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## **2312G Turbine Temperature Indicating System Test Set**

### USER INSTRUCTION MANUAL BARFIELD M/N 2312G Series

56-101-00550-B  
August 20, 2008

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BARFIELD, INC.

This Manual is applicable for the following Models and Parts Numbers:

<u>Model Number</u>	<u>Part Number</u>
2312G-8	101-00550
2312G-15	101-00551
2312G-22	101-00552
2312G-16A	101-00554
2312G-25	101-00555
2312G-8 (w/o case)	101-00557



T A T G R O U P

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### **CONTACT INFORMATION**

Users are requested to notify the manufacturer of any discrepancy, omission, or error found in this manual. Inquiries should include specific questions and reference the publication title, number, chapter, page, figure, paragraph, and effective date.

Please send comments to:

**TECHNICAL CUSTOMER SUPPORT - GSTE  
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MIAMI, FL 33102-5367  
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### **ATTENTION**

Although every effort has been made to provide the end user of this equipment with the most current and accurate information, it may be necessary to revise this manual in the future. Please be sure to complete and return a *Revision Request Form* to Barfield revision services and visit the company website, <http://barfieldinc.com/>, for publication updates.

Additionally, Barfield **MUST** have your name and address on file as a registered user of this equipment to ensure validation of the warranty. Please complete the **OWNER WARRANTY REGISTRATION** card promptly. This card ensures validation of the warranty.

Please send to:

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USA



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**REVISION RECORD**

REV.	ECO #	REV. DATE	DESCRIPTION OF CHANGE
A	N / A	08 / 08 / 01	Initial Release.
B	260-00729	08 / 20 / 08	Company logo and contact information were updated. Manual was reformatted.



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### **LIST OF APPROVED REPAIR FACILITIES**

The manufacturer of this equipment does not recommend the user to attempt any maintenance or repair. In case of malfunction, contact the manufacturer, to obtain the list of approved repair facilities worldwide, ensuring that this equipment will be serviced using proper procedures and certified instruments. A Return Maintenance Authorization (RMA) number will be assigned during this call, to keep track of the shipment and the service.

#### BARFIELD PRODUCT SUPPORT DIVISION

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**INTRODUCTION**

**1. PUBLICATION BREAKDOWN**

This publication, concerning the 2312G TURBINE TEMPERATURE INDICATING SYSTEM TEST SET, establishes its standards of operation and maintenance.

This publication has been developed to provide instructions for complete testing and troubleshooting of the temperature-indicating system and thermocouples installed on a turbine type engine. Instructions are also provided for testing system resistance and insulation.

This publication contains the description, identification data, and operating procedures for the: 2312G-8, -15, -22, -16A, -25, and -8 (see paragraph 2.B. below) Turbine Temperature Indicating System Test Set, P/N's 101-00550, -00551, -00552, -00554, -00555 and -00557, Figure 1 (hereafter referred to as the 2312G).

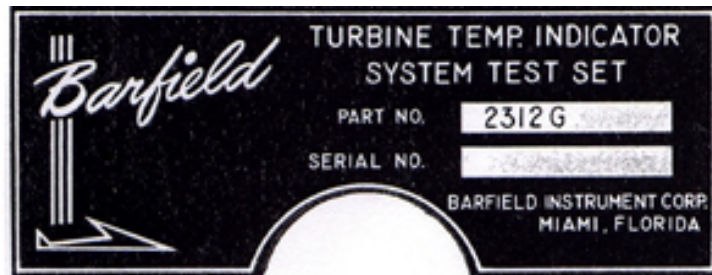
Models -U and -8A, P/N's 101-00553 and 101-00556 respectively, are special modified units for specific applications requested by a manufacturer for individual requirements and are not discussed in this text. If information is required, contact the manufacturer.

**2. INFORMATION PROVIDED WITH THE UNIT**

Besides this User Instruction Manual, the unit is provided with the four items described below.

