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COMPONENT MAINTENANCE MANUAL

**HCU-3 HEATER CONTROL UNIT
(AND ASSOCIATED BATTERY HEATING ELEMENT)**

THIS DOCUMENT SUPPLEMENTS THE APPLICABLE AIRCRAFT
MAINTENANCE MANUAL (AMM) AND THE APPLICABLE COMPONENT
MAINTENANCE MANUAL (CMM) FOR THE BATTERY.

*The data/information contained herein has been reviewed and approved for general release on
the basis that this document contains no export-controlled information*

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RECORD OF REVISIONS

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A	Title changed from ICA to CMM.	06/19/12	JBT
B	Rev Airworthiness Limitations per TSO-C173A	06/28/13	JBT
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1. Scope and Purpose: This Maintenance Manual Supplement provides instructions to insure satisfactory operation, maintenance, and repair of the Concorde HCU-3 Heater Control Unit (HCU) and the associated heating element within the battery.
2. Application: The HCU-3 Heater Control Unit is designed for use with RG[®] Series batteries containing internal heating elements. An HCU must be installed on the heated series of Concorde TSO batteries in order for the battery assembly to operate as designed. See table of compatibility in Section 2 Application of the individual battery CMM. The HCU by itself is INCOMPLETE and may not be installed in an aircraft.
3. Safety Precautions:
 - a. **WARNING: LOW CAPACITY HAZARD.** Aircraft batteries are certified to have a certain minimum capacity for emergency operations in the event of a electrical generator system failure. Never use a battery that has less than 80% of rated capacity.
 - b. **WARNING: ELECTRIC BURN HAZARD.** Lead-acid batteries are capable of delivering high currents if the terminals are shorted. The resulting heat can cause severe burns and is a potential fire hazard. Take the following precautions:
 - Do not place tools or metal objects across battery terminals.
 - Do not wear conductive rings, belt buckles, watches or other jewelry when servicing batteries.
 - Wear insulated gloves and use insulated tools when servicing batteries.
 - Install battery terminal protectors whenever the battery is not connected in the aircraft or to the test equipment.
 - c. **WARNING: DANGER OF EXPLODING BATTERIES.** Lead-acid batteries can produce explosive mixtures of hydrogen and oxygen while on charge or discharge, which can explode if ignited. Take the following precautions:
 - Do not smoke, use an open flame, or cause sparking near a battery.
 - Wear proper eye and face protection when servicing batteries.
 - Make sure work area is well ventilated.
 - Do not constant current charge a battery when installed in an aircraft.
 - Connect cables securely to the battery terminals to avoid arcing.
 - d. **WARNING: DANGER OF CHEMICAL BURNS.** Lead-acid batteries contain sulfuric acid which can cause severe burns to body tissue. Take the following precautions:
 - Never remove or damage vent valves.
 - Avoid contact of the electrolyte with skin, eyes or clothing.
 - Do not touch eyes after touching battery.
 - In the event of acid in the eyes, flush thoroughly with clean cool water for several minutes and get professional medical attention immediately.
 - Refer to battery MSDS for additional information.

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- e. **CAUTION: DANGER OF EQUIPMENT DAMAGE.** To prevent damage to the connector, arc burns, or explosion, batteries should never be connected or disconnected while being charged or discharged. Batteries must be connected or disconnected only when the circuit is open. Ensure the aircraft battery switch, external power source, or the charger/analyzer is in the **AOFF** position before connecting or disconnecting the battery. Battery terminal protectors should be installed whenever the battery is not connected in the aircraft or to the test equipment.
4. Airworthiness Limitations:
 - a. For batteries covered by TSO-C173 the following limitation applies: The conditions and tests for TSO approval of this HCU are minimum performance standards. Those installing this HCU, on or in a specific type or class of aircraft, must determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only according to 14CFR part 43 or the applicable airworthiness requirements. Nickel-cadmium and lead-acid battery safety concerns include the possibility of fire and venting violently.
 - b. For batteries not covered by TSO-C173, there are no airworthiness limitations associated with the installation of Concorde HCUs in an aircraft.
 5. Personnel: Only personnel authorized by the cognizant aviation authority are permitted to service Concorde HCUs. For aircraft registered in the USA, 14CFR Part 43.3 applies.
 6. Installation Procedure:
 - a. Install HCU on battery per Concorde Drawing 5-0313.
 - b. Install battery in accordance with the instructions for the battery installation.
 - c. Connect HCU to the aircraft using the mating connector in the aircraft.
 - d. Annotate log book with HCU serial number and date of installation.
 7. Testing and Fault Isolation:
 - a. Test the HCU every 12 months (\pm 1 month) or whenever:
 - HCU operation appears to be faulty.
 - HCU is mated to a different battery assembly.
 - b. Refer to Figure 1 for electrical schematic of HCU and Table 1 for a list of test equipment.
 - c. With the HCU installed on the battery, test the battery DC heating element as follows:

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1. Calculate the nominal resistance of the DC heating element based on the voltage and current rating using the following formula:

$$R_{\text{calculated}} = \text{Heater Voltage} / \text{Heater Amperage}$$

NOTE: Refer to the envelope drawing of the battery to obtain the rated Heater Voltage and Heater Amperage for the DC heater.

2. Multiply the calculated resistance by 1.20 to get the maximum allowable resistance and multiply the calculated resistance by 0.80 to get the minimum allowable resistance:

$$R_{\text{maximum}} = R_{\text{calculated}} \times 1.20$$

$$R_{\text{minimum}} = R_{\text{calculated}} \times 0.80$$

3. Measure the resistance between J2 pins E and M. If the measured resistance is more than R_{maximum} or less than R_{minimum} , reject the battery.

Example: Heater rating from battery envelope drawing is 7.08 Amps at 28.25 VDC.

$$R_{\text{calculated}} = 28.25 / 7.08 = 3.99 \text{ ohms.}$$

$$R_{\text{maximum}} = R_{\text{calculated}} \times 1.20 = 3.99 \text{ ohms} \times 1.20 = 4.79 \text{ ohms}$$

$$R_{\text{minimum}} = R_{\text{calculated}} \times 0.80 = 3.99 \text{ ohms} \times 0.80 = 3.19 \text{ ohms.}$$

If the measured resistance is more than 4.79 ohms or less than 3.19 ohms, reject the battery.

4. Measure the resistance between J2 pin E and battery case, and between J2 pin M and battery case. If either resistance is less than 1 megohm, reject the battery.

NOTE: To get a true reading from the battery case, probe one of the HCU mounting screws.

- d. With the HCU installed on the battery, test the battery AC heating element as follows:

1. Calculate the nominal resistance of the AC heating element based on the voltage and current rating using the following formula:

$$R_{\text{calculated}} = \text{Heater Voltage} / \text{Heater Amperage}$$

NOTE: Refer to the envelope drawing of the battery to obtain the rated Heater Voltage and Heater Amperage for the AC heater.

2. Multiply the calculated resistance by 1.20 to get the maximum allowable resistance and multiply the calculated resistance by 0.80 to get the minimum allowable resistance:

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$$R_{\text{maximum}} = R_{\text{calculated}} \times 1.20$$

$$R_{\text{minimum}} = R_{\text{calculated}} \times 0.80$$

3. Measure the resistance between J2 pins G and J. If the measured resistance is more than R_{maximum} or less than R_{minimum} , reject the battery.

Example: Heater rating from battery envelope drawing is 1.74 Amps at 115 VAC.

$$R_{\text{calculated}} = 115/1.74 = 66.1 \text{ ohms.}$$

$$R_{\text{maximum}} = R_{\text{calculated}} \times 1.20 = 66.1 \text{ ohms} \times 1.20 = 79.3 \text{ ohms}$$

$$R_{\text{minimum}} = R_{\text{calculated}} \times 0.80 = 66.1 \text{ ohms} \times 0.80 = 52.9 \text{ ohms.}$$

If the measured resistance is more than 79.3 ohms or less than 52.9 ohms, reject the battery.

4. Measure the resistance between J2 pin G and battery case, and between J2 pin J and battery case. If either resistance is less than 1 megohm, reject the battery.

NOTE: To get a true reading from the battery case, probe one of the HCU mounting screws.

