INCH - POUND
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PERFORMANCE SPECIFICATION

HEATER, SPACE - CONVECTIVE, SELF-POWERED, LIQUID FUEL, SHC 35

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 self-powered, liquid fuel burning, 35,000 BTU, convective space heater, hereinafter referred to as the SHC, and accessories.

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 Non-Government Publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Natick Research, Development, and Engineering Center, Natick, MA 01760-5018 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

AMSC N/A FSC 4520

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

ASHRAE 51 Laboratory Methods of Testing Fans for Rating Purposes

(Application for copies should be addressed to American Society of Heating, Refrigeration and Air Conditioning Engineers, 1791 Tullie Circle N.E., Atlanta, GA 30329)

2.3 Government documents. The following documents form a part of this document 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) cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

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

2.4 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. 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. Items furnished under this specification shall be subjected to conformance inspection in accordance with 4.3.

3.3 Materials. The contractor shall select the materials used for fabrication, but the materials shall be capable of meeting all the operational and environmental requirements specified herein. Dissimilar metal contact resulting in electrolytic couples which promotes corrosion through galvanic action shall be avoided.

3.3.1 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.

3.4 Performance requirements. For verification of the following performance requirements, see Table II. The SHC, accessories, and materials shall be capable of meeting all the performance requirements herein in all specified environments and climatic categories, including basic climate,

basic cold, severe cold, salt fog and wind/rain. The SHC and accessories shall also be capable of meeting all the specified requirements herein prior and subsequent to all dynamic testing, including vibration, loose cargo, and drop.

3.4.1 Burner system. The burner shall be activated by a single switch on the operator control panel and shall require no additional operator interaction for starting or during operation . The burner shall also incorporate a sensing device which shall continuously monitor flame presence and quality.

3.4.1.1 Combustion air intake. Air for combustion shall be mechanically separated from the breathable air stream and sourced from outside the heater housing. The combustion air inlet area shall have provisions to prevent excessive water, ice build up or snow ingestion which may degrade heater performance. A flexible combustion air inlet pipe shall be provided for accessing outside air when the SHC is operated inside a tent or shelter. The pipe shall be easily attachable requiring no tools and all necessary hardware shall be captive to pipe or heater.

3.4.2 Fuel capability. The SHC shall be safely operated with all of the fuels listed in Table I at the corresponding environmental conditions, with no operator adjustments required to accommodate varying fuel types. Any cold weather fuel shall be operable in the SHC in temperatures up to +60° F without producing a hazardous condition, premature component wear or loss of efficiency. The heater shall operate for a minimum of 14 hours on 5 gallons of fuel.

TABLE I. Compatible Fuels

Ambient Temperature Range	Military Symbol OCONUS	Military Symbol CONUS
Above +25° F	F-54 Regular Grade	DF-2
Above +10° F		DF-1
Above -60° F	F-34	JP-8
Above -60° F		DFA

3.4.3 Ignition system. The ignition system shall consist of the ignitor element and the ignitor power supply. The ignitor element and the power supply shall be replaceable within 15 minutes using only onboard tools.

3.4.4. Fuel system. The fuel system shall include a gravity feed fuel supply line connector, (located within SHC envelope), a filter, an automatic fuel shutoff device, all internal fuel lines and a pump (if required). The heater shall operate from fuel supplied by gravity feed from a U.S. Army standard 5 gallon can NSN 7240-01-337-5269 with the standard gravity feed adapter NSN 7240-21-911-8834 and a gravity feed fuel supply line.

3.4.4.1 Trapped air. Bleeding of trapped air in the fuel line and fuel system shall be automatic and without fuel leakage.

3.4.4.2 Fuel filter. The filter shall remove foreign particles, suspended ice crystals and separate water from the fuel. The filter housing shall be clear to allow for visual inspection of the filter element for foreign particles before, during and after operation. The filter shall be located within a protected area on the SHC and shall be located to allow for 15 minute removal, cleaning and replacement of filter element using only onboard tools. The filter housing shall be of a design that shall not break due to freezing of entrapped water.

3.4.4.3 Automatic fuel shut off capability. Fuel flow shall stop within 2 seconds when the heater start switch is turned to the off position, or when a fault is detected by the system controller during operation. When the start switch is in the off position, and the SHC is connected to the five gallon fuel can in the operational position (inverted), no fuel shall flow from the filter assembly when disassembled for cleaning.

3.4.4.4 Fuel drainage. The SHC shall provide a means to drain residual fuel from the fuel system after disconnection from the five gallon supply.

3.4.4.5 Fuel lines.

3.4.4.5.1 Internal fuel lines. Internal fuel lines shall be easily disconnectable and removable for servicing using common hand tools. Where necessary, fuel shutoff valves, solenoids or drains shall be used to prevent continuous spillage of fuel while disconnecting fuel lines. Any overflow or vented fuel shall be routed to the outside of the heater enclosure preventing liquid or vapor build up within the enclosure. Fuel lines, fittings, and controls shall be sufficiently isolated from the combustion chamber and high heat areas to prevent being adversely affected from heat.

3.4.4.5.2 External fuel lines. The gravity feed fuel supply line shall be easily connectable the heater and gravity feed adapter while wearing cold weather gloves. Fuel shall not flow from the supply line if disconnected from the heater while attached to a full inverted 5 gallon fuel can. The gravity feed fuel supply line shall be 12 feet long.

3.4.4.6 Gaskets and seals. Gaskets and seals shall be suitable for use with specified fuels.

3.4.5 Heat exchanger. The heat exchanger shall be a separable modular component. The heat exchanger shall be gas tight to prevent any of the combustion products from entering the breathable air stream. The heat exchanger and related components shall be designed for maximum efficiency consistent with maintaining discharge temperatures of the exhaust gases above the dew point with or without the use of the accessory exhaust pipe. At no time during operation shall ice formation from the exhaust accumulate within or on any of the combustion system components including the accessory exhaust pipe discharge area.

3.4.5.1 Heat exchanger over temperature protection. The heat exchanger shall incorporate a temperature sensor that shall prevent excessive overheating resulting from possible abnormal operating conditions. The sensor shall positively stop fuel flow to the burner in the event of a heat exchanger over temperature condition. The heat exchanger and related combustion system components shall not suffer any loss of performance or damage when overheated to the point of sensor activation. The sensor shall be manually resettable from outside of the heater enclosure without the removal of panels or covers.

3.4.5.2 Exhaust outlet position. The heater exhaust gases shall be discharged horizontally to facilitate connection to the exhaust pipe when operated within a tent or shelter. The discharge area (exhaust pipe connection point) shall be located and positioned to prevent the ingestion of exhaust gases into the heater breathable air inlet area.

3.4.5.3 Exhaust pipe. During inside tent operation, products of combustion shall be vented to the exterior of the tent or shelter using an exhaust pipe that is routed under or through the tent wall cuff. The exhaust pipe shall be of sufficient length to provide two feet of clearance outside of the wall before discharging the products of combustion. The exhaust pipe shall be protected from rodents entering the pipe.

3.4.5.3.1 Exhaust leakage. There shall be no leakage of exhaust into the tent if the exhaust pipe outlet is blocked.

3.4.5.3.2 Exhaust pipe connection. The interface connection shall have all necessary hardware for attachment to the SHC permanently attached to the exhaust pipe. The attachment of the exhaust pipe shall require no tools and be easily performed with or without anticontact gloves NSN 8415-00-227-1220.

3.4.5.3.3 Exhaust pipe flexibility. The exhaust pipe shall be of sufficient size and resilience to prevent transverse collapsing, excessive area reduction during sharp bends, and shall return the hose to a circular shape after flattening the duct or pipe to 50 percent of the diameter.

3.4.5.3.4 Exhaust pipe temperature. The exhaust pipe must be insulated in such a way that the tent fabric is not damaged or discolored by its use. The exhaust pipe surface temperature rise during operation shall be below 150° F during high fire rates except for the SHC connection point and the immediate area around the exhaust pipe outlet.

3.4.6 Heated air system. The SHC shall provide a minimum of 275 CFM indicated heated air. The heater shall automatically shut off if the heated air outlet exceeds 275° F.

3.4.6.1 Circulation system. The blower or fan system shall be modular as to permit simple removal for service or maintenance.

3.4.6.2 Breathable heated air inlet/outlet. The heated air inlet area and heated air outlet area shall incorporate a metal debris and finger guard to protect components and personnel during normal maintenance and operation. The inlet and outlet guards shall prevent any objects larger than 3/4 inch diameter from entering the enclosure. The inlet and outlet of the enclosure shall be designed to allow the attachment of flexible duct work when operated inside or outside of a tent or shelter. The attachment points shall not protrude outside of the protective frame and shall be protected from impact damage during transportation without the shipping transport bag.

3.4.6.3 Flexible air ducts. Flexible air ducts shall be provided to direct tent return air to the SHC and heated air to the MCPS tent. Both ducts shall be designed to pass through the two tent wall cuffs. Both duct assemblies shall have a minimum "R" value of 4.25 $hr \circ °F \circ ft^2/BTU$.

3.4.6.3.1 Air duct flexibility. Both breathable air ducts shall be of sufficient size and resilience to prevent transverse collapsing, excessive area reduction during sharp bends, and shall return the hose to a circular shape after flattening the duct to 50 percent of the diameter.

3.4.6.3.2 Air duct attachment. The attaching of the ducts to the SHC shall require no tools and be performed wearing anticontact gloves NSN 8415-00-227-1220. Any hardware needed for connection shall be attached to the duct.

3.4.6.3.3 Outlet louver. The heated air outlet duct shall have a manually rotatable (360 degree) louver installed in the tent end of this duct assembly. This louver shall be used to direct the heated air entering the tent in a safe comfortable direction to ensure the most even possible heating of the tent.

3.4.6.3.4 Duct inlet guard. The heater return air duct shall have a debris guard permanently installed in the tent end of this duct assembly preventing debris larger than 3/4 inch diameter entering into the duct.

3.4.7 Operator control panel. The operator control panel shall be weather proof and sized to allow passage through the MCPS 12 inch diameter tent wall sleeve while containing all basic information needed for proper identification, utilization, actuation, or manipulation of the control elements. Sufficient spacing shall be allowed for component manipulation with cold weather gloves. This control panel may not be monitored at all times and shall be organized for quick reference by the operator and shall include an audio tone to be activated during a fault condition. The control panel shall be connected to the SHC by a separable cable, sufficient in length to allow attachment of the control box to a horizontal member of the tent while operating the heater outside of the tent. The cable connections shall be weather proof with protective caps fastened to both ends of the cable. The control panel and heater shall also have a protective cap fastened to the connector for use when disconnected from the cable. The control panel shall have a simple fastening device to hang the panel from the horizontal frame members of a tent that can be

connected and disconnected with anticontact gloves. The control panel shall be designed to provide protection to the switch, status light, or other controls or indicators from damage if dropped or improperly packed for shipment or storage.

3.4.7.1 "On" light. A green "on" indicator light shall illuminate when the on/off switch is in the ON position and shall be located adjacent to the control switch. If a fault condition occurs, the green indicator light shall remain on until the on/off switch is positioned to the off position.