- A. The identification label, similar to Figure 1, is located on the back of the tensiometer and provides the following information:

Manufacturers' Name  
Designation of Equipment  
Equipment Part Number.  
Equipment Serial No.  
National Stock Number (for models -8 and -22 only)



**Figure 1 IDENTIFICATION LABEL**

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- B. The Owner's Warranty Registration card (Figure 2) is to be completed by the owner and returned to Barfield, Inc. within **ten (10) days** of purchase to ensure automatic update of printed matter and validation of warranty.

**OWNER WARRANTY REGISTRATION**

RETURNING THIS CARD COMPLETED ENABLES US TO KEEP YOU  
AUTOMATICALLY INFORMED OF TECHNICAL UPDATES and VALIDATES YOUR WARRANTY.

NAME \_\_\_\_\_ TITLE \_\_\_\_\_  
 DEPARTMENT \_\_\_\_\_  
 COMPANY \_\_\_\_\_  
 ADDRESS \_\_\_\_\_  
 CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_  
 P/N \_\_\_\_\_ S/N \_\_\_\_\_ MODEL # \_\_\_\_\_  
 PURCHASED FROM \_\_\_\_\_ DATE \_\_\_\_\_  
 AIRLINE  REPAIR STATION  OEM   
 OTHER \_\_\_\_\_

*INFORMATION GIVEN ON THIS BARFIELD, INC. WARRANTY CARD IS AND WILL REMAIN  
 STRICTLY CONFIDENTIAL AND WILL NOT BE SHARED.*

OW-28 REV / 04.00

**Figure 2** OWNER WARRANTY REGISTRATION CARD

- C. The Limited Warranty Statement Card (Figure 3) lists the manufacturer's obligation to the original purchaser.

**LIMITED ONE YEAR WARRANTY**

**BARFIELD INSTRUMENT CORPORATION** warrants to the original purchaser of this unit sold by us and/or our agent, and all the parts thereof, to be free from defects in material or workmanship under normal use and service within the specified ratings and operating conditions.

Its obligation under this warranty is hereby limited to the repair or replacement of this unit, or part thereof, which is returned to us within one year after date of invoice, suitably packaged in the original container or equivalent and which shall prove, after our examination, to be defective under terms of above paragraph.

No other warranty is expressed or implied. We are not liable for consequential damages.

Some states do not allow the exclusion or limitation of incidental or consequential damages so that the preceding limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may have other rights which vary from state to state.

This warranty does not include the cost of transportation charges to and from the factory.

The repair or replacement of this unit, or any part thereof, does not void or extend the original warranty.

**BARFIELD INSTRUMENT CORPORATION** reserves the right to discontinue this unit without notice, or to make modifications in design at any time, without incurring any obligation to make these modifications in units previously sold.

**BARFIELD INSTRUMENT CORPORATION**  
 4101 N.W. 29 Street  
 Miami, Florida 33142 U.S.A.

FORM 991-00001

**Figure 3** LIMITED WARRANTY STATEMENT CARD



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- D. The Certificate of Calibration: Each new unit and re-certified unit, is delivered with a Certificate of Calibration that shows the date of the last calibration and when the next calibration is due. It certifies the accuracy of the unit and lists the part number and serial number to which it applies.

### 3. **RECERTIFICATION**

This equipment has a one-year recertification requirement. Qualified technicians in a shop equipped with the necessary tooling and facilities must perform the maintenance required by this unit.



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## **CHAPTER 1: PRODUCT DESCRIPTION**

### **1. GENERAL DESCRIPTION**

- A. The 2312G provides the means for quickly test, calibrate and troubleshoot a turbine temperature indicating system installed on this type of engines. It has sufficient sensitivity and accuracy to test thermocouple and system resistance, insulation, and indicator calibration. It features portability, simplicity of operation, direct reading, and multifunction versatility.
- B. The 2312G is supplied with a vinyl carrying case with test cable compartment and a plug-in test cable (except 2312G-8, P/N 101-00557).