- e. With the HCU installed on the battery, test the heater relay K1 as follows:
 1. Apply 28VDC between J2 pin E (+) and J2 pin M (-).
 2. Measure the resistance between J2 pin J and J2 pin G. If the resistance is less than 1 megohm, reject the HCU.
- f. To access the HCU components that require testing, remove the HCU from the battery.
- g. Test the heater thermostat (TS1) as follows:
 1. Place digital thermometer probe in thermal contact with thermostat TS1.
 2. Use freeze spray to decrease the temperature of TS1 below 15.5°C (60°F).
 3. Measure the resistance between J2 pins D and E.
 4. If the measured resistance is greater than 1 ohm, reject the HCU.
 5. Use a heat gun to increase the temperature of TS1 above 29.4°C (85°F).
 6. Measure resistance between J2 pins D and E.
 7. If the measured resistance is less than 1 megohm, reject the HCU.
- h. Test the heater thermostat (TS2) as follows:
 1. Place digital thermometer probe in thermal contact with thermostat TS2.
 2. Use freeze spray to decrease the temperature of TS2 below 4.4°C (40°F).
 3. Measure the resistance between J2 pins C and D.
 4. If the measured resistance is greater than 1 ohm, reject the HCU.
 5. Use a heat gun to increase the temperature of TS2 above 18.3°C (65°F).

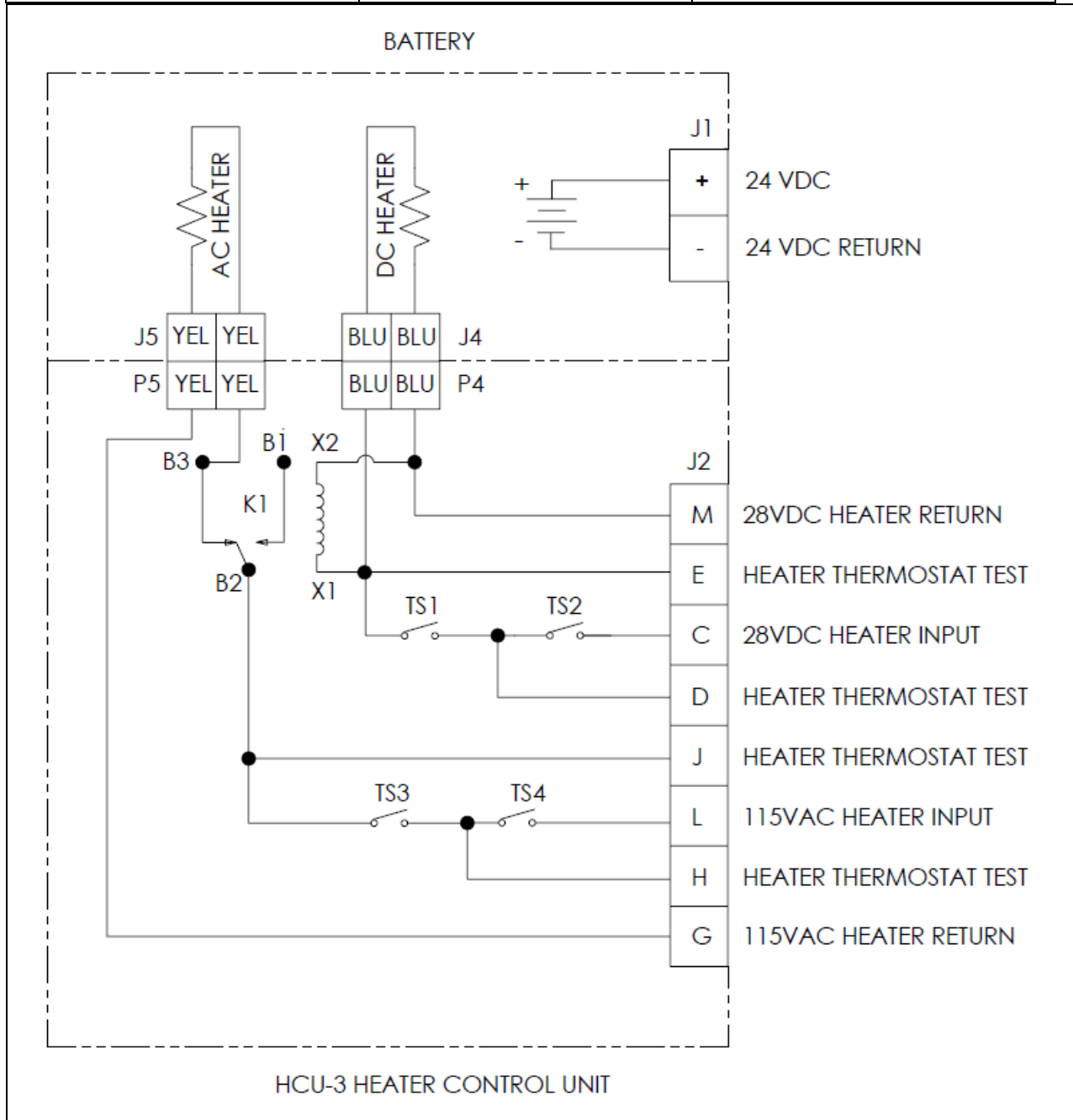
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6. Measure resistance between J2 pins C and D.
 7. If the measured resistance is less than 1 megohm, reject the HCU.
- i. Test the heater thermostat (TS3) as follows:
1. Place digital thermometer probe in thermal contact with thermostat TS3.
 2. Use freeze spray to decrease the temperature of TS3 below 1.7°C (35°F).
 3. Measure the resistance between J2 pins J and H.
 4. If the measured resistance is greater than 1 ohm, reject the HCU.
 5. Use a heat gun to increase the temperature of TS3 above 12.8°C (55°F).
 6. Measure resistance between J2 pins J and H.
 7. If the measured resistance is less than 1 megohm, reject the HCU.
- j. Test the heater thermostat (TS4) as follows:
1. Place digital thermometer probe in thermal contact with thermostat TS4.
 2. Use freeze spray to decrease the temperature of TS4 below 18.3°C (65°F).
 3. Measure the resistance between J2 pins H and L.
 4. If the measured resistance is greater than 1 ohm, reject the HCU.
 5. Use a heat gun to increase the temperature of TS4 above 29.4°C (85°F).
 6. Measure resistance between J2 pins H and L.
 7. If the measured resistance is less than 1 megohm, reject the HCU.
- k. Install the HCU on the battery and re-check the battery DC heating element per paragraph 7(c) and the battery AC heating element per paragraph 7(d).
- l. Troubleshooting Summary:

Symptom	Probable Cause	Corrective Action
Resistance of DC heater element out of range	Heater failure	Replace battery
Resistance of DC heater to battery case is less than 1 megohm	Heater failure	Replace battery
Resistance of AC heater element out of range	Heater failure	Replace battery
Resistance of AC heater to battery case is less than 1 megohm	Heater failure	Replace battery

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Relay K1 fails to open	K1 failure	Replace HCU
TS1 out of range	TS1 failure	Replace HCU
TS2 out of range	TS2 failure	Replace HCU
TS3 out of range	TS3 failure	Replace HCU
TS4 out of range	TS4 failure	Replace HCU



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Figure 1. Schematic Diagram for HCU-3

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Table 1. List of Test Equipment

Description	Source	Part Number	Purpose
Digital Multimeter (DMM), with a resistance range of at least 0.1 ohms to 1 Megohm with accuracy of 0.1% or better.	Commercially Available	N/A	Measuring resistance of heater element and thermostats
DC Power Supply, with output capability of 28VDC and at least 100mA.	Commercially Available	N/A	Applying 28VDC to coil of relay K1
Digital Thermometer	Commercially Available	Fluke Model 51 or equivalent	Measuring temperature of thermostats
Mating Connector P2	Various	MS27467T15B97SN or equivalent	Connect HCU J2 to DMM
No. 16 and 20 Gauge Socket Probes	Commercially Available	N/A	Connect HCU J2 pins to DMM (as an alternative to using mating connector).

8. Replacement / Repair:
 - a. The HCU is non-repairable and must be replaced if it has a fault.
 - b. Replace HCU by removing failed HCU and installing a new HCU in accordance with paragraph 6 of this supplement.

9. Storage Limitations: None.

10. Disposal: Dispose spent batteries and HCUs in accordance with local ordinances and regulations.