3.4.7.2 Charging light. A green "charging" indicator light located on the control panel shall illuminate when the battery stops supplying heater power and begins to charge from the internal power generation system. This light shall remain illuminated throughout the charging and charged condition of the battery.

3.4.7.3 Charged light. A green "battery charged" indicator light located on the control panel shall illuminate when the battery has reached its normal starting potential. This light shall remain illuminated through out the charged condition of the battery.

3.4.7.4 Fault light. A red "fault" indicator light located on the control panel shall illuminate and pulse out a series of flashes in unison with the audible tone. The fault code shall not be presented until the end of the post purge cycle. The fault code shall repetitively be presented until the on/off switch is positioned to the off position.

3.4.7.5 Fault tone. An audible tone located within the control panel. This tone shall pulse in unison with the fault condition light.

3.4.7.6 Thermostat. A tent thermostat shall be provided to supply the input for control of the heater fire rate in unison with the manually adjusted temperature control knob and shall be located on the control panel.

3.4.7.7 Temperature control knob. The temperature control knob shall provide the manually adjusted temperature set point within the tent being heated. By rotation of the control knob the heater shall increase or decrease the burner fire rate in relation to the setting of the control knob and the tent thermostat sensing device. The control shall be manually adjustable within the range 40° (±5) to 80° (±5) F. Temperature settings of the control knob shall be indicated by the numbers 1 through 5.

3.4.7.8 Set point light. A yellow indicator light shall illuminate indicating that the thermostat is "satisfied".

3.4.7.9 On/Off Switch. A single on/off switch shall be located on the control panel and initiate all start and stop functions of the SHC.

3.4.8 Internal power generation system. The SHC shall contain an internal electrical power generation system that is silent, contains no moving parts, is self contained, and requires no adjustments before, during, or after heater operation. No special periodic maintenance shall be required. The generator output wattage shall provide sufficient electrical power to operate the heater during all thermostat settings during and after battery charging. The generator system shall have built-in "FAIL-SAFE" protection from overheating, overcharging, shock hazard, etc. The generator shall be modular for ease of repair and replacement.

3.4.9 Power regulation system. The power regulation system shall be automatic providing consistent generator output voltage and current control during various burner fire rates and battery state of charge conditions. The power regulation system shall be modular.

3.4.10 Power storage battery. The power storage battery shall be mounted to the heater and shall not require installation or removal when the heater is in use or in the transport bag. It shall be included in the overall weight of the heater. The battery shall be replaceable by one person within 15 minutes. There shall be no exposed wires, terminals, bolts, screws or fuse connections that can be shorted when using metal tools around or in the battery area.

3.4.10.1 Cold starting capacity. Sufficient basic cold starting power shall be stored in the battery to provide two complete start cycles at -25° F after being charged by the heater. Once started at -25° F, the battery shall accept a charge and repetitively start the heater in ambient temperatures to -60° F with heater shut off cycles for fuel and PMCS of 30 minutes.

3.4.10.2 Fuse protection. The power storage battery shall be fuse protected within 6 inches of exiting the battery. The fuse holder(s) shall be weather proof. The fuse(s) shall be easily removable for inspection or maintenance to temperatures of -30° F.

3.4.10.3 Battery leakage. The battery, when subjected to any attitude, shall display no leakage of caustic, hazardous material or liquid and shall be transportable by all modes of shipment.

3.4.10.4 Fail-safe venting. The power storage battery and stowage location shall be vented to the atmosphere. No fumes or liquid shall enter the heated (breathable) air stream, combustion air stream or electronic circuits and electrical component areas in the event of a mechanical rupture or battery over heat condition.

3.4.10.5 Shelf life. The battery shall have a minimum storage life of two years.

3.4.10.6 Recharging. Within an ambient temperature range of -25° F to +60° F, the battery pack shall be 99% recharged within 40 minutes of SHC start as measured from the actuation of the on/off control switch to illumination of the charged light followed by the post purge cycle. Prolonged usage in temperatures from -25° F to -60° F with shut off times of one hour shall not

shorten the life or reduce the charging reliability of the battery.

3.4.10.7 External battery charge. The power storage battery shall have provisions for being charged using a commercially available 115 volt AC to 12 volt DC battery charger. Any adapter necessary shall be included within the accessory package.

3.4.11 Electrical harness. The electrical harness and connectors for the battery, ignitor, ignitor power supply, flame sensor, and control box cable, shall remain flexible and not break or crack when manipulated in temperatures to -60° F.; all other connectors and wires to -30° F.

3.4.11.1 Connectors. Electrical connections shall be of a quick disconnect design wherever feasible. Connectors shall be of the type that will not disconnect or become loose under the dynamic and environmental conditions specified herein, during the service life of the equipment. The connectors and harness shall be routed and protected from excessive heat.

3.4.11.2 Connector keying. When the use of connectors of the same shell size in adjacent locations cannot be avoided, differences in the keying arrangement shall be used to prevent mismating. Multi-contact connectors, including printed circuit assembly connections, shall be keyed, polarized, or of a contact configuration to prevent improper connection positioning or mating.

3.4.11.3 Fuse protection. Necessary fuse protection shall be incorporated to protect against component damage, electrical shorts, and personnel burns. Fuses shall be readily accessible for removal or replacement and protected from accidental grounding from rings, watches or tools. No other component shall be removed in order to gain access to fuses. No special tools shall be required for fuse replacement. Spare fuses shall be located adjacent to the fuse holder.

3.4.12 Automatic built in test (ABIT) capability. The ABIT shall perform starting, stopping, power generation, fault shut off, burner modulation and additional operational functions. All functions shall be automatically executed without additional input from the user other than activation of the on/off switch, adjustment of the thermostat control and connection of fuel. The ABIT system shall provide prediction and detection of malfunction or degradation of systems, subsystems or components specified. When a self monitored function or component falls outside of its safe operating level the ABIT system shall automatically initiate a shut down of the heater. The ABIT system shall function from the initiation of the on/off switch. The ABIT system shall isolate the fault to the lowest replaceable component or fuel supply and identify the specific manual diagnostic for correction during pre-start, start, and operation. The fault code shall be displayed by use of a red fault light accompanied by an audible tone as a string of pulses in unison, with a pause between each code (string) presented. The visual and audible fault code shall be annunciated on the control panel until the switch is positioned to the "off" position.

3.4.12.1 Pre-purge diagnostic control. The pre-purge cycle in the heater control system shall

provide component and electrical operational checks to insure safe reliable starting. At a minimum the combustion air flow, low starting voltage, tilt, ignitor and ignition power source shall be checked for proper operating ranges. If a safe and reliable burner start is not probable then the burner start sequence shall be terminated. If fuel has been introduced into the burner area a post purge cycle shall follow. This pre-purge pre-run function shall be automatic and shall provide a fault code and tone if terminated identifying the source of shut down. The fuel flow to the burner shall be stopped within 2 seconds if initiated after detection of a fault condition or if the on/off switch is positioned to the "off" position.

3.4.12.2 Start cycle. The burner start cycle shall be a consistent automatic timed function allowing minimal fuel flow into the burner combustion area during a failed start condition. If combustion cannot be initiated within this allotted time, the fuel delivery system shall stop followed by the post purge and identifying fault code with tone. There shall not be an unsafe or hazardous condition created by repetitive failed start attempts.

3.4.12.3 Post-purge diagnostic control. Post-purge shall be a consistently timed function insuring sufficient evacuation of burner fumes and cool down of components for safe relocation, PMCS, or refueling after any time fuel has entered the burner area. When the on/off switch is positioned to the off position or a fault is detected the fuel flow shall be shut off to the burner area followed by the post purge cycle or post purge cycle and fault code.

3.4.12.4 Hot re-light diagnostic control. The burner shall be controlled so that it cannot be restarted until the completion of the post purge cycle.

3.4.12.5 Low voltage shut down fault during operation. When a voltage level not sufficient to safely continue heater operation is detected, the fuel flow to the burner shall stop and be followed by the post purge cycle, fault code and audible tone. The low voltage shut off value during heater operation (after start) shall provide adequate power reserves for the full post-purge cycle and repetitive display of the identifying fault code and audible tone for a minimum of 10 minutes.

3.4.12.6 High voltage shut fault down. If the generator used requires voltage or current regulation to prevent battery overcharging, unsafe operation or component degradation, automatic over voltage protection shall stop the burner fuel flow, followed by the post-purge cycle, identifying fault code and audible tone for a minimum of 10 minutes.

3.4.12.7 Tilt fault during operation. The heater shall operate at 15 degrees in any direction. If the heater is tilted manually or by weather conditions greater than 15 degrees roll and pitch the fuel shall be shut off to the burner area followed by the post purge cycle and the identifying fault code and audible tone.

3.4.12.8 Ignition element fault. If the ignition element is or becomes inoperable, the heater

shall automatically terminate the start cycle then provide the identifying fault code, and audible tone.

3.4.12.9 Ignition power fault. If the power required for activation of the ignition element is or becomes inoperable the heater shall automatically shut off then provide the identifying fault code, and audible tone.

3.4.12.10 Combustion air fault during run. If the burner combustion blower motor fails to supply adequate combustion air flow the heater shall automatically shut off then provide the identifying fault code, and audible tone.

3.4.12.11 Fail to start fault. If the burner fails to automatically light within a safe allotted time, fuel flow shall be shut off to the burner followed by the post purge cycle, identifying fault code, and audible tone.

3.4.12.12 Loss of flame fault. If the burner flame goes out after the start cycle and the on/off switch is positioned in the on position the fuel flow shall be shut off followed by the post purge cycle, identifying fault code, and audible tone.

3.4.12.13 Heat exchanger over temperature fault. If the heat exchanger is over-fired or lacks sufficient cooling air flow the fuel shall be shut off to the burner followed by the post purge cycle, identifying fault code, and audible tone.

3.4.12.14 Generator over temperature fault. If the operating temperature of the generator becomes high enough to degrade its performance, or becomes hazardous, the fuel shall be shut off to the burner followed by the post purge cycle, identifying fault code, and audible tone.

3.4.13 Frame/enclosure system. During start-up and operation the SHC shall not produce sound pressure levels in excess of 68 db(A) as measured 3 feet from heater. The enclosure shall be sufficiently cool to allow safe handling and return to the shipping storage bag immediately following the end of the post purge cycle. The enclosure shall be opened for inspection without the use of tools and shall be non-flammable.

3.4.13.1 Weather proof. The heater shall be weather proof when configured inside of the transport storage bag(s), when configured for outside tent operation, and when outside of the transport storage bag(s) with no ducts or fuel lines attached, using dust covers as necessary.

3.4.13.2 Corrosion resistance. The heater and its accessories shall be designed and constructed to provide corrosion resistance during use. All metal components shall be treated or of a composition that shall prevent corrosion. The color of the SHC shall be either green, tan, or white as specified (see 6.2, 6.4 and 6.5).

3.4.13.3 Hour meter. An hour meter shall be installed to provide hours of operation. The hour meter shall be easily accessible without tools.