### **2. THEORY**

- A. The low resistance ohmmeter circuits are the four-wire type. This circuit virtually eliminates the effects of lead wire resistance so that direct readings as low as 0.02 ohm are easily done.
- B. A high resistance ohmmeter measures resistance leakage up to one (1) megaohm. The 45-volt power supply often reveals leakage that is not detected by conventional low voltage ohmmeters, but is well within circuit insulation limitations.
- C. A Wheatstone Bridge circuit provides an accurate direct reading of lead resistance. A self-contained resistance standard is provided for calibration immediately before making lead resistance measurement. This eliminates the need for measuring test lead resistance and subtracting its value from subsequent measurements. A unique transistor switching circuit protects the meter from overloads due to attempting measurements much lower or higher than nominal.
- D. For indicator calibration tests, an adjustable thermocouple simulator is provided with simulated lead resistance. Ambient temperature correction is set by a panel adjustment and direct comparison made between the 2312G and the indicator under test up to 1000° C.

### **3. SWITCHING FUNCTIONS** (Refer to Figure 4.)

- A. The meter bezel knob (3) permits setting of the meter pointer as required.
- B. The "CAL. ADJUST" control knob (4) permits exact adjustment to desired test points when used in conjunction with the "TEST" pushbutton (6) or the "CAL" pushbutton (7).

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- C. The “FUNCTION” switch (5):
- (1) In the “RX1” position, permits resistance measurement readings in direct values on the panel meter (2) “RX1 / RX10” scale.
  - (2) In the “RX10” position, the reading on the “RX1 / RX10” scale must be multiplied by 10.
  - (3) In the “INS.” position, insulation resistance (2.5k to 1 megaohm) is displayed on panel meter’s “INS.” scale.
  - (4) In the “LEAD” position, lead resistance value is displayed on the panel meter’s “LEAD RES.” scale.
  - (5) In the “IND.” position, the 2312G is a millivolt source for simulating temperatures from - 20 to +1000° C displayed on the panel meter’s °C scale.
- D. The BLACK “TEST” pushbutton activates applicable circuitry and permits meter readings of the function selected.
- E. The RED “CAL.” pushbutton is used with the “CAL. ADJUST” control knob and allows scale adjustment.

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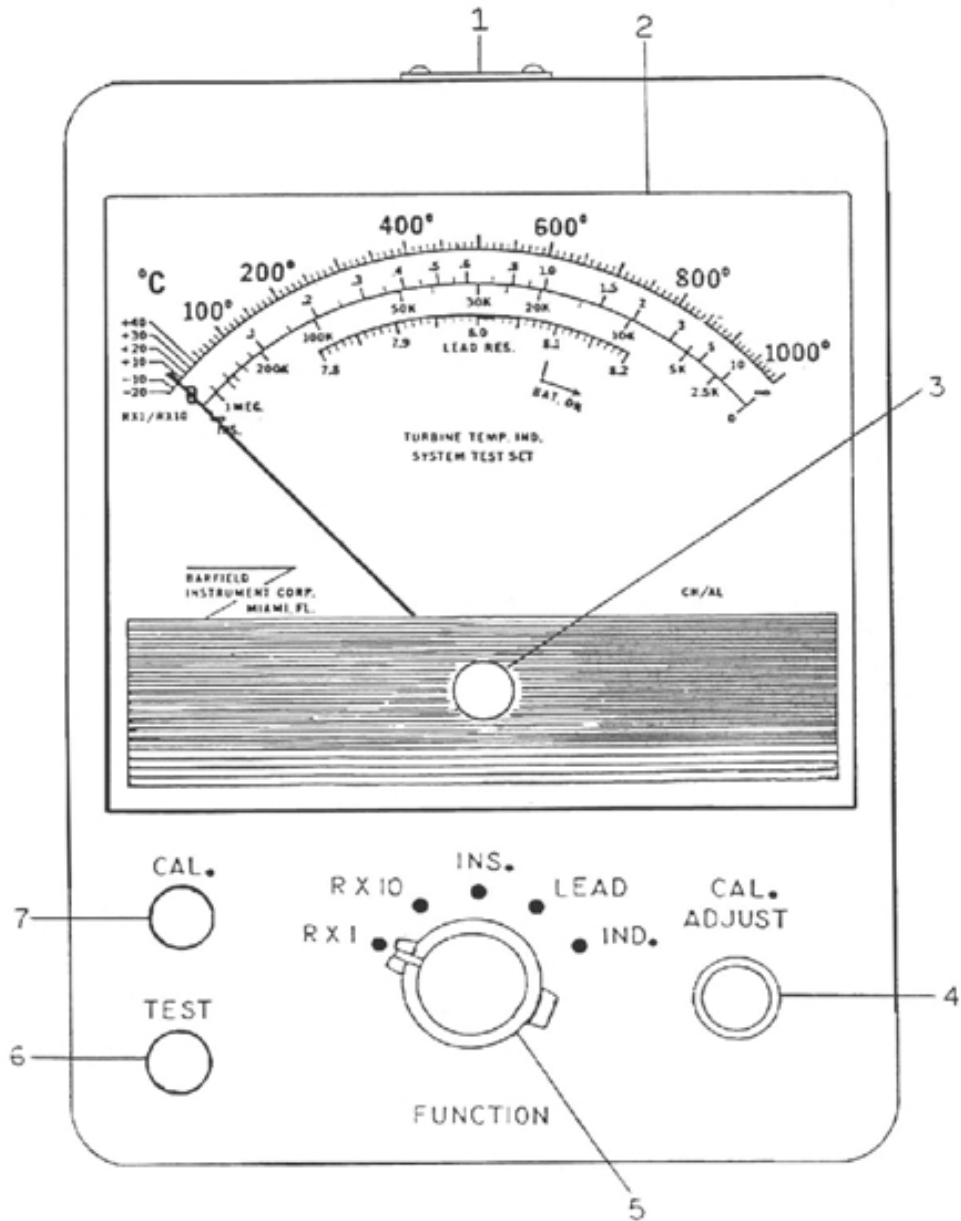


