-00-153-5661) while filled with water.

4.5 Environmental requirements. All environmental requirements shall be verified as follows.

4.5.1 Storage test. Subject one heater to storage testing. Bring chamber air temperature up to 155° F ($\pm 3^{\circ}$ F) and 75% relative humidity ($\pm 5\%$), once these conditions are attained, hold for a 4 hour storage period. Remove the heater and perform functionally check. Failure of the heater to operate due to damage incurred during storage testing shall constitute a test failure.

4.5.2 Basic climate operation test. Stabilize climatic chamber ambient air temperature at 40° F ($\pm 2^{\circ}$ F) to operate heater. Cold soak heater, accessories and fuel. Set up and operate heater in the SCT (NSN 8340-01-359-1481). Use fuels specified (see Table II). Perform indicated efficiency, smoke test and heat output test per Appendix A. Failure of the heater to operate over the minimum range of 9,000 BTU/Hr - 10,000 BTU/Hr (± 500 BTU) within acceptable smoke and efficiency levels shall constitute a failure.

4.5.3 Basic cold operation test. Stabilize climatic chamber air temperature at -25° F ($\pm 2^{\circ}$ F) to operate heater. Cold soak heater, accessories and fuel. Set up and operate heater in the SCT (NSN 8340-01-359-1481). Use fuels specified (see Table II). Perform indicated efficiency, smoke test and heat output test per Appendix A. Failure of the heater to operate over the minimum range of 10,000 BTU/Hr - 12,000 BTU/Hr (± 500 BTU) within acceptable smoke and efficiency levels shall constitute a failure.

4.5.4 Severe cold operation test. Stabilize climatic chamber air temperature at -60° F ($\pm 2^{\circ}$ F) to operate heater. Cold soak heater, accessories and fuel. Set up and operate heater in the SCT (NSN 8340-01-359-1481). Use fuels specified (see Table II). Perform indicated efficiency, smoke test and heat output test per Appendix A. Failure of the heater to operate over the minimum range of 10,000 BTU/Hr - 12,000 BTU/Hr (± 500 BTU) within acceptable smoke and efficiency levels shall constitute a failure.

4.5.5 Severe cold manipulation test. Perform a severe cold manipulation and component replacement test. Cold soak the heater, fuel, and accessories to -60° F for a minimum of 4 hours. After component temperature stabilization unpack the heater, connect all fuel lines and set up for operation. Repack all components for transport/storage. Perform this test cycle 3 times. Operate heater at -60° F. Any evidence of damage to fuel lines, fittings,

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components and accessories or any inability to manipulate components while wearing the appropriate cold weather clothing shall constitute a test failure.

4.5.6 High altitude test. Provide a field site, which is 4,000 feet Above Sea Level (ASL) minimum, or simulate conditions at 4,000 feet ASL for operational checkouts. Operate heater for a minimum of one hour. Ambient temperature shall be 50° F or below. Perform smoke spot per Appendix A within 15 minutes after starting and again before shut down. Perform indicated efficiency test per Appendix A and measure fuel flow. Heat output less than 85% rated capacity, unacceptable smoke readings, heater pulsing, or sputtering, shall constitute a failure.

4.6 Interface requirements. The heater shall meet the following interface and interoperability requirements.

4.6.1 Tent interface inspection. During tests of 4.5.2, 4.5.3, and 4.5.4, verify tent used is as specified in 3.6.1. Verify exhaust pipe is compatible with tent. Verify the heater is a safe distance from tent walls during operation. Verify heater controls are accessible during operation.

4.6.2 Fuel interface inspection. During tests of 4.5.2, 4.5.3, and 4.5.4, verify fuels used are as specified in 3.6.2

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or purchase order (see 6.2). When actual packaging of material is to be performed by DOD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Departments System Command. Packaging data retrieval is available from the managing Military Departments or Defense Agency's automated packaging files, CD-ROM products, or by contracting 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 is intended for heating the soldier Crew Tent (SCT) and other small 4 or 5 man tents.

6.2 Acquisition requirements. Acquisition documents should specify the following:

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- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).
- c. When a first article is required (see 3.1.).
- d. Sampling plan for first article and conformance test (see 4.2 and 4.3).
- e. Packaging requirements (see 5.1).

