CHAPTER

77

ENGINE INDICATING

ENGINE INDICATING

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TO: RECIPIENTS OF JT12 OVERHAUL MANUAL, PART NUMBER 435108

REVISION NO. 74 DATED APRIL 1, 2007

HIGHLIGHTS - ENGINE INDICATING

CHAPTER/ SECTION	PAGE NO	DESCRIPTION OF CHANGE	EFFECT OF CHANGE
77-00-00 ACCY	1101 1104 1106 1108 1114 1120	Added engine indicating part section. Revised thermocouple terminal insulation cement specification. (PCR JT12-013)	-ALL

R 1. Engine Indicating Components - General

R A. General

R (1) In this section are procedures for Cleaning, Inspection,
R Repair, and Test of engine indicating components for the
R JT12/JFTD12 engine.

2. Thermocouples

See Figure 1101.

A. Cleaning

(1) Because the operating temperatures in which turbine discharge indicating thermocouples operate are high, carbon deposits and collected dirt usually found at cooler engine positions will not be a problem for cleaning. Do all minor cleaning operations which could be necessary (but be careful to prevent mechanical damage to the part).

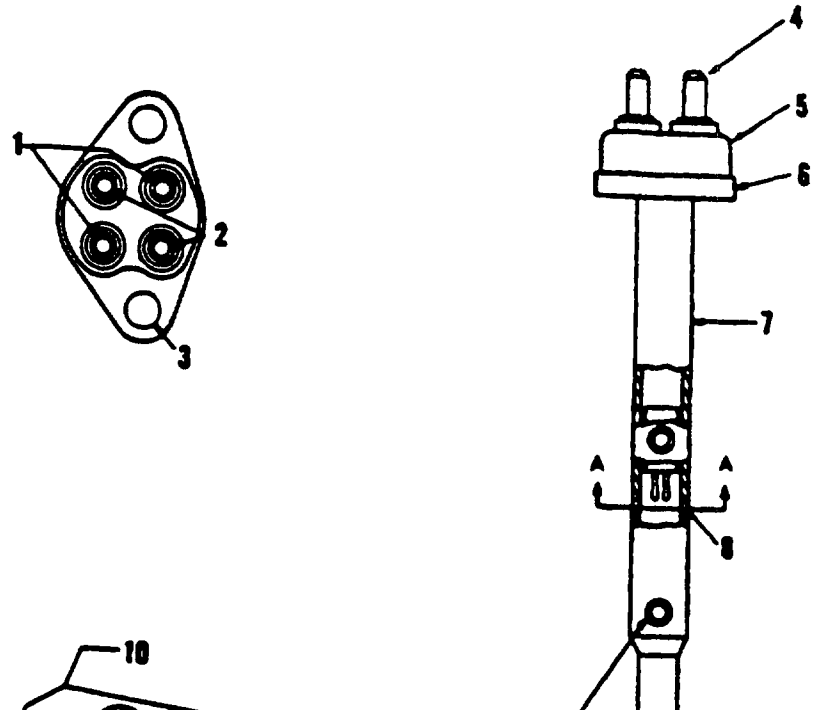
NOTE: Carbon coating on a thermocouple head decreases thermocouple resistance. Before you do a resistance check, remove this coating with igniter plug cleaning equipment that uses AC Cleaning Compound Type 2. Be careful not to use too much grit blasting on the part.

CAUTION: THE INSULATION MATERIAL USED IN THE THERMOCOUPLE PROBE WILL EASILY ABSORB LIQUIDS. BECAUSE THERE CAN BE BAD EFFECTS ON THERMOCOUPLE OPERATION IF THERE ARE LIQUIDS IN THE INSULATION, IT IS IMPORTANT NOT TO USE LIQUID SOLVENTS THAT CAN GET INTO THE SHIELD.

(2) Clean the thermocouple internally with air blast of approximately 100 psi through a small nozzle. Put the nozzle into the probe exhaust holes and blast carbon deposits around the thermocouple lead. This removal of carbon will help to increase insulation resistance of the thermocouple.

NOTE: Make the recommended nozzle from 0.040 inch ID and 0.058 inch OD stainless steel tubing. See Figure 1102 for an example of this tool.