Figure 4 2312G PANEL LAYOUT



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**CHAPTER 2: PRODUCT SPECIFICATIONS**

**1. PHYSICAL DATA**

- A. Depth      11.4 CM (4.5 in)
- B. Width      15.2 CM (6 in)
- C. Height     20.3 CM (8 in)
- D. Weight     1.7 Kg (3.75 lbs)

NOTE: All physical data specifications include carrying case.

**2. SPECIFICATIONS**

Specifications for all models of the 2312G are identical except for the “LEAD” function circuit. The Lead measuring circuit and the simulating resistance in the indicator function are the value of the system lead resistance applicable to the particular system.

<b>FUNCTION POSITION</b>	<b>RANGE</b>	<b>ACCURACY</b>
R X 1	.02 to 10 Ohms	±10% of Reading
R X 10	0.2 to 100 Ohms	±10% of Reading
INS	2.5k to 1 megaohm	±10% of Reading
LEAD (2312G-8) (2312G-15) (2312G-22) (2312G-U) (2312G-16A) 2312G-25)	7.8 to 8.2 Ohms 14.5 to 15.5 Ohms 21.0 to 23.0 Ohms 0.55 to 0.75 Ohms 15.5 to 16.5 Ohms 24.0 to 26.0 Ohms	±.01 Ohm at 8 Ohms ±.02 Ohm at 15 Ohms ±.025 Ohm at 22 Ohms ±.005 Ohm at .58 & .74 ±.025 Ohm at 16 Ohms ±.025 Ohm at 25 Ohms
IND	-20 to +1000 °	±5° @ 600-900 ±10° elsewhere

**SPECIFICATIONS  
Table 1**



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## **CHAPTER 3: OPERATION**

### **1. GENERAL OPERATING INSTRUCTIONS**

Consult temperature indicator system and/or engine manufacturers' instructions for procedures and specifications. Read complete 2312G Operation procedures before attempting to use the 2312G.

#### A. Overload Protection Circuit:

Because of the meter protection circuit in the "LEAD" function, resistances much lower or higher than nominal will disable the measurement circuit, and the meter pointer will start to move quickly and then return to rest, at or near, bottom of scale. Measurement can be resumed by releasing the "TEST" pushbutton, waiting a couple of seconds for automatic reset, then pressing the "TEST" pushbutton again. If the resistance is out of range, but not sufficient to trip the protective circuit, the pointer will go to one of its stops, but the current will not be sufficient to overload the meter.

