THIS DRAWING TO BE REVISED IN WORD ONLY. PLEASE CONTACT DOCUMENT SERVICES-GREENVILLE AT DIALCOMM 288-2817.
TEST PROCEDURE FOR PRODUCTION THERMOCOUPLES

1.0 SCOPE

1.1 THIS PROCEDURE COVERS TESTING PRODUCTION THERMOCOUPLES DURING TURBINE PRODUCTION ASSEMBLY, TURBINE TEST, OR INCLUDING RECEIVING INSPECTION.

1.2 THIS PROCEDURE PERTAINS TO THERMOCOUPLES OF ANY (K, T, E, J, ETC.) CALIBRATION, WITH METAL SHEATHS, UNGROUNDED JUNCTIONS, AND ENVIRONMENTAL SEALS.

2.0 REFERENCED DOCUMENTS

2.1 ASTM E 780 STANDARD METHOD FOR MEASURING THE INSULATION RESISTANCE OF SHEATHED THERMOCOUPLE MATERIAL AT ROOM TEMPERATURE.

2.2 ASTM E 585 SPECIFICATION FOR SHEATHED BASE METAL THERMOCOUPLE MATERIALS.

2.3 ASTM E 608 SPECIFICATION FOR METAL SHEATHED BASE METAL THERMOCOUPLES.

2.4 DELETED

3.0 VOID

4.0 STANDARD TESTS AND INSPECTIONS

THE FOLLOWING TESTS MAY BE PERFORMED ON A RANDOM SAMPLE BASIS. RANDOM SAMPLE SHALL BE 6% MINIMUM. HOWEVER 100% INSPECTION SHOULD BE PERFORMED AS LONG AS DEFECTS REPORTED EXCEED SIX SIGMA GUIDELINES.

<table>
<thead>
<tr>
<th>TEST</th>
<th>REF</th>
</tr>
</thead>
<tbody>
<tr>
<td>VISUAL INSPECTION</td>
<td>6.1</td>
</tr>
<tr>
<td>DIMENSIONAL INSPECTION</td>
<td>6.2</td>
</tr>
<tr>
<td>INSULATION RESISTANCE AT ROOM TEMP</td>
<td>6.3</td>
</tr>
<tr>
<td>ELECTRICAL CONTINUITY</td>
<td>6.4</td>
</tr>
<tr>
<td>THERMOCOUPLE POLARITY</td>
<td>6.5</td>
</tr>
<tr>
<td>ITEM IDENTIFICATION</td>
<td>6.6</td>
</tr>
</tbody>
</table>

© COPYRIGHT 1995 GENERAL ELECTRIC COMPANY

PROPRIETARY INFORMATION - THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF GENERAL ELECTRIC COMPANY AND MAY NOT BE USED OR DISCLOSED TO OTHERS, EXCEPT WITH THE WRITTEN PERMISSION OF GENERAL ELECTRIC COMPANY.
5.0 TEST EQUIPMENT

5.1 MEGOHMMETER: MANUFACTURED BY AEMC MODEL 1000 OR EQUAL. THE MEGOHMMETER MUST BE CAPABLE OF DETERMINING VALUES OF RESISTANCE FROM 500,000 OHM TO 1000 MEG OHM MINIMUM WITHIN ± 10%. THE APPLIED VOLTAGE FOR THE RESISTANCE MEASUREMENT IS 50VDC.

5.2 DIGITAL MULTIMETER MANUFACTURED BY FLUKE MODEL 8050A, DIGITAL MEASURING INSTRUMENTS MODEL 135 TESTMATE, OR EQUAL.

6.0 TEST PROCEDURES

6.1 VISUAL INSPECTION

6.1.1 VERIFY THAT THERMOCOUPLE HAS NO OBVIOUS DAMAGE AND THERE ARE NO INCONSISTENCIES IN APPEARANCE. INSPECT THAT PHYSICAL CONFIGURATION IS PER OUTLINE IN GE ORDERING DRAWING.

6.1.2 INSPECTION TO VERIFY THAT SURFACE FINISH, STRAIGHTNESS, AND CLEANLINESS ARE ACCEPTABLE.

6.2 DIMENSIONAL INSPECTION

6.2.1 EACH THERMOCOUPLE SHOULD BE MEASURED TO ENSURE THE DIMENSIONS ARE PER THE GE ORDERING DRAWING.

6.3 INSULATION RESISTANCE TEST

6.3.1 THE MINIMUM ELECTRICAL INSULATION RESISTANCE BETWEEN THE THERMOCOUPLE AND THE SHEATH SHALL BE 100 MEGOHMS OR GREATER AT ROOM TEMPERATURE AT 50 VDC (SEE PARA. 6.3.8)
6.3.2 TO OBTAIN AN ACCURATE RESISTANCE READING FROM THE METER, YOU MUST TAKE ENVIRONMENTAL CONDITIONS INTO CONSIDERATION. YOU MUST TEST IN AN AREA WHERE THE HUMIDITY IS LESS THAN 50%. THE IDEAL TEMPERATURE IS 68 DEG F. IF YOU MUST TEST AT A TEMPERATURE OTHER THAN 68, MULTIPLY THE RESISTANCE READ FROM THE METER BY THE FOLLOWING MULTIPLICATION FACTOR:

<table>
<thead>
<tr>
<th>DEG F</th>
<th>MULTIPLICATION FACTOR</th>
<th>DEG F</th>
<th>MULTIPLICATION FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>0.25</td>
<td>86</td>
<td>1.98</td>
</tr>
<tr>
<td>41</td>
<td>0.36</td>
<td>95</td>
<td>2.80</td>
</tr>
<tr>
<td>50</td>
<td>0.50</td>
<td>104</td>
<td>3.95</td>
</tr>
<tr>
<td>59</td>
<td>0.75</td>
<td>113</td>
<td>5.60</td>
</tr>
<tr>
<td>68</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>1.40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.3.3 ADJUST THE MEGOMETER THROUGH THE SELECTOR SWITCH FOR AN OUTPUT VOLTAGE OF 50VDC AND SIMULTANEOUSLY SELECT THE RANGE WHICH WILL READ GIGOHMS (1000 MEGOHMS = 1 GIGOHM). PERFORM THE PRELIMINARY CHECK AS OUTLINED BELOW:

VERIFY SELECTOR SWITCH IS NOT BETWEEN POSITIONS. SELECTOR SWITCH SHOULD CLICK INTO POSITION. VERIFY POINTER IS ON BLACK TRIANGLE ON SELECTOR SCALE.

MEGOMETER SHOULD BE KEPT IN ITS CASE FOR MECHANICAL PROTECTION FOR THE METER.

PRELIMINARY CHECK

WHEN THE PUSH-TO-MEASURE BUTTON IS IN THE OFF POSITION, THE POINTER SHOULD BE ON ZERO OF THE VOLTMETER SCALE, AND ON ONE OF THE ML2 SCALE. IF IT IS NOT, USE THE MECHANICAL ZERO ADJUST ON THE FRONT OF THE INSTRUMENT.

- DETACH THE LEADS FROM THE INSTRUMENT.
- PRESS THE PUSH-TO-MEASURE BUTTON INTO THE ON POSITION. THE POINTER SHOULD DEFLект COMPLETELY TO THE FAR RIGHT OF THE SCALE. THE GREEN NEON "BAT" LAMP SHOULD LIGHT UP.

NOTES: ENSURE THAT THE "BAT." LIGHT (GREEN) DOES NOT GO OUT AT ANY POINT DURING THE TESTING. IF THE LIGHT DOES NOT ILLUMINATE, STOP THE TEST AND CHANGE THE BATTERIES BEFORE CONTINUING.

VERIFY THAT NO VOLTAGE IS PRESENT ON THE CIRCUIT TO BE TESTED.
6.3.4 VERIFY THE T/C TO BE TESTED IS CLEAN, DRY, AND AT ROOM TEMP.

6.3.5 WHEN TESTING THE INSULATION RESISTANCE OF EITHER 362A1102P022 OR 372A2221P011, YOU WILL NEED TO ATTACH CLIPS TO THE WIRES OF THE MEGOHM METER. WITH THE 3 ELECTRICAL LEADS CONNECTED TO THE INPUT TERMINALS OF THE MEGOHM METER (LINE, EARTH, AND GUARD TERMINALS).

TO TEST 351A3488 OR EARLIER (SEE FIGURE 1):
- ATTACH THE FIRST ELECTRICAL LEAD FROM THE LINE TERMINAL TO THE THERMOCOUPLE BARE WIRE CONDUCTORS TWISTED TOGETHER
- ATTACH THE SECOND LEAD FROM EARTH TO THE MIDDLE OF THE METAL SHEATH
- ATTACH THE THIRD LEAD FROM THE GUARD TERMINAL TO THE INSULATION OVER THE WIRES
- GROUND THE THERMOCOUPLE

TO TEST THE 362A1102P022 (SEE FIGURE 2):
- ATTACH THE FIRST ELECTRICAL LEAD FROM THE LINE TERMINAL TO EITHER STUD.
- ATTACH THE SECOND LEAD FROM EARTH TO THE MIDDLE OF THE METAL SHEATH
- ATTACH THE THIRD LEAD FROM THE GUARD TERMINAL TO THE METAL SHEATH
- GROUND THE THERMOCOUPLE

TO TEST THE 372A2221P011 (SEE FIGURE 3):
- ATTACH THE FIRST ELECTRICAL LEAD TO THE LINE TERMINAL AND CAREFULLY CLIP THE OTHER END TO EITHER PIN OF THE T/C CONNECTOR
- ATTACH THE SECOND LEAD FROM EARTH TO THE MIDDLE OF THE METAL SHEATH
- ATTACH THE THIRD LEAD FROM THE GUARD TERMINAL TO THE METAL SHEATH
- GROUND THE THERMOCOUPLE

6.3.6 NOTE THE TIME AND ENERGIZE FOR 30 SECONDS THE MEASURING CIRCUIT IN THE MEGOHM METER BY PUSHING DOWN ON THE "ON" BUTTON. DO NOT LOCK BUTTON ON.