3.4.14 Accessories. The SHC shall include the following accessories as required to meet this performance specification: Two breathable air ducts, exhaust pipe, combustion air pipe, shipping transport bag(s), control panel, control panel connection cable, battery charging adapter, plastic gravity feed adapter kit NSN 7240-21-911-8834 or equivalent, fuel can stand NSN 7240-01-318-5222 and gravity feed fuel supply line.

3.4.15 Spares. Spare parts shall include the ignitor, fuel filter element, flame sensor, and any other recommended components. Spares shall be located within the storage/transport bag.

3.4.16 Tools. Tool(s) required to remove or replace any spare part shall be included and stowed within the heater or in the storage transport bag(s).

3.4.17 Combustion efficiency/heater output.

3.4.17.1 ASHRAE performance. The heater shall provide 30,500 BTU/Hr minimum heat output when the thermostat is not satisfied using JP8 fuel and 25,500 BTU/Hr maximum heat output with DF2 when the thermostat is satisfied using both air ducts and exhaust pipe. The heated air discharge rate shall be a minimum of 250 CFM during any heat output setting using both air ducts and exhaust pipe (see Appendix A).

3.4.17.2 Indicated efficiency. The burner system shall operate during any temperature setting at a minimum of 70 % indicated combustion efficiency.

3.4.17.3 Burner smoke spot. After 3 minutes of burner operation the heater shall not produce smoke in excess of Bacharach No. 3 in any mode of operation or under any identified performance test condition.

3.5 Physical characteristics.

3.5.1 Weight. The weight of the heater outside of the transport storage bag without accessories shall not exceed 74 pounds. The heater, all accessories and spares when packed within the shipping storage bag(s) shall not exceed 142 pounds. The heater itself, while in the shipping bag, shall not exceed 102 pounds.

3.5.2 Volume. The outside dimensions of the heater shall not exceed six cubic feet.

3.5.3 Fasteners. All external fasteners used to attach covers or access panels for inspection or maintenance shall be captive, limiting loss in snow or dark conditions.

3.6 Interface requirements.

3.6.1 Modular command post system (MCPS) tent interface (outside operation). The heater shall be designed for outside MCPS tent operation and unprotected climatic exposure. The SHC ducts shall attach to the two 12.5 inch diameter sleeves located 101 inches apart (center to center) 3 inches off of the floor (with tent set up) in one MCPS tent wall. Special consideration shall be given to the heater enclosure and exhaust outlet design to prevent damage or fire to any tent fabric that may come into contact with the enclosure and related components during movement of the tent walls in wind gust conditions. 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.

3.6.1.1 MCPS modification kit. When specified, (see 6.2), the SHC shall be provided with a kit that shall allow the operator to modify a plain MCPS tent wall to interface with the SHC inlet and outlet ducts. The kit shall include all necessary components and hardware to modify the MCPS wall for SHC outside operation. The kit shall include all necessary templates, and instructions to insure duct hole locations are placed correctly as defined in 3.6.1. The duct openings shall allow passage of the air ducts through the tent wall and shall provide a snug fit to prevent outside air from entering the MCPS. When the SHC ducts are not attached, the duct openings shall be completely sealable to prevent outside air from entering the MCPS. The kit shall include all necessary tools required to perform the modification.

3.6.2 Modular command post system (MCPS) tent interface (inside operation). The SHC shall operate inside an MCPS tent in severe cold climatic exposure. The heater and components shall allow the placement of the heater within two feet of the tent wall. The SHC shall not damage or cause fire to any tent fabric that may come into contact with the enclosure or exhaust pipe during movement of the tent walls in wind gust conditions. 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.

3.7 Reliability/maintainability.

3.7.1 Mean Time Between Essential Function Failure (MTBEFF)/Maintenance Ratio(MR). The quantitative reliability requirement is a MTBEFF of 615 hours. The SHC heater essential functions are heating air sufficient to maintain a minimum 50° F temperature inside a tent having 80 to 150 square feet of floor area, and circulating heated air in the tent without the use of external power. 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 SHC 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).

3.7.2 Field serviceability. Spare parts shall be capable of being removed and replaced within the operational environment by MOS nonspecific personnel wearing anticontact gloves NSN 8415-00-227-1220 within 15 minutes. Fielding the SHC shall have no impact on the manpower or personnel structure. Spare parts shall be installed and wired for field maintenance to - 60° F.

3.7.3 Common test equipment. There shall be no new system specific test, measurement, and diagnostic equipment, or special tools to repair or maintain the heater. The heater shall be capable of complete disassembly and reassembled using common hand tools.

3.7.4 False alarm rate. The ABIT system shall have a zero false alarm rate.

3.7.5 Preventive maintenance checks and services (PMCS). The heater's breathable air ducts, fuel connection, and fuel filter location and connection shall be designed in such a manner to allow for operator inspection and clearance (walk around) between the MCPS tent wall and the heater without disconnection from the tent. A PMCS shall be performed before and after operation of the SHC and shall not exceed 10 minutes time to accomplish. The minimum PMCS items to be checked during any climatic condition specified in this performance specification during day light or dark using a flash light shall be:

a. Outside tent operation: Fuel filter (water-ice crystals, dirt), secure connections of the duct work to the heater and tent, secure control box connection, the gravity fuel supply for proper connection, snow or ice coverage or blockage, fuel leaks and general condition to permit operation for up to five gallons of fuel.

b. Inside tent operation: Fuel filter (water-ice crystals, dirt), secure connections of the exhaust pipe, combustion air pipe, secure control box connection, gravity fuel supply, fuel leaks and general condition to permit operation for up to five gallons of fuel.

3.7.6 Operator/maintenance manual. The manual shall be stowable within the SHC transport bag (see 6.6).

3.8 Environmental conditions.

3.8.1 Salt fog. The SHC and accessories shall show no evidence of peeling, blistering paint, possible electrical shorts due to salt deposits, deterioration, clogging or binding of moving parts, or change in tolerance limits of any internal or external parts.

3.8.2 Wind/rain. The SHC shall be operable in winds of 45 mph and rains of 4 inches per hour.

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

3.8.4 Basic climate operation. The SHC and accessories shall be operable in temperatures of +60° F to 0° F and provide a range of 24.5 KBTU maximum (low setting) and 32.5 KBTU minimum (high setting).

3.8.5 Basic cold operation. The SHC and accessories shall be operable in temperatures of -5° F to -25° F and provide a minimum of 32.5 KBTU.

3.8.6 Severe cold climate operation. When using specified fuels, the SHC and accessories shall operate inside or outside of a tent and provide a minimum of 32.5 KBTU when cold soaked and started at -30° F and operated to -60° F.

3.8.7 Severe cold manipulation. The SHC shall be compatible with temperatures of -60° F allowing unpacking, connection to the MCPS tent and stowage within the transport storage bag. Breathable air ducts, combustion pipes, battery, flame sensor, ignitor, control panel and cable, fuel hose, and hose couplers shall remain flexible, replaceable and operational.

3.8.8 High altitude. The SHC shall operate without loss of performance (70% minimum efficiency and smoke spot less than #3) or component degradation when operated at altitudes of 6,000 feet above sea level.

3.8.9 Minimum test run. The SHC shall be capable of starting, battery charging, operating at 70% or higher efficiency, and providing a smoke level less than #3 to verify performance.

3.9 Transportability.

3.9.1 Military vehicles. The SHC shall be easily transportable in the High Mobility Multipurpose Wheeled Vehicle (HMMWV), heavy-HMMWV, the Commercial Utility Cargo Vehicle (CUCV), and standard Army cargo trucks (2 1/2 to 5 ton) and all standard Army cargo trailers having a 1/4 to 1 1/2 ton capacity.

3.9.2 Vibration. The SHC and accessories shall remain fully operational after being subjected to the basic vibration profiles.

3.9.3 Loose cargo. The SHC and accessories shall remain fully operational after being subject to loose cargo testing.

3.9.4 Drop. The SHC and accessories shall remain fully operational after being subject to drop testing.

3.9.5 Transport and storage bag. An SHC transport and storage protection bag shall be included to house all necessary components for operation and field maintenance. This reusable transport and storage bag(s) shall house the heater, supply and return breathable air ducts, exhaust pipe, combustion air inlet pipe, control panel, control panel connection cable, fuel can stand assembly (tripod), (plastic) gravity feed adapter kit, gravity feed fuel supply line, spare parts, tools, battery charge adapter (if required) and operator/maintenance manual. The bag(s) shall provide protection for international shipping by any mode. The weather proof shipping bag(s) shall have the necessary hand holds to be easily carried by four people. The hand holds shall be placed to provide a uniform load distribution. The bag(s) shall be rain/wind proof and operational to - 60° F. The bag(s) shall be designed for removal and return of the heater and necessary accessory components by two people in all temperatures, while wearing the field duty uniform and the cold weather ensemble. When fully packed for shipment, if two packing bags are used, they shall be capable of being strapped together. In the shipping configuration there shall be no damage that would impair the operational status of the heater or its accessories when subjected to vibration, loose cargo and drop.

3.10 Identification and marking.

3.10.1 Labels/tags. The SHC shall have warnings and information labels providing quick and easy identification of assembly, maintenance items, safety cautions, operating instructions and fuels affixed to accessories, enclosures or panels. Lifting requirements shall be clearly labeled.

3.11 Interchangeability.

3.11.1 Replacement parts. All parts shall be physically interchangeable with like parts of other units furnished under the same contract.

3.12 Safety.

3.12.1 Operational safety. The SHC and its components shall perform in all modes of operation in a safe manner. Design shall be for minimum hazard with safety devices, warning devices, and special emergency procedures employed to reduce potentially marginal, critical, or catastrophic conditions to a safe level. Known hazards and hazards that may become evident during performance testing shall be controlled to protect personnel, equipment, and property. System safety shall be consistent with the operational requirements of the system. Design safety is preferred over procedural safety. Where design safety features must be compromised to achieve optimum SHC system performance or reliability, the contractor shall recommend alternate means for approval by the procuring activity. All equipment shall include fail safe features for safety of personnel during installation, operation, maintenance, and repair activities.

3.12.2 Breathable air. Products of combustion shall remain separated from the breathable heated air stream. Heated air inside the MCPS shall be within the 8-hour Threshold Limit Values-

Time Weighted Average (TLV-TWA) for carbon dioxide, nitrogen dioxide, carbon monoxide, formaldehyde and ammonia.

3.12.3 Electrical shock. The SHC shall have provisions to protect the operator from electrical shock or burns. At a minimum, the operator control panel indicator light shall always be illuminated when the heater has an electrical component continuity and cannot be safely accessed for maintenance while operating or after a fault condition.

3.12.4 Sharp edges/moving parts. Non-functional sharp edges and projections shall be eliminated. The SHC shall provide operator protection from all moving parts.

3.12.5 Surface areas. All surface areas of the heater shall be below 120° F during operation except for the exhaust pipe outlet area, the heated breathable air outlet duct connection point and the heated air duct outlet louver.

3.13 Human factors engineering

3.13.1 Human machine interface. The equipment shall provide a human machine interface (HMI) that shall enable inexperienced operators to initiate and control all equipment functions. The system command structure and operator interface shall be simple, flexible, responsive, error tolerant and require minimal operator interaction.