B. Inspection



L-06856 (0000)

1. Alumel Studs
2. Chromel Studs
3. Mount Holes
4. Studs
5. Head
6. Flange
7. Probe
8. Exhaust Gas Port
9. Inlet Gas Holes
10. 10 Degrees ± 2 Degrees

R
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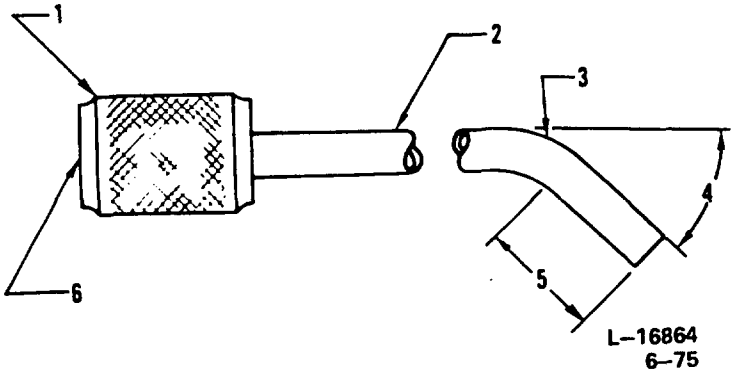
Thermocouple
Figure 1101



1. Standard Connector
2. 0.040 Inch ID/0.058 Inch OD Tube
3. One-Quarter Inch Radius
4. 45 Degrees
5. 0.200 Inch
6. Apply Air Pressure Here

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Thermocouple Probe Cleaning Nozzle
Figure 1102

(1) Examine all surfaces of thermocouples for nicks, cracks, bends, or apparent heat erosion.

(2) Make sure that the probe is straight. Permitted deformation of the small OD (lower end) of the probe is 1/8 inch.

(3) Minor nicks in the shield are not cause to reject the part. A crack makes the thermocouple not serviceable.

(4) Do not try to repair minor bends in the shield.

(5) Look in the exhaust and inlet port openings for carbon buildup. If necessary remove carbon with a straight piece of steel wire.

(6) Make sure that the probe is not loose.

(7) Examine the terminal posts to be sure that they are not loose and that the threads are not damaged. Deformation of 0.025 inch is permitted if the posts are not loose and the probe is in good condition electrically. It is not permitted to make bent posts straight or to try to repair them.

(8) On dual-junction thermocouples, after abrasive blast examine the area shown in Figure 1101 for missing terminal post insulation.

(9) Replace worn plasma coating.

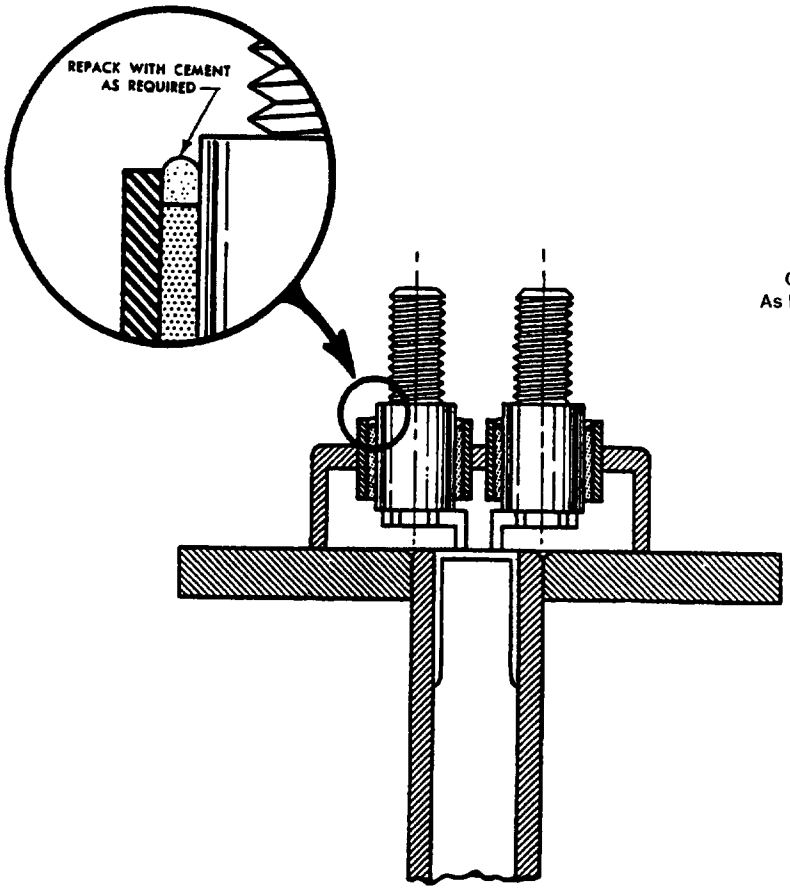
C. Repair

(1) Terminal insulation replacement

See Figure 1103.