#### B. Preparation For Use:

##### (1) Battery Installation/Replacement:

- (a) Place the 2312G on a clean area. (A clean cloth or paper pad placed to the right of the 2312G to receive the inverted panel is desirable.) Remove the four (4) corner screws. Withdraw the panel and rest it to the right of its case.
- (b) Insert the 1.5-volt, size D (NEDA 13A) battery by grasping the ends and pushing straight down. **Observe polarity.** The RED terminal is positive (+).
- (c) Insert the 45-volt No. 415 (NEDA 213) battery. **Observe polarity.** Align terminals and swing into clips. Use pressure from the bottom until battery is seated in clips and terminals.

NOTE: To remove batteries, reverse steps (b) and (c) above.

##### (2) Battery Check:

Perform the 2312G battery check before each test procedure that follows.

- (a) To check the 45-volt battery used for insulation testing:

- 1) Rotate the "FUNCTION" selector switch to "INS" position.

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- 2) Press the "CAL." Pushbutton. Adjust the "CAL. ADJUST" control for full scale "0" on the panel meter's "INS." scale.

NOTE: If deflection is not as specified, replace the 45-volt battery as outlined above.

- (b) To check the 1.5-volt battery used for all functions other than insulation:

- 1) Rotate the "FUNCTION" selector switch to the "RX1", "RX10" or "IND." position.
- 2) Press the "CAL." pushbutton switch. Adjust the "CAL. ADJUST" control for full-scale infinity mark on the panel meter's "RX1 / RX10" scale.

NOTE: If deflection is not as specified, replace the 1.5-volt battery as outlined above.

NOTE: Approximate battery condition may be checked by rotating the "CAL. ADJUST" fully counterclockwise. Set "FUNCTION" selector to "RX1" for 1.5-volt battery, and to "INS." for 45-volt battery test. Depress the "CAL." pushbutton, insure pointer deflection is beyond "BAT. OK" line.

- (3) Insert test lead plug fully into receptacle (Refer to 1-1, Figure 1, 1) at the top of the 2312G before attempting to operate the 2312G.

NOTE: For ALL battery checks, the test cable plug must be inserted and test lead clips disconnected.

- (4) Adjust meter pointer with meter bezel knob to low end of scale zero ("0") before resistance or insulation tests. Adjust to ambient for indicator tests. (An accurate thermometer placed next to the indicator under test is recommended.)

NOTE: More positive pointer action is achieved when bezel knob is positioned so that clockwise knob movement moves pointer downscale. If action is reversed, rotate knob 180 degrees.

- (5) To remove inherent friction, gently tap 2312G meter bezel after each adjustment and before reading. Also tap system indicator before reading unless specifically instructed otherwise by manufacturer's instructions.

### C. Hot Engine Testing

**A hot engine will cause thermocouples to generate a small potential, which will produce errors in measured resistance values.** This effect is inherent in any type of resistance measuring instrument. It is more troublesome in ohmmeters than in Wheatstone Bridge circuits, so it will be more noticeable on the "RX1" and RX10" functions than on the "LEAD" function.

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This effect can be circumvented by taking two measurements: the first, with test leads connected in one polarity; and then, reversing the lead connections for the second measurement. The true value is equal to the average of the two readings (i.e., add the two readings and divide by two). The two readings must be taken in quick succession so that the thermocouple temperature will be the same for both readings. If the thermocouples are too hot, the readings will be too far from nominal to provide sufficient accuracy. In this case, wait for the engine to cool further.

### 2. THERMOCOUPLE RESISTANCE TEST PROCEDURE

- A. Disconnect at least one lead from system temperature indicator.
- B. Insure 2312G meter reads zero ("0").
- C. Rotate the "FUNCTION" selector to "RX1".
- D. **Before connecting 2312G leads**, press and hold RED "CAL." pushbutton while turning "CAL. ADJUST" to move meter pointer to infinity (full scale).
- E. Carefully connect test lead clips to thermocouple bank to insure a good electrical connection. Press the BLACK "TEST" pushbutton while reading resistance directly on the "RX1 / RX10" scale.

