PERFORMANCE SPECIFICATION SHEET

WIRING HARNESS FOR BATTERY, RECHARGEABLE, REPAIRABLE, NICKEL CADMIUM, VENTED, 24-VOLT, BB-664/A

This specification is approved for use within Army CECOM Life Cycle Management Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

The requirements for acquiring the product herein shall consist of this specification and MIL-PRF-81757.

REQUIREMENTS

1. Part or identifying number. The part or identifying number (PIN) of the wiring harness shall be M81757/23-1.

2. Wiring harness assembly. The wiring harness shall fit inside a M81757/21-1 (BB-664/A) battery and shall provide over-temperature warning, over-temperature cut-outs, and have internal heating elements. The wiring harness shall consist of the following:

a. One auxiliary receptacle (J2), conforming to the interface requirements of an MS27505E11E35S back panel box mounting receptacle to provide connection to battery sensing and control points. The receptacle shell shall be conductive, corrosion resistant, and shall be capable of operation over a range of -65°C to 200°C. The J2 receptacle shall be connected as shown in Figure 2. Contacts shall be so designed that the sockets will not be damaged during repeated mating of counterpart connectors. The back of the connector shall be potted to prevent migration of electrolyte.

b. One normally open temperature switch (S1) mounted as shown in Figure 1. The switch shall close when the battery temperature exceeds 57 ± 3°C (135°F) and shall reopen when the battery temperature falls below 49 ± 3°C (120°F). The temperature switch shall be certified to withstand a minimum of 10,000 operating cycles at 30VDC and 1.0 ampere. The height of the thermoswitch, including the cell link, shall be no greater than 0.753 inches.

c. One temperature transducer (TH1) shall be mounted as shown in Figure 1. Potting shall be employed to isolate the temperature transducer from any unconnected battery voltage. Transducer temperature and resistance profile shall be as specified below.

Temperature	Acceptable Resistance Range (ohms)
10°C (50°F)	2760-2860
16°C (60°F)	2840-2930
21°C (70°F)	2910-2990
27°C (80°F)	2990-3050
32°C (90°F)	3060-3125
38°C (100°F)	3130-3200
43°C (110°F)	3200-3280

d. One center tap voltage lead, having a ring terminal wire lug, shall be as shown in Figure 1.

e. Three copper, ring terminal wire lugs, two of which can accommodate # 22 AWG wire (Ref. letter A and D) and one that can accommodate two # 22 AWG wires (same cross-sectional area as one # 19 AWG wire). All three shall accommodate #8-32 screws.

f. The battery harness shall contain a heater assembly as shown in Figure 3. The three heater strips shall have the following properties:

1) The center heater shall have a total resistance of 76.7 ± 2 ohms over the length of 10 7/8 inches and a resistance of not less than 3.4 ohms for a distance of not less than one inch starting from the edge with the wire connections, connected in series with the 10 7/8 inches section. The resistance shall be uniformly distributed when contact is made with the cells at 6.74 ohms per inch.

2) The heater placed on the left (connector) side of the battery, in contact with nine cells, shall have a total resistance of 162 ± 2 ohms. This resistance shall be uniformly distributed where contact is made with the cells at 15.2 ohms per inch.

3) The heater placed on the right side, in contact with ten cells, shall have a total resistance of 145 ± 2 ohms. This resistance shall be uniformly distributed where contact is made with the cells at 12.2 ohms per inch.

g. Two (2) series connected single pole double throw (SPDT) thermoswitches (S3 & S3A), shall be used to control the operation of the battery heater. The height of each thermoswitch, including the cell link, shall be no greater than 0.923 inches. These thermoswitches shall be mounted on cell links and shall transfer their contacts when the battery temperature decreases to -1.7 ± 3.3°C (29 ± 6°F). Contacts shall transfer back to deactivate the heater when battery temperature rises above 6.7 ± 4.5°C (44 ± 8°F). The temperature differential between the opening and closing point shall be not less than 5° C.

h. The removable links used for device mounting shall be copper with a cross-sectional area not less than 0.039 in^2, with nickel plating that complies with SAE-AMS-QQ-N-290, Class 1, Grade E. Finish shall be smooth and free of corrosion, pits, and blow-holes. Dimensions shall be equivalent to M81757/21-2.