(a) If insulation is missing around a terminal post, fill in the area with Saureisen Cement No. 8 or Compound Z18, then heat to 65°C (150°F) for three hours or let air dry for 24 hours. Refer to Section 70-12-01, General-02 in the Standard Practices Manual, Source Code 80703.

NOTE: Mix the cement powder filler and liquid binder in a powder to binder ratio of three to one by weight. Change the quantity of binder to change the consistency of the mixture.



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Dual-Junction Thermocouple Probe
Terminal Repair
Figure 1103

(2) Plasma coating replacement (free turbine parts only)

Se Figure 1104.

(a) Replace worn plasma coat as follows:

1 Apply masks to areas which will not get coating.

R 2 Prepare the area by SPOP 170. Refer to Section
R 70-46-01 in the Standard Practices Manual.

3 Apply plasma coat to the worn area in the limits shown in the figure with PWA 1318 powder. Refer to Section 70-46-01 in the Standard Practices Manual. Coat must bring plasma coat thickness back to 0.003 - 0.007 inch. Dimensions shown in the figure are after coating.

D. Testing

NOTE: Before the tests that follow are done, make sure that the thermocouple is satisfactorily clean as specified above.

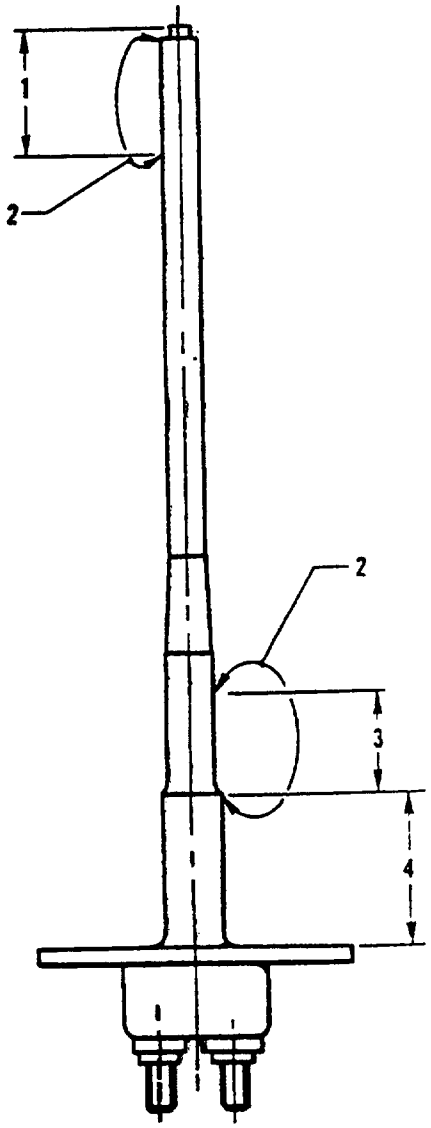
(1) Continuity and resistance check

(a) Use a sensitive ohhmeter or Wheatstone bridge to measure the continuity and resistance of the thermocouple. Internal resistance of the thermocouple must not be more than 0.250 ohm.

(b) With a low-voltage ohmmeter, measure the insulation resistance between the chromel and alumel terminals and the body of the thermocouple for a minimum of 25 seconds for each inspection. Resistance must be 50,000 ohms or higher. If the resistance is in limits, the thermocouple is serviceable.

NOTE: Use a low-voltage ohmmeter that uses less than 40 volts (DC) and is accurate to five percent to measure insulation resistance. Never use a Megger or other high-voltage tester.

(2) Functional test



L-22702 (0000)

1. 0.700 Inch Minimum (Plasma Coat Can Extend Across End Of Plug), 0.241 - 0.247 Inch Diameter
2. Plasma Coat Area
3. 0.505 Inch (0.315 - 0.321 Inch Diameter For This Distance)
4. 1.000 - 1.050 Inch

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(a) If the continuity and resistance check shows that there is a possible problem with a thermocouple, do a functional test of the thermocouple. A functional test applies changes in temperature to a thermocouple and measures the voltage changes that are the result. A temperature-controlled oven will increase the temperature and a pyropotentiometer will give thermocouple readings in degrees of temperature. Thermocouple readings that are ± 4°C (7°F) of laboratory standard accuracy are satisfactory.