3.13.2 Component access. All major components shall be accessible within five minutes for inspection, cleaning or repair using no tools or tools supplied with the SHC.

3.13.3 Lifting. The SHC, when removed from the transport/storage bag, shall be transportable by two people wearing cold weather gear. The SHC inside the transport bag shall be transportable by three people. The SHC and accessories inside the transport/storage bag(s) shall be transportable by four people.

3.13.4 Handles. The handles on the SHC shall remain cool enough during operation to allow movement without the use of gloves.

3.13.5 Personnel clothing. The system shall be easily operated by personnel attired in clothing appropriate for all intended user environments.

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. When a first article inspection is required (see 3.1, 6.2), the SHC shall undergo all the tests and examinations outlined in Table II. Sampling for first article inspection shall be as specified in the contract or purchase order (see 6.2 and 6.8).

4.3 Conformance inspection. Conformance inspections shall be conducted according to the tests specified in Table II (see 6.9). The sampling rate for conformance inspection shall be as specified in the contract or purchase order (see 6.2).

4.3.1 End item examination. Each SHC shall be examined for the requirements specified in Table II. 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 examinations, dimensional measurements and the minimum run cycle.

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

4.3.3 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 (see 6.7).

TABLE II Requirement and Verification Outline

Requirement	Requirement paragraph	Verification paragraph	First article inspection	Conformance inspection	End item examination
Burner system	3.4.1	4.4.1	X	X	
Combustion air intake	3.4.1.1	4.4.1.1	X	X	
Fuel capability	3.4.2	4.4.2	X	X	
Ignition system	3.4.3	4.4.3	X	X	
Fuel system	3.4.4	4.4.4	X	X	
Trapped air	3.4.4.1	4.4.4.1	X	X	
Fuel filter	3.4.4.2	4.4.4.2	X	X	
Automatic fuel shut-off capability	3.4.4.3	4.4.4.3	X		
Fuel drainage	3.4.4.4	4.4.4.4	X		
Internal fuel lines	3.4.4.5.1	4.4.4.5.1	X		
External fuel lines	3.4.4.5.2	4.4.4.5.2	X		
Gaskets and seals	3.4.4.6	4.4.4.6	X		
Heat exchanger	3.4.5	4.4.5	X		
Heat exchanger over temperature protection	3.4.5.1	4.4.5.1	X	X	
Exhaust outlet position	3.4.5.2	4.4.5.2	X		

Exhaust pipe	3.4.5.3	4.4.5.3	X		
Exhaust leakage	3.4.5.3.1	4.4.5.3.1	X		
Exhaust pipe connection	3.4.5.3.2	4.4.5.3.2	X		
Exhaust pipe flexibility	3.4.5.3.3	4.4.5.3.3	X		
Exhaust pipe temperature	3.4.5.3.4	4.4.5.3.4	X		
Heated air system	3.4.6	4.4.6	X	X	
Circulation system	3.4.6.1	4.4.6.1	X	X	
Breathable heated air inlet/outlet	3.4.6.2	4.4.6.2	X		
Flexible air ducts	3.4.6.3	4.4.6.3	X		
Air duct flexibility	3.4.6.3.1	4.4.6.3.1	X		
Air duct attachment	3.4.6.3.2	4.4.6.3.2	X		
Outlet louver	3.4.6.3.3	4.4.6.3.3	X		
Duct inlet guard	3.4.6.3.4	4.4.6.3.4	X		
Operator control panel	3.4.7	4.4.7	X		
"On" light	3.4.7.1	4.4.7.1	X	X	
Charging light	3.4.7.2	4.4.7.2	X	X	
Charged light	3.4.7.3	4.4.7.3	X	X	
Fault light	3.4.7.4	4.4.7.4	X	X	
Fault tone	3.4.7.5	4.4.7.5	X	X	
Thermostat	3.4.7.6	4.4.7.6	X	X	
Temperature control knob	3.4.7.7	4.4.7.7	X	X	
Set point light	3.4.7.8	4.4.7.8	X	X	
On/off switch	3.4.7.9	4.4.7.9	X	X	
Internal power generation system	3.4.8	4.4.8	X		
Power regulation system	3.4.9	4.4.9	X	X	
Power storage battery	3.4.10	4.4.10	X		
Cold starting capacity	3.4.10.1	4.4.10.1	X	X	
Fuse protection	3.4.10.2	4.4.10.2	X	X	

TABLE II (continued)

Requirement	Requirement paragraph	Verification paragraph	First article inspection	Conformance inspection	End item examination
Battery leakage	3.4.10.3	4.4.10.3	X	X	
Fail-safe venting	3.4.10.4	4.4.10.4	X	X	
Shelf life	3.4.10.5	4.4.10.5	X	X	
Recharging	3.4.10.6	4.4.10.6	X	X	
External battery charge	3.4.10.7	4.4.10.7	X	X	
Electrical harness	3.4.11	4.4.11	X		
Connectors	3.4.11.1	4.4.11.1	X		
Connector keying	3.4.11.2	4.4.11.2	X		
Fuse protection	3.4.11.3	4.4.11.3	X	X	
Automatic built-in test capability	3.4.12	4.4.12	X	X	
Pre-purge diagnostic control	3.4.12.1	4.4.12.1	X	X	
Start cycle	3.4.12.2	4.4.12.2	X	X	
Post-purge diagnostic control	3.4.12.3	4.4.12.3	X	X	
Hot re-light diagnostic control	3.4.12.4	4.4.12.4	X	X	
Low voltage shut down fault	3.4.12.5	4.4.12.5	X	X	
High voltage shut down fault	3.4.12.6	4.4.12.6	X	X	
Tilt fault during operation	3.4.12.7	4.4.12.7	X	X	
Ignitor element fault	3.4.12.8	4.4.12.8	X	X	

Ignition power fault	3.4.12.9	4.4.12.9	X	X	
Combustion air fault during run	3.4.12.10	4.4.12.10	X	X	
Fail to start fault	3.4.12.11	4.4.12.11	X	X	
Loss of flame fault	3.4.12.12	4.4.12.12	X	X	
Heat exchanger overtemp fault	3.4.12.13	4.4.12.13	X	X	
Generator over temp fault	3.4.12.14	4.4.12.14	X	X	
Frame/enclosure system	3.4.13	4.4.13	X	X	
Weather proof	3.4.13.1	4.4.13.1	X		
Corrosion resistance	3.4.13.2	4.4.13.2	X		
Hour meter	3.4.13.3	4.4.13.3	X	X	X
Accessories	3.4.14	4.4.14	X	X	X
Spares	3.4.15	4.4.15	X	X	X
Tools	3.4.16	4.4.16	X	X	X
ASHRAE performance	3.4.17.1	4.4.17.1	X	X	
Indicated efficiency	3.4.17.2	4.4.17.2	X	X	
Burner smoke spot	3.4.17.3	4.4.17.3	X	X	
Weight	3.5.1	4.5.1	X	X	
Volume	3.5.2	4.5.2	X	X	
Fasteners	3.5.3	4.5.3	X	X	
MCPS interface outside operation	3.6.1	4.6.1	X		
MCPS modification kit	3.6.1.1	4.6.1.1	X		
MCPS interface inside operation	3.6.2	4.6.2	X		
MTBEFF/MR	3.7.1	4.7.1	X		
Field serviceability	3.7.2	4.7.2	X	X	
Common test equipment	3.7.3	4.7.3	X	X	
False alarm rate	3.7.4	4.7.4	X	X	

TABLE II (Continued)

Requirement	Requirement paragraph	Verification paragraph	First article inspection	Conformance inspection	End item examination
PMCS	3.7.5	4.7.5	X		
Operator/maintenance manual	3.7.6	4.7.6	X	X	X
Salt fog	3.8.1	4.8.1	X		
Wind/rain	3.8.2	4.8.2	X		
Storage	3.8.3	4.8.3	X		
Basic climate operation	3.8.4	4.8.4	X		
Basic cold operation	3.8.5	4.8.5	X	X	
Severe cold climate operation	3.8.6	4.8.6	X		
Severe cold manipulation	3.8.7	4.8.7	X		
High altitude	3.8.8	4.8.8	X		
Minimum test run	3.8.9	4.8.9	X	X	X
Transportability on military vehicles	3.9.1	4.9.1	X		
Vibration	3.9.2	4.9.2	X		
Loose cargo	3.9.3	4.9.3	X		
Drop	3.9.4	4.9.4	X		
Transport/storage bag	3.9.5	4.9.5	X	X	X
Labels/tags	3.10.1	4.10.1	X	X	X
Replacement parts	3.11.1	4.11.1	X	X	X

Operational safety	3.12.1	4.12.1	X	X	
Breathable air	3.12.2	4.12.2	X	X	
Electrical shock	3.12.3	4.12.3	X	X	
Sharp edges/moving parts	3.12.4	4.12.4	X	X	X
Surface areas	3.12.5	4.12.5	X		
Human machine interface	3.13.1	4.13.1	X	X	
Component access	3.13.2	4.13.2	X	X	
Lifting	3.13.3	4.13.3	X		
Handles	3.13.4	4.13.4	X		
Personnel clothing	3.13.5	4.13.5	X	X	

4.4 Tests and examinations. Unless otherwise specified, all verifications shall be conducted under ambient conditions of 60° ± 5° F.

4.4.1 Burner system. During any performance testing specified herein, manual compensation for varying fuel types or operator interaction other than connecting the SHC to the fuel supply and activating a switch, shall constitute a failure.

4.4.1.1 Combustion air intake. Inspect the SHC for air ductwork, metal panels or similar hard barriers to verify that the combustion air is mechanically separated from the SHC breathable air system. Inspect the SHC for a protective cover, diffuser or similar device that shall limit rain, ice and snow from entering the combustion air stream. Configure the heater as specified in 4.6.2. The combustion pipe shall lay on the tent floor and be routed outdoors under or through the tent wall a minimum of two feet from the tent wall. Verify that no tools are required and all necessary hardware for connection is attached.

4.4.2 Fuel capability. Operate the SHC with JP-8 or DFA in the outside MCPS configuration. Measure fuel usage over a minimum 6 hour period at basic cold conditions with the control panel thermostat set in the middle of it's range. Average fuel consumption above 0.36 gallons per hour shall constitute a failure.

4.4.3 Ignition system. Verify during tests of 4.7.2 and 4.8.7.

4.4.4 Fuel system. Visually determine that the gravity feed fuel supply line mates with the standard gravity feed adapter during severe cold weather manipulation per 4.8.8 and the fuel source is the standard five gallon fuel can during reliability testing per 4.7.1. Inability of the fuel line to mate with the standard gravity feed adapter and the SHC to operate with the standard 5 gallon fuel can as a fuel source shall constitute a failure. Visually inspect the heater fuel connection point to verify that it does not protrude outside the frame envelope of the heater and is protected from obstruction by snow and ice.

4.4.4.1 Trapped air. Visually observe the SHC on start. Manual bleeding of the gravity feed fuel supply line by the operator in order to operate the SHC shall constitute a failure.