i. All wire used in the wiring harness shall have insulation with the following properties:

1) Capable of working in environments over 194°F (90°C)
2) Resistant to moisture
3) Alkali resistant
4) Resistant to damage from chafing due to machine vibration
5) Allows the adherence of potting substances

The insulation shall be free from cracks, delaminating of the insulation, splinters, blisters and other non-homogeneities visible to the normal eye. When used, sheathing or heat-shrink shall provide for enough flexibility to allow harness installation in a M81757/21-1 (BB-664/A) battery. Connections requiring potting shall consist of the J2 connector, transducer, thermoswitch, heater blankets, and wire lugs (ring terminals). Potting compound used shall not support flame, absorb moisture, and shall be impervious to the electrolyte of the battery. Potting compound shall be free of gel particles, ingredient lumps, agglomerates, and all foreign substances, such as grit, oil, dirt, or water. Wire colors, sizes, and connection point terminations shall be as follows:

REF LTR	COLOR	AWG (MIN)	TERMINATIONS	
A	Red	22	J2 Socket 4	Power (+) Lug
B	White	22	J2 Socket 6	Transducer
C	White	22	J2 Socket 7	Transducer
D	White	22	J2 Socket 2	Cell # 10 Lug
E	Black	22	J2 Socket 3	Power (-) Lug
F	Green	22	S1	Power (-) Lug
G	Green	22	J2 Socket 5	S1
H	Yellow	22	J2 Socket 10	S3
I	Yellow	22	J2 Socket 12	Heater 3
J	*No longer used*			
K	Orange	22	S3A	S3
L	Orange	22	J2 Socket 11	S3A
M	Yellow	22	J2 Socket 9	Heater 3
N	Yellow	22	S3A	S3
O	White	22	S3A	Heater 3
		22	Heater 1	Heater 2
		22	Heater 2	Heater 3

NOTE:
See Figure 2 for reference letter to wire relationships

3. MIL-PRF-81757 variance. The battery shall comply with MIL-PRF-81757 except as follows.

3.1 Modify the following paragraph:

3.6.2 Fasteners. After the phrase "…free of any coating…" add the following: "except as otherwise specified herein."

3.2 Add the following new paragraphs:

"3.6.4.5 Thermistors. The harness assembly shall utilize temperature sensor devices that exhibit the resistance-temperature characteristics specified herein. Potting employed to isolate the thermal sensors from any battery voltage shall conform to paragraph 2i herein."

"3.6.4.6 Device mounting. The devices (thermoswitches and thermistors) shall be mounted as shown in Figure 1. Devices shall be mounted in such a manner that they shall not become detached during handling. The devices shall be positioned on the links in such a manner that they shall not interfere with the tool operations required for removal and mounting of cell."

3.3 Modify the following paragraph:

3.8 Color and marking. Delete in its entirety and replace with the following: "For wiring harnesses, all thermoswitches shall be marked: S1, S3, and S3A. The thermistor shall be marked TH1. Wires shall be marked according to the letter designations of paragraph 2i herein."

3.4 Modify the following paragraph:

3.9 Environmental requirements. Following any test requirement, wiring harnesses shall comply with the requirements specified in subparagraphs a, d, f, and i. In addition, the wire insulation shall meet the criteria specified in this specification sheet, paragraph 2f.

3.5 Add the following new paragraphs:

"3.10.31 Testing of wiring harness. The harness assembly, when subjected to the connection continuity of harness test, wiring harness temperature test, temperature shock test, or alkali resistance test, shall be as specified herein:

"a. Continuity. When tested as specified in 4.5.32, continuity results shall be as follows:

(1) Test points of 4.5.32a: Continuity

(2) Test points of 4.5.32b: Resistance (see paragraph 2f herein)

(3) Test points of 4.5.32c: Not less than 1.0 megohm.

"b. There shall be no evidence of alkali migration into harness wires and components; breakdown of insulation; stripping of metal plating from connectors; corrosion of metal parts; nor cracking of potting compound.

"c. The transducer shall meet the requirements herein.

"d. The thermoswitches shall close or open within the specified temperature ranges herein.