(b) To calibrate a thermocouple, put it in an oven with another of the same type of which the accuracy is known. Heat soak the probes (keep them at 600°C (1112°F) for one hour or more) and then compare the readings.

3. Thermocouple Cable
See Figure 1105.

A. Cleaning

R (1) Clean external surfaces of the cable assembly by
R SPOP 208. Refer to Section 70-21-00 of the Standard
R Practices Manual.

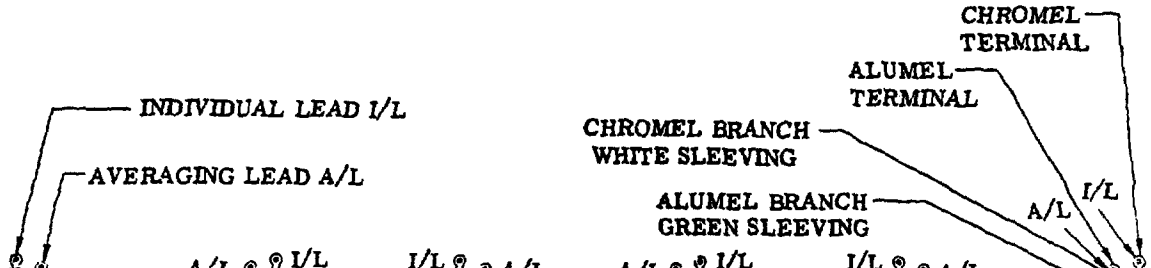
CAUTION: THERE MUST BE NO FOREIGN MATERIAL REMAINING ON TERMINALS (THIS CAN DECREASE OR PREVENT CORRECT OPERATION OF THE EXHAUST INDICATING SYSTEM).

(2) If necessary clean all terminal contact surfaces with 400 grit emery cloth.

B. Inspection

(1) Examine the thermocouple cable assembly for mechanical damage to the stainless steel braid, glass fiber sleeves, or terminals. Look for rupture or bad fraying, and for broken conductor strands at all terminals. Reject the cable assembly if rupture or fraying is found. Wind areas with possible damage with heat-protective tape.

(2) Examine mounting clips for condition of the cushion material. Replace clips with defects.



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Thermocouple Cable Assembly
(Typical)
Figure 1105

C. Repair

NOTE: Refer to Tool Group A9 and Figure 1105.

(1) Terminal lug repair

NOTE: Do the tests in this section before the repairs are done.

(a) Remove the terminal spacer which goes across the terminal leads.

(b) Cut and remove the insulation sleeve material.

(c) Cut off the terminal immediately to the rear of the weld. Open the remaining portion of the terminal and remove it from the branch lead.

NOTE: Do not make thermocouple harness leads so short by repair that this will put stress on the terminal posts when the cable assembly is installed back on an engine.

(d) Examine the thermocouple band which attaches the stainless steel braid in position for condition. If a band is damaged, remove it and install a new band with the applicable Die.

(e) Push the stainless steel braid back on the branch approximately one-half inch.

CAUTION: DURING REMOVAL OF THE SLEEVE AND INSULATION BE CAREFUL NOT TO CAUSE DAMAGE TO THE INSULATION UNDER THE BRAID.

(f) Remove the sleeve material and insulation approximately 3/16 from the end of the wire.

(g) Clean the end of the wire with a stainless steel wire brush. Cut off frayed insulation and put 3M Insulating Tape No. 69 (or equivalent).

(h) Attach a terminal lug of the applicable material (alumel or chromel) to the wire (close the small ears of the lug around the wire with the Press and the applicable Die.

(i) Fusion weld the terminal to the wire. Examine the weld and clean the junction with a stainless steel wire brush.

(j) Close the large terminal ears across the insulation with the Press and Die.

(k) Install the large piece of sleeve as shown in the figure.

(l) Use the Press and applicable Die to close the terminal spacer on the sleeve across the two terminal leads.

(2) Harness connector contact replacement repair. See Figure 1107.

(a) Remove the two screws that attach the clamps to the end of the shield and remove the two clamps.

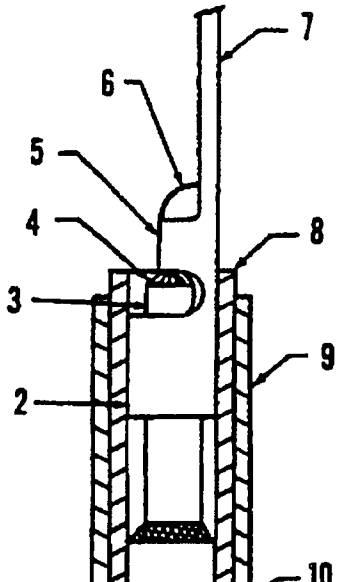
(b) Turn the shield off the shell and push the shield back on the cable.