4.4.4.2 Fuel filter. Visually inspect the filter for location in a protected area and for a clear filter housing. Verify filter performance during reliability testing per 4.7.1. Any shut down related to foreign particles by passing the filter and entering the burner system shall constitute a failure. Verify that the filter element can be removed and replaced by performing 4.7.2 and 4.8.7. Verify filter housing durability by filling filter and housing with equal amounts of JP-8 and water, then cold soak for two hours at -30 F. Any damage to the filter or housing shall constitute a test failure.

4.4.4.3 Automatic fuel shut off capability. Configure the SHC for operation with a full 5 gallon inverted fuel can connected and with the on/off switch in the off position, then disassemble the fuel filter. Fuel flow through the gravity feed system to the disassembled filter shall constitute a failure. Verify fuel shut off by operating the SHC for 5 minutes, position switch to off position and observe flow of fuel. Failure of fuel flow to stop immediately (1 second) after activating the off switch shall constitute a failure.

4.4.4.4 Fuel drainage. Visually inspect the internal fuel system for residual fuel after operation. Any amounts of residual fuel which cannot be easily drained which would prohibit the SHC from being transported safely shall constitute a failure.

4.4.4.5 Fuel lines.

4.4.4.5.1 Internal fuel lines. With out disassembly, visually inspect for compatibility of fittings, fuel vents vented to the outside of the enclosure, and fuel line accessibility for repair. During reliability testing per 4.7.1, 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.

4.4.4.5.2 External fuel lines. Disconnect the gravity feed fuel supply line from SHC after setup for operation with a full 5 gallon fuel can, any leakage of fuel from the fuel line shall constitute a failure.

4.4.4.6 Gaskets and seals. Without disassembly, visually inspect gaskets and seals during reliability testing per 4.7.1 every 100 hours and at the end of testing. Any signs of degradation or loss of performance shall constitute a test failure.

4.4.5 Heat exchanger. Remove and replace the heat exchanger. Inability to remove and replace the heat exchanger using only common tools within 1 hour shall constitute a failure. Pressure test all production heat exchangers by blocking the necessary openings, applying 5 PSI of internal pressure and submerse totally in water prior to assemblage into the heater. In addition, test one heat exchanger after reliability testing. Any seepage of bubbles from the heat exchangers surface shall constitute a test failure. Operate a SHC in the outside the tent configuration and one in the inside configuration for a minimum of 3 hours in each configuration at an ambient of -45° F. Any ice formation on the exhaust outlet on the heat exchanger or the exhaust pipe outlet area

shall constitute a test failure.

4.4.5.1 Heat exchanger over temperature protection. Start the heater with the circulating air system blocked. The heater shall automatically stop prior to damage of any components by tripping of a temperature sensor. Reset the sensor and restart the heater. Inability of the heater to shut off prior to any damage or any signs of heater performance degradation after restart shall constitute a failure. Remove heat exchanger and pressure test as specified in 4.4.5. Any bubbles seeping from the heat exchangers surface shall constitute a test failure.

4.4.5.2 Exhaust outlet position. Operate SHC in the inside tent configuration. Any exhaust gases entering the tent shall constitute a failure.

4.4.5.3 Exhaust pipe. Configure the SHC in the inside tent configuration. Failure of the exhaust pipe to fall to the floor and route under or through the tent wall and provide at least 2 feet of clearance from both sides of the tent wall shall constitute a failure.

4.4.5.3.1 Exhaust leakage. Operate the heater for a minimum of 15 minutes with the exhaust pipe attached, then completely block off the exhaust pipe outlet for 3 minutes. Any evidence of smoke or soot accumulation on the out side of the exhaust pipe or around the heater connection point shall constitute a failure.

4.4.5.3.2 Exhaust pipe connection. Connect the exhaust pipe to the heater under the severe cold manipulation conditions per 4.8.7. Inability to connect the exhaust pipe while wearing anti-contact gloves using only attached hardware shall constitute a failure.

4.4.5.3.3 Exhaust pipe flexibility. Physically compress the exhaust pipe to 50 percent of it's original diameter. Inability of the pipe to return to it's original shape on its own shall constitute a failure.

4.4.5.3.4 Exhaust pipe temperature. Operate an SHC for one hour at the basic climate category in the inside MCPS configuration of 4.6.2. Any area on the outside surface of the exhaust pipe that comes in contact with or within 18 inches of the tent wall, which reaches temperatures in excess of 150° F above the outside ambient shall constitute a test failure.

4.4.6 Heated air system. Operate the SHC until the battery charging light is on per the minimum run cycle 4.8.9. Perform test of Appendix B, para. B.2.1. Any readings below 270 CFM shall constitute a failure. Place a temperature probe a minimum of 2 inches inside of the louver end of the heated air outlet duct. Operate heater, after the battery charging light is on, slowly restrict the air flow to the intake end of the return duct while measuring the temperature of the heated air flow. Inability of the heater to stop fuel flow to the burner, provide a post purge and the identifying fault code before the outlet air temperature exceeds 275° F shall constitute a failure.

4.4.6.1 Circulation system. Remove and replace the circulation fan(s) or blower(s). Inability to remove and replace the fans with common hand tools, reusable electrical connectors and no wire splicing or new solder joints, within one hour, shall constitute a failure.

4.4.6.2 Breathable heated air inlet/outlet. Visually inspect finger guards by running a 3/4 inch diameter metal sphere over finger guards on both the inlet and outlet. Absence of finger guards or passing through the finger guards by the sphere shall constitute a failure.

4.4.6.3 Flexible air ducts. Configure SHC per 4.6.1 outside tent operation. Inability of the outlet of the heated air duct and the inlet of the return air duct to pass through the cuffs on the tent walls with out removing the outlet louvre or the inlet debris guard shall constitute a failure.

4.4.6.3.1 Air duct flexibility. Compress the air duct by hand to 50% of it's original diameter. Inability of the duct to return to it's original diameter on it's own shall constitute a failure.

4.4.6.3.2 Air duct attachment. Configure SHC per 4.6.1 outside tent operation and perform severe cold manipulation 4.8.7. Inability to connect both air ducts to the heater, with no tools while wearing anticontact gloves shall constitute a failure.

4.4.6.3.3 Outlet louver. Inability of the duct outlet louver to be rotated manually 360 degrees without the use of tools shall constitute a failure.

4.4.6.3.4 Duct inlet guard. Run a metal sphere no larger than 3/4 inch diameter across the inlet guard. Inability of the guard to prevent the sphere from passing through any area shall constitute a failure.

4.4.7 Operator control panel. Configure the SHC in the outside tent operation set up per 4.6.1. Inability to pass through tent cuff, attach to tent cross member or be connected to the heater by the cable shall constitute a failure. Visually inspect control panel for switch and status light protection, retained protective caps on both ends of cable and retained protective cap on control panel/cable interface.

4.4.7.1 "On" light. Performing tests 4.4.12.5 through 4.4.12.14. Failure of the green light to remain on during fault testing, then shutting off when off switch is activated shall constitute a test failure.

4.4.7.2 Charging light. Operate the heater per the minimum test run 4.8.9. Install a properly sized shunt in the battery lead wires and attach a volt meter. Observe the current direction and the charging light on the control panel. Failure of the charging light to illuminate when the current reverses and the battery is accepting a charge from the internal generator, shall constitute a test failure.

4.4.7.3 Charged light. Operate the SHC per the minimum test run of 4.8.9. When the battery charged light is illuminated, turn the heater off and allow it to run the normal post-purge cycle. Remove the battery and perform a state of charge test as recommended by the battery manufacturer. A battery charge of less than 99% of full capacity shall constitute a test failure.

4.4.7.4 Fault light. Perform tests 4.4.12.5 through 4.4.12.14. Failure of the fault light to activate and present the correct diagnostic code for identifying the cause of shut down shall constitute a test failure.

4.4.7.5 Fault tone. Perform tests 4.4.12.5 through 4.4.12.14. Failure of the fault tone to activate and pulse in unison with the fault light shall constitute a test failure.

4.4.7.6 Thermostat. Absence of a thermostat on the operator's control panel shall constitute a failure.

4.4.7.7 Temperature control knob. Attach a temperature sensor and meter to the outside of the control box adjacent to the thermostat temperature sensor. Operate the heater configured as 4.6.1 outside tent operation during 4.8.4 basic climate at 20° F. (±2). Position the control knob to the lowest (1) setting. Failure of the set point light to illuminate as the tent temperature rises and the attached temperature sensor indicates 40° (±5) F shall constitute a failure. Position the control knob to the highest (5) setting. The amber set point light shall go off and remain off until the attached temperature sensor indicates 80° (±5) F. Failure of the set point light to go off then re-illuminate when the temperature sensor indicates 80° (±5) F shall constitute a test failure.

4.4.7.8 Set point light. Rotate the thermostat knob from low to high settings 5 times during the warm up of test 4.4.7.7. Failure of the set point light to illuminate at the low setting and go off at the high setting shall constitute a test failure.

4.4.7.9 On/off switch. Failure of the switch to activate a pre-purge and start the heater when turned to the on position shall constitute a failure. Failure of the switch to shut off the heater (all control panel lights out, fuel stopped to the burner) and provide a post purge if heater was running, shall constitute a test failure.

4.4.8 Internal power generation system. Failure of the generator to supply sufficient power to conform to all testing parameters shall constitute a test failure. If the generator requires adjustment for proper performance after or during installation or while operating, a test failure shall be scored. Failure of the generator to be removed and replaced within one hour using only standard tools shall constitute a test failure.

4.4.9 Power regulation system. Any electrical voltage or current induced heater component failure, or fault related shut down (low voltage, high voltage) during any specified performance testing shall constitute a failure. Failure of the regulator to be removed and replaced within one

hour using only standard tools shall constitute a test failure.

4.4.10 Power storage battery. Visually inspect for a protected and secure battery housing located on the SHC. Exposed wires, fuses, or terminals shall constitute a failure. Perform field serviceability 4.7.2 and severe cold manipulation 4.8.7. Inability to manipulate and remove and replace the battery into the battery housing on the heater shall constitute a test failure.

4.4.10.1 Cold starting capacity. Operate the heater for one hour at any temperature below 60° F then shut off. Without removing the battery, cold soak the heater in climatic operation 4.8.5 basic cold, configure as 4.6.1 outside tent operation. Turn on heater then switch off after initiation of the burner flame indicated by a 50° F. temperature rise in the exhaust outlet. Switch the heater control to the on position within 2 minutes after post purge has ended. Operate the heater until the charged light is illuminated maintaining ambient temperature of - 25° F. Continue operating the heater reducing the ambient temperature to - 45° F over a period of one hour stabilizing the heater at - 45° F for 30 minutes. Shut the heater off for 30 minutes then restart and lower the temperature to - 60° F over a period of one hour stabilizing the heater at -60° F for 30 minutes. Shut off the heater for 30 minutes then restart and operate until the battery charged light is illuminated then shut off. Failure of the heater to start during any of the cycles due to low voltage shall constitute a test failure.