"e. There shall be no mechanical failure of components.

"f. There shall be no dimensional distortion beyond specified limits."

"3.10.32 Heater blanket. The M81757/21-1 (BB-664/A) battery shall have a heater blanket consisting of three heater strips as described elsewhere in this specification sheet. It shall have a total power of 342 ± 15 watts of heat uniformly delivered to the battery cells. When tested as

specified in 4.5.34 installed in a M81757/21-1 (BB-664/A) battery, it shall be capable of raising the cell temperature from -54°C (-65°F) to -10°C (+14°F) in not less than one hour after the start of heating. Heater hot spot temperature shall not exceed 110°C (230°F). When tested as specified in 4.5.35, the heater shall demonstrate operation for 500 hours without deterioration or breakdown under visual examination or dielectric strength testing or change of resistance."

VERIFICATION

1. MIL-PRF-81757 variance. The battery shall comply with MIL-PRF-81757 except as follows.

1.1 Modify the following paragraphs:

4.2.1 Inspection of batteries. Delete in its entirety and replace with: "For harness-only qualification, two harnesses shall be provided; one for the tests in Table IV of MIL-PRF-81757 and the other for those tests added to table IV by the variance herein."

4.5.3 Electrolyte resistance. Add the following at the end of the paragraph: "Functional testing shall consist of the connection continuity of harness test of 4.5.32."

4.5.16 Vibration test. The wiring harness shall be installed in a M81757/21-1 or similar configuration battery (i.e., BB-476/A) for vibration testing. No charge or discharge shall be performed before, during, or after vibration testing (i.e., the condition of the cells used will not impact test outcome). Following vibration testing, the wiring harness shall be removed from the battery. Each harness shall be subject to the connection of continuity of harness test at 4.5.32. Visually examine each harness. Harnesses shall meet the requirements of 3.9 as modified herein and 3.10.31.

4.5.17 Temperature shock test. Subject wiring harnesses to the same temperature shock method specified for batteries, except that all battery-specific steps (i.e., cover removal/replacement, charging, discharging) are not applicable. After the temperature shock test, perform the connection continuity of harness test of 4.5.32. Harnesses shall meet the requirements of 3.9 as modified herein and 3.10.31.

1.2 Add the following new paragraphs:

"4.5.32 Connection continuity of harness. Continuity of the wiring harness terminations shall be checked with an ohmmeter between the points specified below. Continuity shall comply with 3.10.31.

"a.	J2 Socket 2	to	Cell # 10 Lug
	J2 Socket 3	to	Power (-) Lug
	J2 Socket 4	to	Power (+) Lug
	J2 Socket 10	to	J2 Socket 11
"b.	J2 Socket 6	to	J2 Socket 7 (resistance of transducer; see 2c above)
	J2 Socket 9	to	J2 Socket 12 (resistance of heater assembly)
"c.	J2 Socket 5	to	J2 Socket 3

J2 Socket 5	to	Power (-) Lug
J2 Socket 10	to	J2 Socket 12
J2 Socket 10	to	J2 Socket 9”

“4.5.33 Wiring harness temperature test. The following test shall be performed. After completion of testing, the wiring harnesses shall meet the requirements of 3.1 and 3.10.31.

“a. Fixture the wiring harness so that an ohmmeter is connected across the terminals of the transducer and all thermoswitches. Note: Thermoswitches S3 and S3A require monitoring of dual output.

“b. Place the harness into an environmental chamber.

“c. Set the chamber to reach a temperature within a range of +3.4 ± 1.1°C (38°F); allow the test sample to stabilize for not less than 1 hour.

“d. Set the chamber to ramp down the temperature to not less than -5.0°C (23°F) at a rate not greater than 1°C per five minutes while monitoring the continuity of thermoswitches S3 and S3A continuously.

“e. Once thermoswitches S3 and S3A change status, record the temperature and stop the temperature decrease.

“f. Set the chamber to reach a temperature within a range of 1.0 ± 1.1°C (34°F).

“g. Set the chamber to ramp up the temperature to not less than 11.2°C (52°F) at a rate not greater than 1°C per five minutes while monitoring the continuity of thermoswitches S3 and S3A continuously.