NOTE: It is possible to use an applicable mating connector as a fixture to hold the shell while the shield is removed.

(c) Remove the retaining ring from the shell and remove the shell and outer insulator. Remove the potting compound from the rear of the connector insert and from between the wires with a small chisel and hammer. Be careful not to cause damage to the wire insulation. Be sure that the potting compound is fully removed from the retaining ring and the retaining groove in the shell.

(d) Remove damaged contacts (apply heat locally to melt the braze). If it is necessary to replace the inner insulator or shield, remove all contacts to release these parts.

NOTE: When contacts are removed during disassembly the connector, identify the wires to make sure that they can go through the correct insulator holes and are connected with braze to tips of the applicable material (alumel or chromel) during assembly. Refer to the wiring diagram in Figure 1108.



L-11218 (0000)

1. Wire Braid
2. Large Ear
3. Wire Insulation
4. Wire
5. Small Ear
6. Weld
7. Terminal Lug
8. Insulation Sleeve Material
9. Terminal Spacer
10. Cable Band

Thermocouple Cable
Terminal Lug Repair
Figure 1106

(e) Clean the bare ends of the wires with a stainless steel wire brush.

(f) Push the shield on to the cable with the threaded end toward the bare wires.

(g) Install the inner insulator on the cable with the retaining ring recess toward the shield and with the wires extended through the applicable holes in the insulator.

(h) Braze a contact of the applicable type and material (alumel or chromel) to each wire by AMS 2665. Refer to Section 70-42-03 in the Standard Practices Manual.

(i) Apply AMS 3410 flux to the wire and to the well of the contact.

(j) Install the wire into the well of the contact.

NOTE: Hold the wire on the same axis as the contact while the braze is done.

(k) Apply heat locally to the contact to the melting point of the braze, approximately 635°C (1175°F).

(l) Apply silver braze material to the well of the contact. Use the minimum quantity of braze and do not let the braze flow up the wire.

(m) After all the wires are brazed, let the assembly become cool, at room temperature.

(n) Blow a stream of wet steam at the braze joints to remove the flux.

NOTE: It is very important to remove all flux from the assembly.

(o) Examine the braze joints.

(p) Let the insulation dry fully before assembly continues.

(q) Install the outer insulators on the contacts (align the key slots in the two insulators).

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(r) Install the shell on the insulators (engage the key of the shell in the slots of the insulators).

(s) Install the retaining ring in the groove of the shell. Make sure that the ring is its correct position.

(t) Install an applicable mating plug on the connector to make sure that parts are correctly aligned while the potting compound is applied.

(u) Mix potting compound (Cotronics Corp. 900-SM25) as specified on the container label.

NOTE: Compound is available from Cotronics Corp., 3379 Shore Parkway, Brookly, NY 11235-3623, TEL: (718) 646-7996, FAX: (718) 646-3028.

(v) Apply the potting compound between the wires and the rear of the contacts to a height of 3/4 inch from the rear insert. Do not let potting compound get into the rear threads of the connector shell.

(w) Attach the shield to the shell.

NOTE: Use an applicable mating connector as a fixture to hold the shell while the shield is tightened.

(x) With the mating connector in position, let the potting compound cure as specified on the container label.

(y) Attach the two clamps to the shield with two screws.

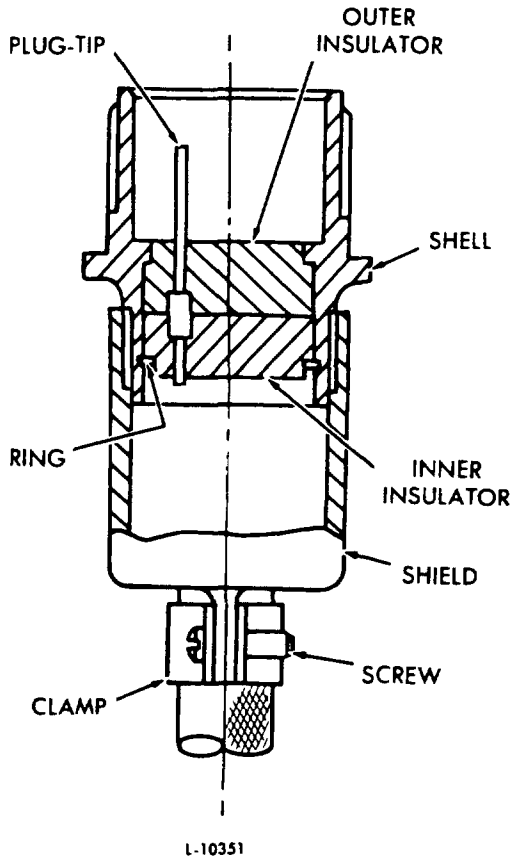
(z) Repaired assemblies must be in test limits as specified in Testing.