4.4.10.2 Fuse protection. Inspect the battery construction for fuse protection. If the battery is connected to the heater by the use of battery posts or leads, fuses shall be within 6 inches of the battery. Perform 4.7.2 field serviceability, using supplied tools and adjacent spare fuse(s). Inability to manipulate the battery wires and remove and replace fuses within 15 minutes shall constitute a test failure.

4.4.10.3 Battery leakage. Inspect the battery manufacturer's specifications, installation and shipping instructions. Inability for the battery to be transportable in a fully charged state with FAA approval for air shipment shall constitute a failure. Inspect all batteries used after vibration and drop testing. Any signs of punctured cells, or caustic liquid leakage shall constitute a test failure.

4.4.10.4 Fail-safe venting. Inspect the battery housing and mounting location. Any design which could allow ruptured battery fumes to enter the breathable airstream shall constitute a failure.

4.4.10.5 Shelf life. Examine battery manufacturer's certification, a shelf life of less than 2 years shall constitute a failure.

4.4.10.6 Recharging. Operate the SHC at 40° F, at the completion of the run cycle, turn the heater off within 10 minutes of the charged indication. Adjust the temperature of the chamber to -25° (±2) F and cold soak the heater and battery. Start the heater and run to battery charged indication. A time to charge longer than 40 minutes from the time the on switch is activated to the

charged light is illuminated shall constitute a test failure. Connect a volt meter to the battery leads to monitor the voltage during heater operation. Using the battery manufactures minimum charge voltage as a base line, operate the heater in basic climatic condition to 60° (±2) F with the tent thermostat set to the lowest setting (tent satisfied position 1). During operation the battery voltage shall increase and remain no less than the manufactures minimum charging voltage. Failure of the battery to charge within 40 minutes and the voltage of the battery to remain above the recommended minimum voltage during or after battery charge shall constitute a test failure.

4.4.10.7 External battery charge. Use a standard 12 VDC battery charger to charge a partially discharged battery to a fully charged state. Failure to recharge the battery shall constitute a test failure.

4.4.11 Electrical Harness. Perform severe cold manipulation 4.8.7. Inspect all other wires and connectors and wire insulation against manufacturers literature for ratings of -30° F or colder.

4.4.11.1 Connectors. Inspect the assembly of a completed heater. Adjacent identical connectors shall be cause for rejection. After vibration and drop testing inspect wire connectors. Any evidence of loose or separated connectors shall constitute a failure. Inspect the electrical harness and connectors during performance of reliability testing every 100 hours +/- 10 hours and again at the completion of the test. Any signs of heat damage shall constitute a test failure.

4.4.11.2 Connector keying. Inspect the manufactures construction and assembly of contact configurations. Any assembly connections which display the possibility of improper electrical connection, mating or positioning shall constitute a test failure.

4.4.11.3 Fuse protection. Inspect the electrical system for fuse protection. Absence of fuses, spare fuses and fuse holders and/or requiring special tools to replace fuses shall constitute a test failure.

4.4.12 Automatic built-in test (ABIT) capability. Any requirement for the tester (operator) to adjust for fuel type, combustion air flow, generator electrical power routing or any other function that would require periodic operator intervention for efficient and safe heater operation, during any run mode, other than connection of the necessary air ducts, control cable, combustion pipe, and fuel supply, shall constitute a failure.

4.4.12.1 Pre-purge diagnostic control. Configure heater per 4.6.1. outside tent operation and perform a. through c.

a. Combustion air flow. If a combustion air blower is used to provide burner air flow, disconnect the blower electrical connector then start heater, leave the connector(s) hanging free. Repeat with the combustion motor fan/rotor blade froze (artificially jammed)

with the electrical system connected. If a combustion motor is not used, block the combustion air inlet. Failure of the ABIT system to identify combustion motor or combustion air as a cause for shut down through the fault light and audible tone on the control panel shall constitute a failure.

b. Low starting voltage. Start the heater, after burner operation, but before the battery charging light is illuminated shut off the heater. Repeat until the battery is discharged to the point of low voltage. Failure of the ABIT system to shut off the heater during the burner start cycle and identify low voltage as a cause for shut down through the audible tone and fault light on the operator's control panel shall constitute a test failure.

c. Tilt the heater past 15 degrees to the angle required for shut off but less than 45 degrees. Activate on switch. Failure of the ABIT system to identify tilt as a cause for shut down through the audible tone and fault light shall constitute a test failure. Perform this test pitch up and down and roll left and right.

4.4.12.2 Start cycle. Configure the heater per 4.6.1 outside tent operation, empty of fuel and disconnected from the external fuel supply. Activate the on switch. Measure the time between the actuation of burner fuel pump to the stoppage of fuel pump. Without changing the battery repeat test. Failure of the ABIT system to shut off the fuel within 2 seconds and identify the fault as a start time out or start failure shall constitute a test failure.

4.4.12.3 Post purge diagnostic control. Configure the heater per 4.6.1 outside tent operation. Shut the heater off after five minutes of operation as measured from the actuation of the on switch. Measure the time from the switch off position to the end of the post purge cycle. Repeat this test using the same battery. Post purge times shall be consistent within ± 5 seconds. Burner fuel flow shall consistently stop within ± 2 seconds. Failure of the ABIT to accurately provide a post purge which sufficiently evacuates burner fumes and cool heater for safe relocation, PMCS or refueling shall constitute a failure.

4.4.12.4 Hot re-light diagnostic control. Operate the heater until the battery charging light is on. Position the on/off switch to the off position for two seconds (+/-.5) then to the on position. Failure of the heater to stop fuel flow to the burner, provide a post purge and lock out shall constitute a test failure. Position the on/off switch to the off position then to the on position. Operate the heater until the battery charged light is on then position the on/off switch to the off position. Ten seconds before the end of the post purge cycle position the switch back to the on position . Failure of the heater to finish post purge and lock out, shall constitute a failure.

4.4.12.5 Low voltage shut down fault during operation. Unplug the internal generator then operate heater using a fully charged battery. Operate until heater shuts down due to low voltage. Failure of the ABIT system to shut off the heater, provide a post purge as long as 4.4.12.3 (+/- 5 seconds) and correctly identify low voltage as the cause of shut down for a minimum of 10

minutes shall constitute a test failure.

4.4.12.6 High voltage shut down fault. Operate the heater until battery charging light is illuminated. Induce an above normal voltage level in the system by disconnection of a voltage regulation device or component. Failure of the ABIT system to shut off the heater, provide a post purge as long as 4.4.12.3 (±5 seconds) and correctly identify high voltage as the cause of shut down for a minimum of 10 minutes shall constitute a test failure.

4.4.12.7 Tilt fault during operation. Start the heater. After the heater has stabilized tilt the heater past 15 degrees to the angle required for shut off. Failure of the ABIT system to shut down the heater and identify the fault code as tilt and provide a normal post-purge shall constitute a test failure. Perform this test on four sides. Inspect the attitude sensing device using the manufactures product sheet. A mercury sensor shall not be used.

4.4.12.8 Ignition element fault. Configure the heater per 4.6.1 outside tent operation. Unplug the ignitor and activate start switch. Failure of the ABIT system to identify ignitor, spark plug or ignition as the fault shall constitute a failure.

4.4.12.9 Ignition power fault. Configure the heater per 4.6.1. Disconnect ignitor power source or relay and activate start switch. Failure of the ABIT system to correctly identify ignitor power supply as the fault shall constitute a test failure.

4.4.12.10 Combustion air fault during run. Configure the heater per 4.6.1 outside tent operation. Operate the heater until the battery charged light is illuminated. Disconnect the combustion fan or if no fan is used totally block the combustion air inlet. Failure of the ABIT system to shut down the heater, provide the normal post-purge and correctly identify the fault code as combustion air shall constitute a failure.

4.4.12.11 Fail to start fault. See 4.4.12.2.

4.4.12.12 Loss of flame fault. Configure the heater per 4.6.1 outside tent operation. Operate the heater until the battery charged light is illuminated. Disconnect the external five gallon fuel supply and connect a five gallon can filled with water. Failure of the ABIT system to shut down the heater, provide the normal post-purge and correctly identify the fault code as flame loss shall constitute a failure.

4.4.12.13 Heat exchanger overtemp fault. Operate SHC per 4.4.5.1. Failure of the ABIT system to shut down the heater, provide the normal post-purge and correctly identify the fault code as heat exchanger over temperature shall constitute a failure.

4.4.12.14 Generator over temperature fault. Configure the heater per 4.6.1 outside tent operation. Operate the heater until the battery charged light is illuminated. Gradually block of

the inlet to the return air duct until heater shuts down. Failure of the ABIT system to shut down the heater, provide the normal post-purge and correctly identify the fault code as generator over temperature shall constitute a failure.

4.4.13 Frame/enclosure system. Configure the heater per 4.6.1 outside tent operation. Operate the heater until the battery charged light is on. Measure radiated sound levels during start and run. Any sound levels in excess of 68 dBA as measured 3 feet from the heater shall constitute a failure. Turn the heater off. Immediately after the end of post purge repack the heater and all accessories. The heater and accessories shall remain packed for 30 minutes. Unpack and inspect. Any evidence of discoloration or burn damage to the shipping bag or any or its components from heat, or fumes shall constitute a failure. Remove the enclosure cover to access the flame sensor and ignitor while wearing Arctic gloves. The use of tools to gain access to components shall constitute a failure.

4.4.13.1 Weather proof. Perform wind and rain test of 4.8.2. Any evidence of water entering inside the heater enclosure, battery housing, electronics housing or any area where sensitive components are located shall constitute a failure.

4.4.13.2 Corrosion resistance. Perform salt fog test per 4.8.1 and storage testing 4.8.3.

4.4.13.3 Hour meter. Inspect the SHC for an hour meter. Absence of an hour meter that can be easily read and accessed without tools shall constitute a failure.

4.4.14 Accessories. Inspect the storage transport bag for secure stowage of two breathable air ducts, one exhaust pipe, one combustion air pipe, battery charging adapter (if needed), control panel, control panel cable, (plastic) gravity feed adapter kit, fuel can stand assembly (tripod) and gravity feed fuel supply line.

4.4.15 Spares. Inspect the storage bag for a securely stowed ignitor, fuel filter element and flame sensor.

4.4.16 Tools. Inspect the storage bag for securely stowed tools necessary to remove and replace the spares.

4.4.17 Combustion efficiency/heater output.

4.4.17.1 ASHRAE performance. Perform test in Appendix A in accordance with ASHRAE Standard 51 in ambient temperatures above +40° F. Calculated values other than those stated in 3.4.17.1 shall constitute a failure.

4.4.17.2 Indicated efficiency. Perform test in Appendix B, para. B.2.2. Efficiency readings below 70% at any firing rate shall constitute a test failure.

4.4.17.3 Burner smoke spot. Perform a smoke spot test using the Bacharach oil burner smoke tester and scale (see Appendix B) after a minimum of 3 minutes of heater operation. Any smoke readings greater than a #3 shall constitute a test failure.