6.3 Subject term (key word) listing.

Diesel fired space heater
 JP-8 fired space heater
 Tent heating

6.4 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required, specifications and standards that have been cleared and listed in DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL) must be listed on a separate Contract Data Requirements List (DD Form 1423), which is included as an exhibit to the contract. The technical manuals should be acquired under separate contract line item in the contract.

6.5 Verification alternatives. Contracting documents should provide guidance to offerors regarding the submission of alternatives to specified verification methods (see 4.3.3).

6.6 First article. When requiring a first article, contracting documents should provide specific guidance to offerors. This guidance should cover whether the first article is a first article sample, a first production item, and the number of test items. These documents should also include specific instructions regarding arrangements for examinations, approval of first article results, and disposition of first articles. Pre-solicitation documents should provide Government waiver rights for first article inspection to bidders offering a previously acquired or tested product. Bidders offering such products who wish to rely on previous testing must furnish evidence with the bid that prior government approval is appropriate for the pending contract.

6.7 Recycled, recovered or environmentally preferable materials. Recycled, recovered or environmentally preferable materials should be used to the maximum extent possible, provided the materials meet or exceed the operational, environmental and maintenance requirements specified herein and promote economically advantageous life cycle costs.

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APPENDIX A

Performance Test Procedures

A.1 SCOPE

A.1.1 Scope. This appendix details the performance testing procedures for measuring indicated combustion efficiency, heat output, and burner smoke spot; and is a mandatory part of this specification.

A.2 APPLICABLE DOCUMENTS. None.

A.3 PROCEDURE

A.3.1 Heater test set up. For all performance testing, the following minimum conditions apply:

- a. The heater shall be set up in the normal operating configuration with the correct length of exhaust pipe and on a level surface inside the Soldier Crew Tent (SCT).
- b. A sampling hole (approximately 3" dia) shall be drilled in the exhaust pipe. The sampling hole shall be located within either 6 inches above or 6 inches below the point where the exhaust pipe exits the roof. The draft shall be natural with out the use of any mechanical draft inducer.
- c. Operate heater on an electronic scale to measure fuel consumption, or, weigh heater before and after operation to determine fuel consumption.

A.3.2 Combustion efficiency test. The heaters shall be operated for a minimum of 15 minutes at the required setting before taking readings. The following readings shall be taken consecutively within five minutes:

- a. Measure flue gas temperature at the sampling hole, a thermometer capable of measuring up to 1300 F shall be used.
- b. Measure air temperature immediately around the combustion air intake area of the heater.
- c. Measure the CO₂ % from the sampling hole using a Bacharach CO₂ indicator, Part No. 11-7032.
- d. Use the following formula for determining the combustion efficiency:

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$$E = 1 - \frac{3171 + 2.69T_s + \frac{216.2 + .77}{CO_2}(T_s - T_i) - 5.38 T_i}{HHV}$$

E = Combustion efficiency (%/100)

T_s = Stack temperature (Degrees C)

T_i = Combustion air inlet temperature (Degrees C)

CO₂ = Carbon dioxide (%)

HHV = High heat value (joules/gram) (from fuel certification)

A.3.3 Heat output.

$$\text{Heat output (BTU/Hr)} = F \times P \times (\text{HHV}/1055) \times E \times 60$$

F = Fuel flow rate (ml/min)

P = Fuel density (gm/ml) (DF-2 = .852 gm/ml, JP8 = .797 gm/ml)

HHV = High heat value (DF-2 = 45166 joule/gram, JP8 = 46163 j/gm)

E = Combustion efficiency (from A.3.2)

A.3.4 Smoke spot test. At the sampling hole, measure the smoke spot using a Bacharach Fyrite test kit, P/N 10-5000, smoke tester and compare to the Bacharach smoke spot scale. The heater shall be operating for a minimum of 15 minutes before taking the smoke sample.

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Custodians:

Army - GL

Navy - YD

Air Force - 99

Preparing activity:

Army - GL

Review activities

Army - CR4

Navy - MC

Air Force - 84

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