(3) Thermocouple cable wire braid repair

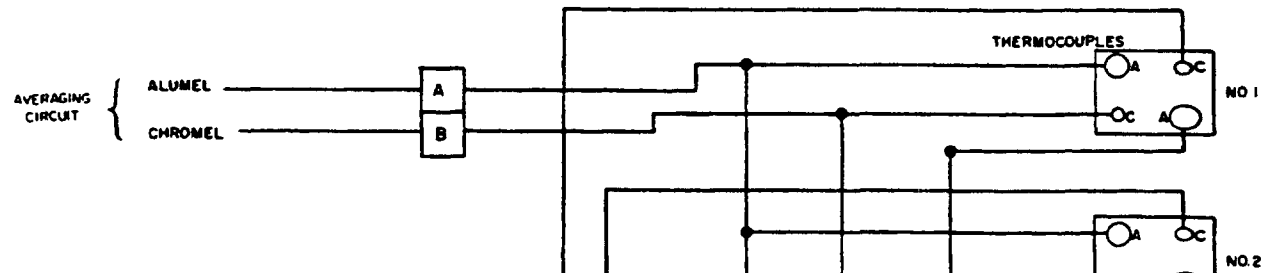
R (a) Repair thermocouple cable wire braid covering which
R is worn, broken, cut, or with other damage. Refer
R to Section 70-00-00, Repair-21 in the Standard
R Practices Manual.

D. Testing

See Figure 1109.



Thermocouple Harness Connector
Contact Replacement Repair
Figure 1107



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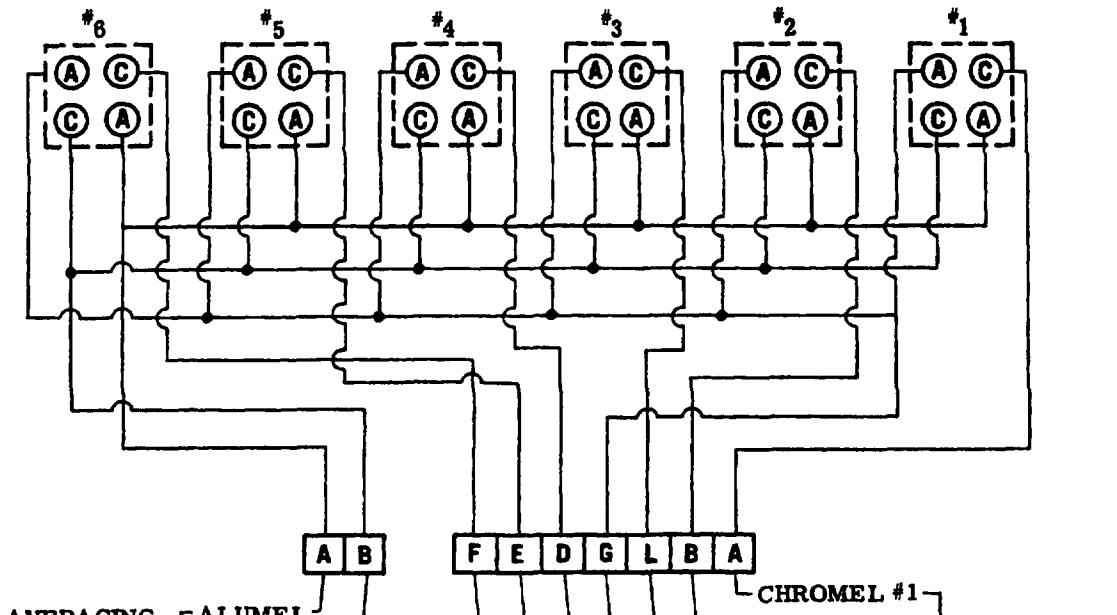
Thermocouple Cable Electrical Schematic (Three-Thermocouple System) Figure 1108 (Sheet 1)



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Thermocouple Cable Electrical Schematic (Six - Thermocouple System) Figure 1108 (Sheet 2)

(1) General

(a) The validity of electrical tests done in the field can depend on limitations inherent in the common ohmmeter. This instrument is not dependable for determining the exact wire resistance of the thermocouple cable. It can however be used to find gross failures such as open or intermittent circuits and metal-to-metal short circuits. Also approximate insulation resistance can be checked if certain precautions are observed. The ohmmeter used in the following test must be of good quality and in good condition, i.e. free from "stickiness" of the meter needle, with pinjacks firm, test leads sound, and dry cells in a condition to permit full-scale deflection for all positions of the range switch.