4.5 Physical Characteristics.

4.5.1 Weight. Weigh the SHC without accessories. Any weight readings greater than 74 pounds shall constitute a test failure. Weigh the SHC inside the transport/storage bag with ducts and accessories inside. Any weight readings greater than 142 pounds shall constitute a test failure. Weigh the SHC alone in the transport bag. A weight reading greater than 102 lbs shall constitute a failure.

4.5.2 Volume. Measure the outside envelope dimensions of the heater. A measurement greater than 6 cubic feet shall constitute a test failure.

4.5.3 Fasteners. Perform the field serviceability test per 4.7.2. Any non-captive fasteners needed to attach covers or access panels for PMCS or maintenance shall constitute a test failure.

4.6 Interface requirements.

4.6.1 MCPS interface (outside operation). Position the SHC outside of a MCPS tent. Configuration shall be conducted by no more than two people. Position the heater adjacent to the outside wall, run the air ducts through the two sleeved entrance holes. If no entrance holes are present, run ducts underneath the tent wall. Unpack and install, the control panel, gravity feed fuel supply line, gravity feed adapter, and tripod. Attach the gravity feed adapter to the government furnished 5 gallon fuel can and invert using the tripod. Average set up times greater than 20 minutes shall constitute a failure. Observe the heater while operated in this configuration, any signs of tent fabric discoloration due to heat shall constitute a failure. Turn off heater and repack for storage, disassembly times greater than 15 minutes shall constitute a failure.

4.6.1.1 MCPS modification kit. Following manufacturer's instructions, install the modification kit to an MCPS tent wall. Any need for tools or hardware other than provided shall constitute a failure. Set up SHC for outside operation using the modified MCPS wall. Inability of the SHC ducts to pass through the duct openings, or any gaps between the duct opening and the duct shall constitute a failure. Remove air ducts and close duct openings. Inability to close duct openings or presence of gaps shall constitute a failure.

4.6.2 MCPS interface (inside operation). Position the SHC inside of a MCPS tent. Inside configuration shall be conducted by no more than two people. Position the heater adjacent to the tent wall that is equipped with the cuffed air duct entrance holes. Unpack and install, the exhaust pipe, combustion air pipe, control panel, the gravity feed adapter, gravity feed fuel supply line and

tripod. Position the tripod outside of the tent. Attach the gravity feed adapter to the government furnished 5 gallon fuel can and invert using the tripod. The time required for two people to unpack and configure the SHC for operation shall not exceed 20 minutes. Observe the heater while operated in this configuration, any signs of tent fabric discoloration due to heat shall constitute a failure. Turn off heater and repack for storage, disassembly times greater than 15 minutes shall constitute a failure.

4.7 Reliability/maintainability.

4.7.1 MTBEFF/Maintenance ratio. Four heaters shall each be placed on a reliability test for a minimum of 461 hours each for a total of 1844 hours collective. There shall be no more than one chargeable essential function failure (cumulative). Fuel type used for test shall be divided equally among DF-2, JP-8, DF-A. The GFE furnished plastic five gallon can shall be used for the fuel source and refilled as needed. Perform 4.4.17.3 burner smoke spot, during the start and each 100 hour interval (± 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.

4.7.2 Field serviceability. Stabilize the SHC in accordance with 4.8.4. basic climate, having the heater in an operational configuration with air ducts attached. After component temperature stabilization, time the removal and replacement of each of the following; the flame sensor, ignitor, fuel filter, battery fuses and battery, using the spares included in the transportation bag except for the battery which shall be reinstalled. Inability to remove and replaced each component within 15 minutes shall constitute a test failure. Remove and replace circulation fan(s) or blower(s), failure to remove and replace within 1 hour shall constitute a failure. After each component removal and replacement the heater shall be returned to the operational configuration. Repack/stow all components to the transportation configuration. Perform this test cycle 3 times. After completion perform a functionally check of the heater per 4.8.9 minimum run cycle.

4.7.3 Common test equipment. Inspect the SHC and maintenance manual. Any requirement for the use any special hand tools and meters shall constitute a failure.

4.7.4 False alarm rate. Inspect all SHC test records. Any ABIT initiated shut downs that had no repair, cause or corrective actions or mis-diagnosed faults shall constitute a test failure.

4.7.5 Preventive maintenance checks and services (PMCS). Configure the heater for 4.6.1 outside tent operation. Perform a walk around inspection of the duct work to the heater and tent, verify a secure control box connection, the gravity fuel supply for proper connection, inspect for snow or ice coverage or blockage, fuel leaks, fuel filter for contamination and general condition. A through examination shall not exceed 10 minutes. No panels or covers shall be removed or opened to gain visual access. Configure the heater for 4.6.2 inside tent operation. Perform a walk around inspection of the connections of the exhaust pipe, combustion pipe, verify a secure

control box connection, the gravity fuel supply for proper connection, inspect for, fuel leaks, fuel filter for contamination and general condition. A through examination shall not exceed 10 minutes. No panels or covers shall be removed or opened to gain visual access.

4.7.6 Operator/maintenance manual. Inspect and verify that the manual is stowable and protected inside the transport and storage bag with the heater and accessories.

4.8 Environmental conditions.

4.8.1 Salt fog. Two properly functioning SHC units with accessories shall be tested IAW the requirements and conditions set forth in MIL-STD-810, Method 509.3. Provide 48 hours of salt fog exposure, followed by 48 hours of dry out.

(1) Expose the SHC with dust covers installed, both air ducts, exhaust and combustion pipe, control panel and connection cable outside of the storage transport bag(s). Subject the remaining items inside the storage bag(s).

(2) Upon completion of the testing, perform a visual check of all SHC contents, and internal components of the SHC for evidence of peeling, blistering paint, possible electrical shorts or impairment due to salt deposits, evidence of deterioration, clogging or binding of moving parts, or change in tolerance limits of any internal or external parts which could prevent the unit from meeting operational and maintainability requirements. Minor oxidation, which can easily be removed, on exposed fasteners and hardware in permissible, provided performance of the part is not adversely effected.

(3) Perform a functionally check of the SHC per 4.8.9 minimum run cycle.

Any evidence of unacceptable corrosion on the SHC or it's components and failure to remain operational after salt fog testing shall constitute a test failure.

4.8.2 Wind/rain. Subject the two SHC's from salt fog testing (if properly functioning) to wind/rain testing IAW the requirements and conditions set forth in MIL-STD-810, Method 506.3, Procedure I-Blowing Rain and perform as follows.

(1) Provide 4 in/hr of rain along with 40-45 mph winds for 30 minutes with the SHC in each of the following three configurations.

a) The storage transportation configuration (storage protected).
b) The SHC outside of the storage transport bag with all dust covers installed (storage unprotected).
c) The SHC outside of the storage transport bag with both air ducts, and external fuel attached (operational).

(2) After each of the three test exposure configurations the item(s) shall be unpacked or opened and checked for water penetration.

(3) During the last 10 minutes of testing in configuration c) the SHC shall be started and operated per 4.8.9 minimum run cycle.

Any signs of water penetration which may cause component degradation or prohibit safe operation of the SHC shall constitute a failure. Failure of the heater to operate after wind/rain exposure shall constitute a failure.

4.8.3 Storage. Subject one SHC to testing IAW MIL-STD 810, method 501, Procedure I-Storage. Bring chamber air temperature up to 155 deg. F (± 3) and 75% relative humidity (=/- 5), once these conditions are attained, hold for a 4 hour storage period. Remove the SHC and perform functionally check per 4.8.9 minimum run cycle. Failure of the heater to operate due to damage withstained during storage testing shall constitute a test failure.

4.8.4 Basic climate operation. The basic climate operation test shall be run in accordance with MIL-STD 810, Method 502.3, Procedure II-Operation. Provide temperatures of 40° F (± 2) to operate heater. Use fuels specified (see Table I). Perform heat capacity test of Appendix B. Values not meeting the requirement of 3.8.4 shall constitute a failure.

4.8.5 Basic cold operation. The basic cold operation test shall be run in accordance with MIL-STD 810, Method 502.3, Procedure II-Operation. Provide temperatures of -25° F (±2) to operate heater. Use fuels specified (see Table I). Perform heat capacity test of Appendix B. Values not meeting the requirement of 3.8.5 shall constitute a failure.

4.8.6 Severe cold climate operation. The severe cold climate operation test shall be run in accordance with MIL-STD 810, Method 502.3, Procedure II-Operation. Provide specified temperatures of -30° F (± 2) to start the heater, then bring test chamber temperature down to -60° F while operating. Use fuels specified (see Table I). Perform heat capacity test of Appendix B. Values not meeting the requirement of 3.8.6 shall constitute a failure.

4.8.7 Severe cold manipulation. Perform a severe cold manipulation and component replacement test. The test shall run in accordance with 810-E method 502.3 procedure III manipulation. Cold soak the SHC in the 4.6.1 configuration with transportation bag and all additional SHC accessories to -60° F. After component temperature stabilization remove battery then re-install, replace ignitor then flame sensor using spares included in the transportation bag. Connect the SHC fuel line to the gravity feed adapter and heater. Repack all components to the transportation configuration. Perform this test cycle 3 times. Warm all components to -30° F and perform test 4.8.9 in the outside tent operation configuration. Any evidence of damage to wires, components and accessories or any inability to manipulate components while wearing the appropriate cold weather clothing shall constitute a test failure.

4.8.8 High altitude. Conduct test in accordance with MIL-STD 810, Method 500.3, procedure II-Operation. Provide a field site which is 6,000 feet altitude minimum for operational checkouts. Configure the heater with exhaust and combustion air pipes using JP-8 or DF-A fuel. Operate heater for a minimum of one hour. Perform smoke spot per 4.4.17.3. within three minutes after starting and again before shut down. No adjustment to fuel type or combustion air flow shall be made. Perform indicated efficiency test per 4.4.17.2. Any degradation in performance as demonstrated by the efficiency test and smoke test, failure of the battery to charge within 40 minutes or failure of the heater to operate shall constitute a failure.

4.8.9 Minimum test run. The minimum run cycle shall consist of operation of the heater for a sufficient time to verify that the green on light, green charging light and the green battery charged light are illuminated. Unless reference is made to a specific function check or fault induced test, perform a smoke spot test 4.4.17.3, indicated efficiency 4.4.17.2, and when air ducts are required an indicated breathable air outlet CFM test using a vane anemometer. For the end item examination, see 4.3.1, the minimum run cycle shall consist of operation to verify the green on light and green charging light are illuminated, power from the internal generator to the battery shall be measured to verify sufficient power is present for recharging the battery. Inability of the heater to function properly during any required minimum test run shall constitute a failure.

4.9 Transportability.

4.9.1 Military vehicles. Inspect the volume of the SHC in the transport bag with all accessories. Assess the ability to be transported by the required vehicles listed in 3.9.1 through inspection of vehicle literature defining cargo storage dimensions and comparing with overall dimensions of the SHC. Inability to transport the SHC with any of the vehicles listed in 3.9.1 shall constitute a failure.

4.9.2 Vibration. Subject two SHC units to basic transportation vibration test IAW the requirements and conditions set forth in MIL-STD-810, Method 514.4, Category 1.