“h. Once thermoswitches S3 and S3A change status, record the temperature and proceed to the next step.

“i. Set the chamber to reach the first temperature set point in the table below. Once the set temperature has been reached, allow the test sample to stabilize for not less than 1 hour.

“j. Record resistance values for the thermistor.

“k. Repeat steps i and j for the second set point in the table below.

“l. Repeat step k until readings have been obtained at all 4 set points.

“m. Set the chamber to reach a temperature within a range of 52.8 ± 1.1°C (127°F); allow the test sample to stabilize for not less than 1 hour.

“n. Set the chamber to ramp up the temperature to not less than 60.0°C (140°F) at a rate not greater than 1°C per five minutes while monitoring the continuity of thermoswitch S1 continuously.

“o. Once thermoswitch S1 closes, record the temperature and stop the temperature increase.

“p. Set the chamber to reach a temperature within a range of 53.2 ± 1.1°C (127°F).

“q. Set the chamber to ramp down the temperature to not greater than 46°C (115°F) at a rate not greater than 1°C per five minutes while monitoring the continuity of thermoswitch S1 continuously.

"r. Once thermoswitch S1 opens, record the temperature and proceed to the next step.

"s. Return chamber to room ambient conditions. Allow the test sample to stabilize for not less than 1 hour. Remove the test sample and examine wiring harness for the requirements of 3.10.31.

"Temperature Set Points, BB-664/A
(1) 10.0 ± 1.1°C (50°F)
(2) 21.0 ± 1.1°C (70°F)
(3) 32.0 ± 1.1°C (90°F)
(4) 43.0 ± 1.1°C (110°F)"

"4.5.34 Heater blanket operation. The heater blanket shall be tested as follows. Install the full harness assembly into a M81757/21-1 (BB-664/A) battery. Charge the battery in accordance with 4.4.3. Store the battery at -54°C (-65°F) for not less than 16 hours. Install temperature monitoring devices on all temperature switches and thermistors, and in not less than 3 cells to monitor electrolyte temperature. Apply 115 VAC ± 10%, 400 Hz ± 5% input power to the heater blanket. Continue testing at these parameters until battery electrolyte temperature exceeds -10°C (+14°F). Allow the entire battery to stabilize at room temperature for not less than 16 hours. Perform the dielectric strength test of 4.5.27. Heater blanket shall comply with 3.9, 3.10.27, and 3.10.32."

"4.5.35 Heater blanket life test. The battery heater shall be tested for 500 hours under the following operating conditions. Insure the heater blanket is not installed in a battery; if connected to the harness, bypass the two heater thermoswitches.

a. Test at 60 ± 3°C (140°F), ambient humidity and atmospheric pressure.

b. Cycle the heater input power by applying 115 VAC ± 10%, 400 Hz ± 5% input power to the heater blanket for 30 ± 5 seconds every 5 minutes.

c. At the 250^{th} and 499^{th} hours, increase the input voltage to 190 volts, RMS, for not less than 0.1 second.

At the completion of 500 hours, examine the heater for deterioration or damage. Conduct the dielectric strength test of 4.5.27. The heater blanket shall comply with 3.9, 3.10.27, and 3.10.32.

1.3 Modify the Tables of MIL-PRF-81757 as follows:

Table IV. Qualification inspection of components and materials. Add the following:

Part	Examinations and tests	Requirement paragraph	Test paragraph
Wiring harness	Connection continuity of harness	3.10.31	4.5.32
Wiring harness	Vibration	3.9	4.5.16
Wiring harness	Heater blanket operation	3.9, 3.10.32	4.5.34
Wiring harness	Heater blanket life test	3.9, 3.10.32	4.5.35
Wiring harness	Temperature shock	3.9, 3.10.31	4.5.17
Wiring harness	Wiring harness temperature test	3.10.31	4.5.33

Table VII. Group B inspection. Add the following:

Test No.	Examinations and tests	Requirement paragraph	Test paragraph
	Subgroup I		
I-4	Dielectric strength and insulation resistance	3.9, 3.10.27	4.5.27

Table VIII. Group C inspection. Add the following:

Test No.	Examinations and tests	Requirement paragraph	Test paragraph
	Subgroup I		
I-10	Electrolyte resistance	3.9, 3.10.3	4.5.3
I-11	Temperature shock	3.9, 3.10.31	4.5.17
I-12	Vibration	3.9	4.5.16
	Subgroup II		
II-8	Wiring harness temperature test	3.10.31	4.5.33
II-9	Heater blanket operation	3.9, 3.10.32	4.5.34

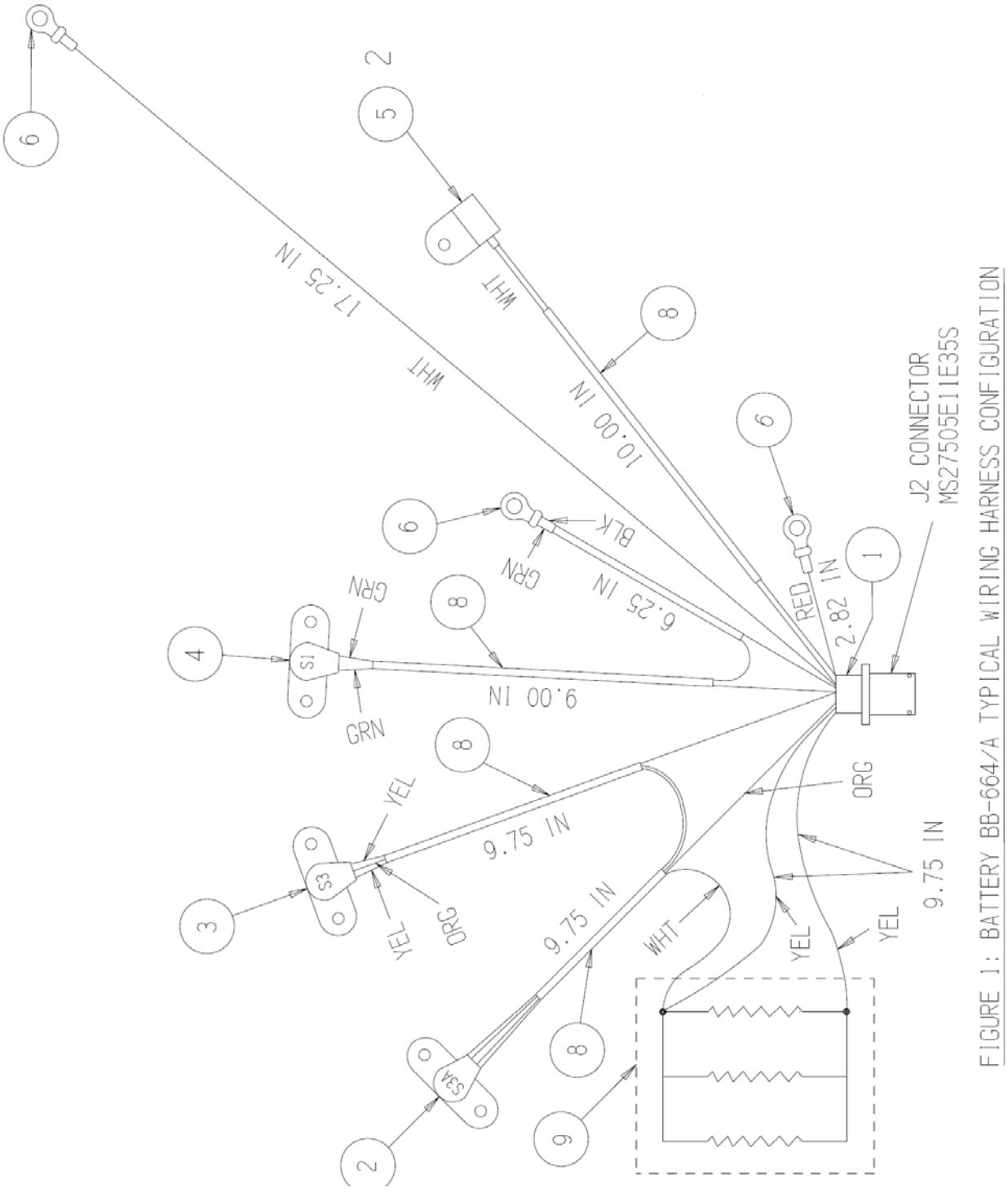

FIGURE 1: BATTERY BB-664/A TYPICAL WIRING HARNESS CONFIGURATION

FIGURE 1 NOTES (internal paragraph reference):