(2) Continuity check

(a) Set the ohmmeter range to have a center scale value of approximately ten ohms.

NOTE: Broken wires which touch intermittently when the cable is bent will cause the needle to fluctuate. False intermittent indications will be the result if the ohmmeter test points do not touch the terminals tightly or if the terminals are not clean. Defects in the ohmmeter test points, leads, and jacks will also cause this.

(b) Use the schematics in Figure 1108 to do a continuity check. Reject the cable assembly if there is not continuity.

(3) Insulation resistance check

(a) Use a low-voltage ohmmeter to look for short circuits, excessive leakage, and internal insulation chafing discrepancies. Make sure of correct instrument operation: touch the test points together and make sure that the needle deflection goes to zero.

NOTE: Use a low-voltage ohmmeter that uses less than 40 volts (DC) and is accurate to five percent to measure insulation

resistance. Never use a Megger or other high-voltage tester.

(b) Put one test point against the steel wire braid covering of the cable and the other point against an alumel conductor.

(c) If the resistance recorded on the ohmmeter scale is less than 50,000 ohms, do this:

1 If full-scale deflection (zero ohms) is recorded, and no terminals touch accidentally, reject the cable assembly.

2 If a large (but not full-scale) deflection is recorded, there may be carbon or moisture in the cable assembly. Carbon usually gives a stable reading, but moisture can give readings which change and are not the same after five to 30 seconds. If there is an indication of moisture, bake the cable at 93 - 121°C (200 - 250°F) for one hour and do the check again.

NOTE: False drift can be a result of variations in the applied voltage. To look for false drift, touch the test points for ten seconds. The reading must not change from full-scale deflection.

(d) Do steps (a), (b), and (c) with one test point against the steel wire braid covering of the cable and the other against a chromel conductor.

(e) Do a resistance check of the insulation between conductors with the low-voltage ohmmeter. Put one test point on a chromel terminal and the other on an alumel terminal. If the resistance recorded is less than 50,000 ohms, reject the cable assembly.

(f) Do steps (a) thru (e) above on the thermocouple front cable (if applicable).

(4) Short circuit check

(a) Set the ohmmeter range to have a center scale value of approximately ten ohms.

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(b) Put one test point against a well-cleaned alumel terminal and the other against a well-cleaned chromel terminal. Bend the cable lightly and monitor the instrument needle. If this causes deflection (unless other terminals were accidentally touched), reject the cable assembly.

(c) Do steps (a) and (b) on the thermocouple front cable if applicable.

4. Free Turbine Pressure Sensing Manifolds

A. Inspection

(1) Replace worn plasma coating.

(2) On probes without plasma coat, a maximum of 0.010 inch wear is permitted on the detail probe (all positions).