6.3.7 AFTER 30 SECONDS RECORD THE READING INDICATED BY THE MEGOHM METER. THE READING SHOULD NOT BE LESS THAN 100 MEGOHM AT 50 VDC. RELEASE ON BUTTON, GREEN LIGHT WILL GO OUT. AFTER APPLYING TEST VOLTAGE, ALLOW (1) MINUTE FOR DISCHARGE BEFORE HANDLING ANY CONNECTIONS TO AVOID ELECTRICAL SHOCK.

6.3.8 ACTUAL TYPICAL MEGOHM READING FOR ANY GOOD QUALITY THERMOCOUPLE SHOULD EXCEED 1000 MEGOHM (1 GIGOHM) AT 50 VDC. ANY THERMOCOUPLE READING WHICH IS MARGINALLY ACCEPTABLE SHOULD BE REJECTED. IF METER DOES NOT READ ON GIGOHM SCALE SET METER ON LOWER SCALE (MEGOHM SCALE) AND RETEST. THIS LOWER SCALE WILL READ RANGES BELOW 1000 MEGOHMS.
6.3.9 NON CONFORMING MATERIAL

THERMOCOUPLES TESTED WHICH HAVE INSULATION RESISTANCE (IR) VALUES BELOW THE REQUIRED 100 MEGOHMS AT 50 VDC SHOULD BE DISPOSITIONED PER FOLLOWING PROCEDURE:

- RECORD SERIAL NUMBER, GE PART NUMBER, MANUFACTURER'S NAME, AND MANUFACTURER'S MODEL NUMBER, AND IR VALUE RECORDED.
- PLACE THERMOCOUPLE INTO AN OVEN AT 200°C FOR 15-30 MINUTES.
- REMOVE THERMOCOUPLE AND LET COOL TO ROOM TEMP. REPEAT 1R TEST. IF THERMOCOUPLE DOES NOT PASS 100 MEG OHM AT 50 VDC REQUIREMENT RETURN THERMOCOUPLE TO SUPPLIER FOR CORRECTIVE Action.

THERMOCOUPLES WHICH PASS THIS TEST INDICATE THE LOW IR IS DIRECTLY RELATED TO MOISTURE CONTAMINATION AND IS NOT CAUSED BY OTHER REASONS.

6.3.10 (IR) TESTS SHOULD BE PERFORMED ON THERMOCOUPLES PRIOR TO INITIAL INSTALLATION ON TURBINE. IR TESTS ARE NOT REQUIRED TO BE PERFORMED AFTER OPERATION ON TURBINE ON PROPERLY FUNCTIONING THERMOCOUPLES. IR TESTS SHOULD ONLY BE REPEATED AFTER INSTALLATION AS PART OF A FAILURE INVESTIGATION OF THE THERMOCOUPLE OR READING. THIS WILL MINIMIZE POTENTIAL FAILURES OF GOOD THERMOCOUPLES DUE TO OPERATOR ERROR BY ACCIDENTALLY PERFORMING MEGGER CHECKS AT HIGHER VOLTAGE LEVELS WHICH ARE DESTRUCTIVE TO THERMOCOUPLES WITH SMALL DIAMETERS (LESSONS LEARNED).

6.4 ELECTRICAL CONTINUITY

6.4.1 CHECK EACH THERMOCOUPLE ELEMENT (POSITIVE TO NEGATIVE) WITH AN OHMMETER FOR A CONTINUOUS WIRE TO WIRE ELECTRICAL CIRCUIT. NO QUANTITATIVE MEASUREMENTS ARE REQUIRED.

6.4.2 CHECK EITHER THERMOCOUPLE CONDUCTOR TO SHEATH, THERE SHOULD BE NO CONNECTION.

6.5 THERMOCOUPLE POLARITY

6.5.1 CHECK EACH THERMOCOUPLE ASSEMBLY THAT HAS A CONNECTION HEAD, CONNECTOR, TRANSITION PIECE, LEAD WIRES, OR ANY TYPE OF TERMINATION DEVICE OF ANY KIND FOR PROPER POLARITY BY HEATING THE MEASUREMENT JUNCTION AND NOTING THE POLARITY OF THE ELECTROMOTIVE FORCE AT THE TERMINATION.
6.5.2 FOR TYPE "K" CHROMEL-ALUMEL T/C - RED IS NEGATIVE AND YELLOW IS POSITIVE.