1. All dimensions are in inches; tolerances are ± .25 inches unless otherwise stated
2. MS27505E11E35S connector (2a)
3. Thermoswitch S3A (2g)
4. Thermoswitch S3 (2g)
5. Thermoswitch S1 (2b)
6. Temperature transducer (2c)
7. Copper ring terminal wire lug (2e)
8. Heat shrink as needed
9. Heater assembly (Figure 3)

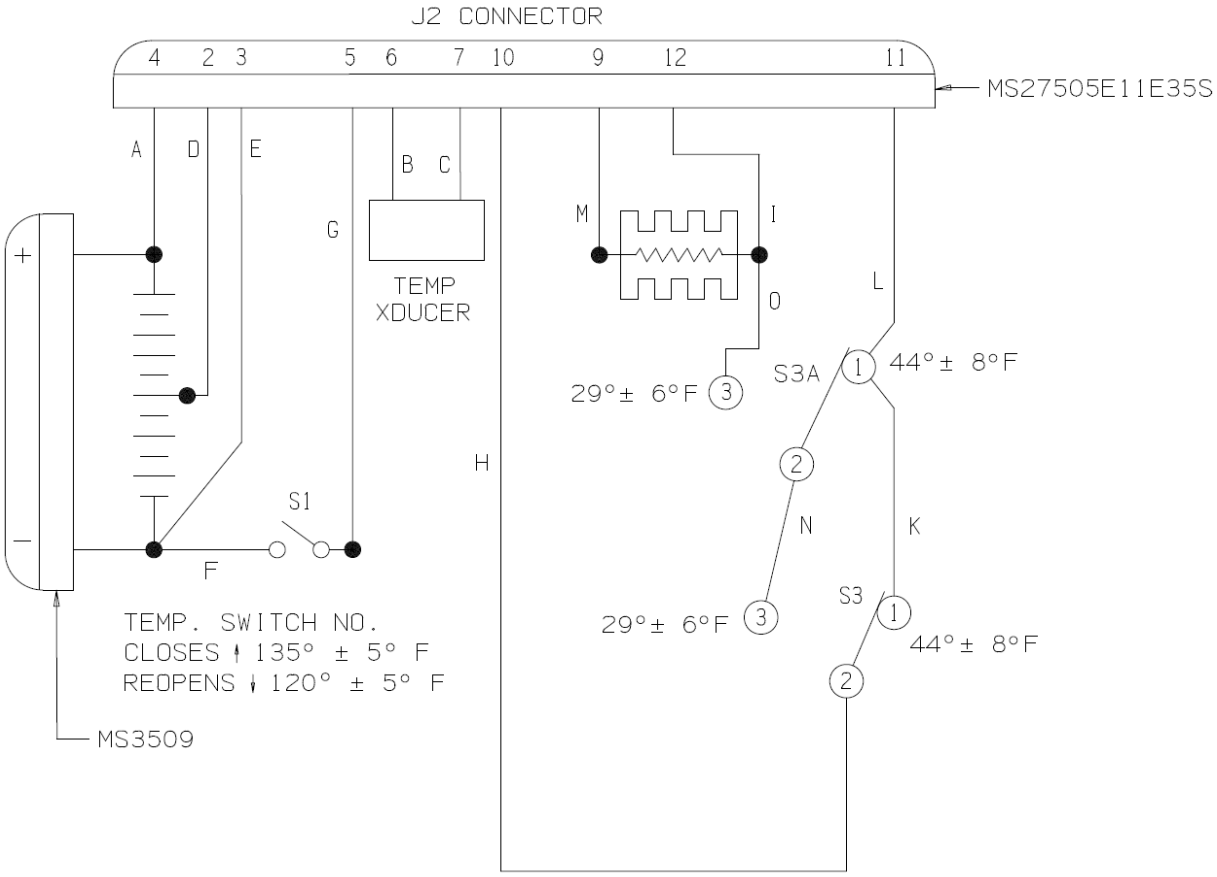

FIGURE 2: Wiring Harness Connections

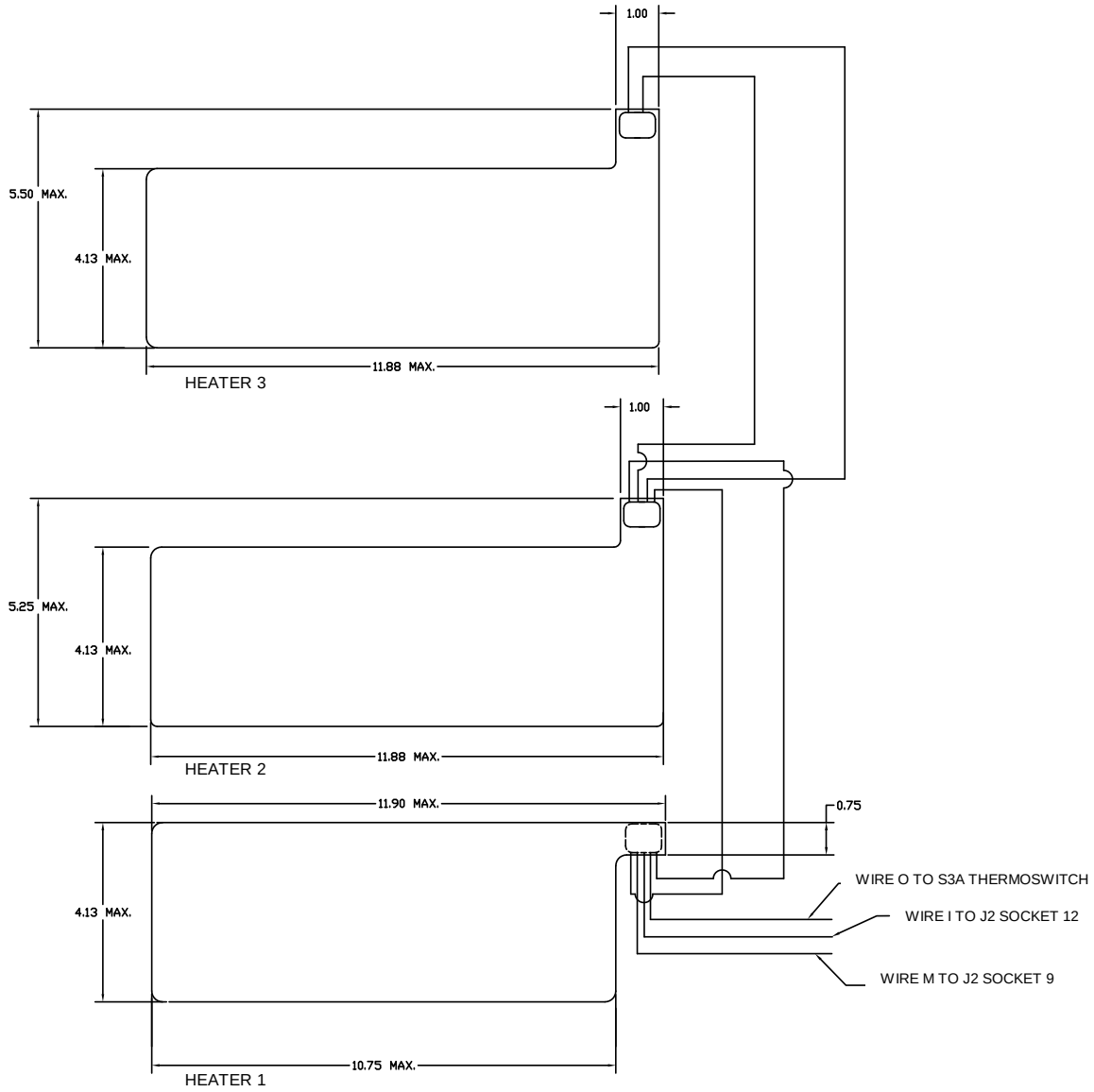

FIGURE 3: Heater Assembly

FIGURE 3 NOTE:
All dimensions are in inches

Custodians:
Army – CR

Preparing activity
Army – CR
(Project Number 6140-2009-024)

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