B. Repair

(1) Plasma coat repair

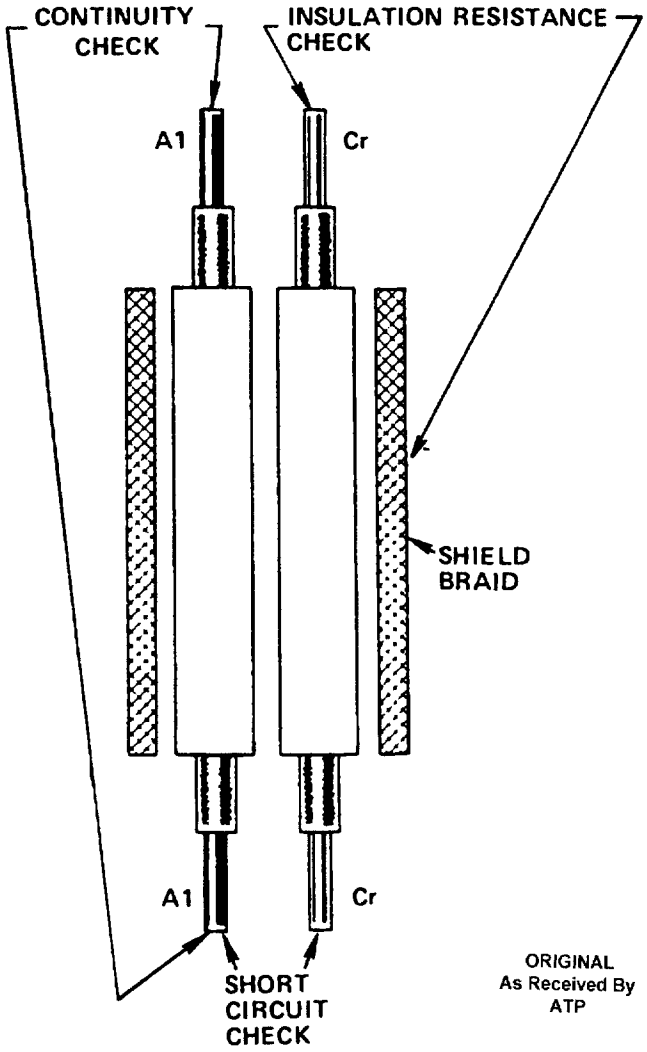
See Figure 1110.

(a) Apply masks to the coat areas.

(b) Do a fluorescent penetrant inspection of the part.

R (c) Prepare the surface for plasma coat by SPOP 170.
R Refer to Section 70-46-01 in the Standard Practices
R Manual.

(d) Apply plasma coat to the worn area in the limits shown in the figure with PWA 1318 powder. Refer to Section 70-46-01 in the Standard Practices Manual. Coat must bring plasma coat thickness back to 0.003 - 0.007 inch. Dimensions shown in the figure are after coating.



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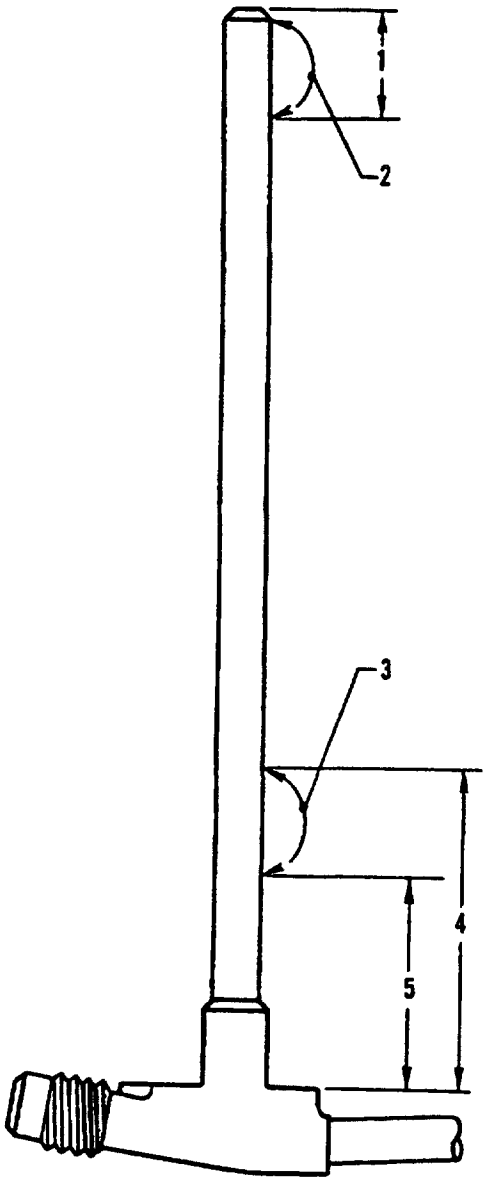
Thermocouple Cable Electrical Check
Figure 1109



L-22703 (0000)

1. 0.540 - 0.660 Inch
2. Plasma Coat Area, 0.241 - 0.247 Inch Diameter
3. Plasma Coat Area, 0.253 - 0.259 Inch Diameter
4. 1.760 - 1.810 Inch
5. 1.160 - 1.210 Inch

5. Pt2 Compressor Inlet Total Pressure Probe

A. Inspection

(1) Probe leak check

(a) Apply clean compressed air at 10 psig to the probe tube.

(b) Seal the total pressure hole on the leading edge of the probe.

(c) Put the probe fully into water and look for bubbles from the anti-ice air inlet and exit ports. Apparent leakage is cause to reject the probe.