(1) Visually check all contents of the SHC and functionally check the heater per 4.8.9. minimum run cycle, prior to vibration test.

(2) Mount the SHC to the vibration table and instrument with a triaxial accelerometer mounted on the SHC frame. Subject the SHC to the vibration environments in all three mutually perpendicular axes (vertical, transverse, and longitudinal).

(3) Test 32 minutes in the two-wheel trailer spectra and 40 minutes for the composite wheel vehicle spectra for a total of 72 minutes of vibration in each of the three axes.

(4) Upon completion of the 216 minutes of testing, perform a visual check of all SHC

contents and an functionally check of the SHC per 4.8.9 minimum run cycle.

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

4.9.3 Loose Cargo Test. Subject two SHC 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 of the SHC and functionally check the heater per 4.8.9 minimum run cycle, prior to the loose cargo test.

(2) Place each SHC on 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 SHC 90 degrees and continuing the test as needed.

(3) Upon completion of the 45 minutes of testing, perform a visual check of all SHC contents and an functionally check of the SHC per 4.8.9 minimum run cycle.

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.

4.9.4 Drop test. Subject two SHC to drop testing IAW MIL-STD-810, Method 516.4, Procedure IV.

(1) Visually check all contents of the SHC and perform the minimum run cycle.

(2) Suspend the SHC by a drop hook such as the desired edge, corner or face is 30 inches from the impact surface. The drop hook shall be triggered allowing the SHC to free fall to the drop surface.

(3) The drop surface shall be a 2-inch thick plywood surface backed by concrete.

(4) A total of seven drops to the following orientations: each bottom corner, the bottom, fuel inlet side bottom edge, exhaust side bottom edge.

(5) Upon completion of the drop testing, perform a visual check of all SHC contents and an functionally check of the SHC per 4.8.9. minimum run cycle.

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 failure.

4.9.5 Transport/storage bag(s). The bag(s) shall contain: Heater, Supply and return breathable air ducts, Exhaust pipe, Combustion air inlet pipe, Control panel and connecting cable, Fuel can stand NSN 7240-01-318-5222, Gravity feed adapter kit NSN 7240-21-911-8834, Spare parts, Operator/maintenance manual, Gravity feed fuel supply line, Battery charger adapter (if required). Inspect the transport storage bag(s) hand holds for uniform load distribution and ruggedness by dragging the bag perpendicular to the attachment points across a rough concrete or similar surface a distance of 100 feet and carrying the bag with four people. If two bags are used, strap both bags together in a shipping configuration. The same transport/storage bag(s) shall be used during all dynamic, environmental testing specified herein. Inability of the bag to withstand all environmental and durability tests shall constitute a failure. Inability of the heater to be 4 man portable while in the bag with all accessories shall constitute a failure.

4.10 Identification and marking.

4.10.1 Labels/tags. Verify that all labels are oriented horizontally so that they may be read quickly and easily from left to right. Placement shall be on or very near the items which they identify. Controls shall not obscure labels. Labels shall be located in a consistent manner throughout the SHC system. Labels shall be printed in capitals. All letters shall be black except for when using a black background the letters shall be white. Label backgrounds shall be red for danger, yellow for caution and black for information. Letter size and width shall be sufficient to be easily read from a distance of six feet in day light or with the aid of a flashlight. Access panels used shall be labeled identifying the component protected inside. If SHC weighs more than 35 lbs it shall be labeled TWO PERSON LIFT. Omission of any of the required labels shall constitute a failure.

4.11 Interchangeability.

4.11.1 Replacement parts. The contractor shall certify that all parts of the SHC are interchangeable with like parts of different SHC units furnished under the same contract.

4.12 Safety.

4.12.1 Operational safety. Observe test records and performance of all test and inspections within this performance specification. Injury to personnel or damage to equipment or property resulting from testing shall constitute a failure.

4.12.2 Breathable air. Test for, at a minimum, carbon dioxide and carbon monoxide while the heater is set up in the configurations of 4.6.1 and 4.6.2. and operating for a minimum of 8 hours in each configuration. Any readings above the TLV-TWA as established by the American Conference of Industrial Hygienists shall constitute a failure.

4.12.3 Electrical shock. Inspect the SHC for exposed wires, absence of fuses and operation of the control panel indicator light during all phases of operation. Any exposed wires, missing fuses and failure of the indicator light to be illuminated during heater operation, pre-purge and post purge shall constitute a failure.

4.12.4 Sharp edges/moving parts. Inspect the SHC for presence of any non-functional sharp edges or exposure of moving parts.

4.12.5 Surface areas. Operate the SHC in the basic climate in the 4.6.1 configuration. After one hour of operation measure all surface areas of the heater and the handles. Any temperature readings above 120° F, other than the immediate exhaust pipe outlet, exhaust pipe connection point, heated air duct connection point and the louvre, shall constitute a test failure.

4.13 Human factors engineering.

4.13.1 Human machine interface. Special attention shall be given to any question or confusion as to set up and tear down such as which air duct attaches to which end of the heater, misleading conclusions or interpretation to fault codes, difficulty in locating components to inspect, and control panel instruction adequacy as a minimum.

4.13.2 Component access. Perform the field serviceability test of 4.7.2.

4.13.3 Lifting. Verify the SHC has the required hand holds for two person carry and the transport storage bag has hand holds for 4 persons. Verify SHC weight requirements for lifting during test of 4.5.1.

4.13.4 Handles. Verify the SHC can be lifted and moved while wearing cold weather gloves.

4.13.5 Personnel clothing. Verify during test of 4.8.7.

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 SHC with accessories is intended to heat personnel and equipment housed in the Modular Command Post System (MCPS) and similarly sized shelters, It provides approximately 35 KBTU of circulated heated air, safely and efficiently, with out the use of external electrical power. The SHC can be safely operated on the following fuels: DF-1, DF-2, DF-A, JP-5, and JP-8.

6.2 Acquisition requirements. Acquisition documents should specify the following:

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 2.3).
c. When a first article is required (see 3.1.).
d. Color of heater required (see 3.4.13.2).
e. Sampling plan size for first article and conformance test (see 4.2 and 4.3).
f. Packaging requirements (see 5.1).
g. When MCPS modification kits are required (see 3.6.1.1)

6.3 Subject term (key word) listing.

Tent heating, Diesel, JP-8

6.4 Color or SHC. Colors approximating the following color chip number of FED-STD-595 have been used to satisfy the requirement of 3.4.13.2:

Color required	Color chip No.
Green 383	34094
Tan 686	33446
White (aircraft)	37875

6.5 Corrosion preventive paint. The use of MIL-P-53022 or MIL-P-53030 as a first coat, then top coating all surfaces with a Chemical Agent Resisting Coating (CARC) conforming to MIL-C-46168 or MIL-C-53039 has been found to satisfy the requirement of 3.4.13.2.

6.6 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 must be acquired under separate contract line item in the contract.

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

6.8 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, or 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.

6.9 Conformance inspection. During acquisition, contracting documents should indicate the designated frequency of conformance tests listed in Table I based on risk assessment for the procurement. Some of these risk factors include contractor past performance, government schedules and budget, product material and design maturity, manufacturing equipment and processes applied, labor skill and training, and uniformity of measuring processes and techniques.

Custodians:

Army - GL
Navy - YD1
Air Force - 99

Review activities

Army - MD1, QM1
Navy - MC
Air Force - 35,84
DLA-CS

Preparing activity:

Army - GL

(Project 4520-0390)

APPENDIX A
ASHRAE Performance Test Procedure

A.1 SCOPE

A.1.1 Scope. This appendix details the ASHRAE procedures for air discharge rate, heating capacity, and measured efficiency; and is a mandatory part of this specification.

A.2 APPLICABLE DOCUMENTS.

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

ASHRAE 41 - Standard Method for Temperature Measurement

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ASME PTC 19.5 - Application, Part II of Fluid Meters

A.3 PROCEDURE

A.3.1 Air discharge rate.

a) Assemble test setup in accordance with ASHRAE Standard 51. The test chamber shall be insulated so that the calculated heat leakage through the walls of the chamber does not exceed 2% of the capacity of the tested heater.
b) Test heater in both inside and outside configurations and high and low fire rates.
c) The heater under test shall be operated until equilibrium conditions are attained before test data are recorded.
d) Measure the air flow and pressure flow losses in accordance with ASHRAE 51 or ASME PTC 19.5 .
e) Measure barometric pressure and temperatures in accordance with ASHRAE 51 and ASHRAE 41.
f) Measure the fuel flow rate.
g) Calculate the air discharge rate (CFM) in accordance with section 9 of ASHRAE Standard 51.

A.3.2 Heating capacity.

a) Use the same setup, data and calculations recorded in A.3.1.

b) Test results shall be corrected to standard conditions using the following properties.

Density	=	0.075 lb. per cubic foot [lbs/ft^3]
Pressure	=	29.92 inches of Mercury [in. Hg]
Temperature	=	68 ^{o}F

c) Calculate the heating capacity using the following equation:

Heating capacity (BTU/Hr) = 60 x Q x d x C_p x (t_{out} - t_{in})

Q = Air discharge rate [SCFM]

d = 0.075 [lbm/ft^3]. Density of air at standard conditions.

C_p = 0.240 [BTU/lbm dry air-°F]. Average specific heat of the ventilating air from temperature rise across heater

(t_{out} - t_{in}) = Air temperature rise across heater [°F]

A.3.3 Measured efficiency.

a) Use the same setup, data, and calculations as recorded in A.3.1 and A.3.2.

b) Calculate an equivalent heat input value (BTU/Hr) based on the energy content of the fuel (from the fuel certification) and the measured flow rate.

c) Calculate the measured efficiency using the following equation:

Measured efficiency (%) = (H / Equivalent heat input) x 100

where H = Heating capacity (BTU/Hr)

APPENDIX B
Indicated Performance Test Procedures

B.1 SCOPE

B.1.1 Scope. This appendix details the procedures for measuring indicated air discharge rate, indicated heating capacity and indicated efficiency, and is a mandatory part of this specification.

B.2 PROCEDURE

B.2.1 Air discharge rate.

a) Test heater in both the inside and outside tent configurations, and at high and low firing rates.
b) The heater under test shall be operated until equilibrium conditions are attained before test data are recorded.
c) Measure the air discharge flow speed using a portable vane anemometer and calculate the air discharge rate (CFM), remove any louvers prior to testing with air ducts.

B.2.2 Indicated efficiency.

a) Measure indicated efficiency with a Bacharach Fyrite test kit, P/N 10-5000, Kane-May Ltd. combustion analyzer Model 9003, or equivalent equipment following manufacturer's instructions.
b) Exhaust samples shall be take 12 inches from where the exhaust exits the heat exchanger.

B.2.3 Heating capacity.

a) Measure fuel flow into the heater.
b) Calculate an equivalent heat input value (BTU/Hr) based on the energy content of the fuel (manufacturer's certification) and the measured flow rate.
c) Calculate the heating capacity using the following equation:

Heat capacity (BTU/Hr) = (Equivalent heat input x Indicated efficiency) / 100

B.2.4 Burner 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.