6.6 ITEM IDENTIFICATION

6.6.1 VERIFY THAT EACH T/C IS IDENTIFIED WITH MANUFACTURER'S NAME, MANUFACTURER'S MODEL NUMBER, SERIAL NUMBER OR MATERIAL TRACEABILITY NUMBER, AND GE PART NUMBER.

7.0 REPORT

7.1.1.1 RESULTS OF ALL ABOVE TESTS SHOULD BE RECORDED. ANY FAILURES SHOULD BE CLEARLY DOCUMENTED ON A QCR OR SERVICE NOTICE, OR OTHER QUALITY DEPARTMENT APPROVED PROCEDURES.

7.1.1.2 REPORT THE FOLLOWING INFORMATION:

7.2.1 DATE AND TIME OF TEST

7.2.2 IDENTIFICATION: GE PART NUMBER, MANUFACTURER NAME, AND SERIAL NUMBER OR DATE CODE

7.2.3 APPLIED VOLTAGE

7.2.4.1 INSULATION RESISTANCE VALUES RECORDED

8.0 SAFETY PRECAUTIONS

8.1 THE MEGOHMETERS ARE SOURCES OF HIGH VOLTAGE. THESE TESTS SHOULD ONLY BE PERFORMED WITH THE STAND ALONE T/C DISCONNECTED FROM ANY TERMINATION POINTS.

8.2 REPLACE DEFECTIVE LEADS WHEN WORN.

8.3 DO NOT OPERATE THE MEGOHMETER IN AN EXPLOSIVE ENVIRONMENT.

8.4 READ THE AEMC MODEL 1000 MEGOHMETER INSTRUCTION MANUAL PRIOR TO USING METER.

8.5.1 WHEN PERFORMING MEGGER CHECKS ALLOW TWICE AS MUCH TIME TO DISCHARGE THE TEST PIECE AS ENERGIZING, REF. 6.3.7.

© COPYRIGHT 1995 GENERAL ELECTRIC COMPANY

PROPRIETARY INFORMATION - THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF GENERAL ELECTRIC COMPANY AND MAY NOT BE USED OR DISCLOSED TO OTHERS, EXCEPT WITH THE WRITTEN PERMISSION OF GENERAL ELECTRIC COMPANY.
9.0  **NOTES**

9.1  INSULATION RESISTANCE MEASUREMENTS ARE CHANGED BY VARIATIONS IN TEMPERATURE OF THE INSULATION MATERIAL. TYPICALLY WHEN THE TEMPERATURE GOES UP THE INSULATION RESISTANCE DROPS, AND INVERSELY WHEN THE TEMP DROPS THE INSULATION RESISTANCE GOES UP. SEE TABLE IN 6.3.2.
FIGURE 1
IR TEST LAYOUT FOR 351A3488 OR EARLIER

- TC BARE CONDUCTOR
- TC LEAD WIRE INSULATION
- TC TRANSITION TUBE
- TC SHEATH
- BLACK TEST LEAD
- TC LEAD WIRE INSULATION
- BLUE TEST LEAD
- GREEN TEST LEAD
- GROUND LEAD
- - LINE (C) (BLACK)
- GUARD (B) (BLUE)
- + EARTH (A) (GREEN)
- MEGOHMMETER
- EARTH

© COPYRIGHT 1995 GENERAL ELECTRIC COMPANY
PROPRIETARY INFORMATION - THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION OF GENERAL ELECTRIC COMPANY AND MAY NOT BE USED OR DISCLOSED TO OTHERS, EXCEPT WITH THE WRITTEN PERMISSION OF GENERAL ELECTRIC COMPANY.

GENERAL ELECTRIC COMPANY
DRAWN
M. MCMANAHAN 95-04-19
ISSUED
CANDICE OWENBY 95-04-21

GE Energy

351A3458
FIGURE 2

IR TEST LAYOUT FOR 362A1102P022

TERMINAL POSTS

TC SHEATH

BLUE TEST LEAD

GREEN TEST LEAD

BLACK TEST LEAD

- LINE (C) BLACK

GUARD (B) BLUE

+ EARTH (A) GREEN

MEGOHMETER

EARTH GROUND
FIGURE 3
IR TEST LAYOUT FOR 372A2221P011

INTERNAL PINS

TC SHEATH

BLUE TEST LEAD

GREEN TEST LEAD

BLACK TEST LEAD

MEGOHMOMETER

- LINE (C) BLACK
- GUARD (B) BLUE
+ EARTH (A) GREEN

EARTH GROUND