**NOTE:** If individual thermocouple is to be measured, disconnect at least one terminal lead of thermocouple to be measured.

### 3. APPROXIMATE SYSTEM LEAD RESISTANCE TEST PROCEDURE

- A. Disconnect at least one thermocouple lead from temperature indicator.
- B. Insure 2312G meter is zero ("0").
- C. Rotate the "FUNCTION" selector to "RX1".
- D. **Before connecting 2312G leads**, press and hold RED "CAL." pushbutton while turning "CAL. ADJUST" to move meter pointer to infinity (full scale).
- E. Insure thermocouple bank is connected to thermocouple system leads.
- F. Carefully connect test lead clips to system lead wires at indicator end, insuring a good electrical connection. Press the BLACK "TEST" pushbutton while reading resistance directly on the "RX1 / RX10" scale. Multiply value obtained by ten (10).

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### 4. PRECISION SYSTEM LEAD RESISTANCE TEST PROCEDURE

**NOTE:** Insure dash number of 2312G is applicable to resistance value of system under test (Refer to Chapter 3, section 2.).

A. If approximate measurement is made as describe in section 3, "Approximate System Lead Resistance Test Procedure", and measurement is not within the range of "LEAD RES." scale, check system for short circuits, bad connections, broken wiring, etc., then do as follows:

- (1) Disconnect at least one thermocouple lead from temperature indicator.
- (2) Insure 2312G meter reads zero ("0").
- (3) Rotate the "FUNCTION" selector to "LEAD".
- (4) **Before connecting 2312G leads**, press and hold RED "CAL." pushbutton while turning "CAL. ADJUST" for precise center scale on bottom "LEAD RES." Scale (gently tap meter to remove inherent friction).
- (5) Insure thermocouple bank is connected to thermocouple system leads.
- (6) Carefully connect test lead clips to system lead wires at indicator end, insuring a good electrical connection. Press the BLACK "TEST" pushbutton while reading resistance on the panel meter's "LEAD RES." scale.

B. If any of the next situations occur, do the following: release the BLACK "TEST" pushbutton; recheck lead connections; then, press the BLACK "TEST" pushbutton again.

- (1) Meter pointer moves down-scale abruptly striking pointer stop, then comes to rest near lower end scale, with resistance much less than desired value.
- (2) Meter pointer comes to rest at, or near, lower end of scale, with resistance less than desired value.
- (3) Meter pointer starts to move up-scale, then comes back down to rest near the lower end of scale, with resistance much higher than desired value.
- (4) Meter pointer moves up-scale to or near upper pointer stop, with resistance higher than desired value.

**NOTE:** Resistance must be within manufacturers' specifications. If results are slightly outside limits, repeat entire procedure to insure test failure is not due to human error.

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### 5. INSULATION TESTING PROCEDURE

- A. Insure 2312G meter is zero (“0”).
- B. Rotate the “FUNCTION” selector to “INS.”
- C. **Before connecting 2312G leads**, press and hold RED “CAL.” pushbutton while turning “CAL. ADJUST” for full scale zero (“0”).
- D. Disconnect both leads at system temperature indicator. Then connect one lead clip to ground and one to the thermocouple system lead wires. (Refer to Engine manufacturers’ Maintenance Manual for specific hookup.)

- E. Press the BLACK “TEST” pushbutton while reading resistance on the “INS.” scale.

NOTE: Resistance to ground must not be less than manufacturers’ specifications.

- F. Disconnect thermocouple leads at engine thermocouple bank, and reconnect one clip to each of the thermocouple leads. Insure lead terminals are not touching each other at either end of the cable.
- G. Press the BLACK “TEST” pushbutton while reading resistance on the “INS.” scale.

NOTE: Interlead resistance must not be less than manufacturers’ specifications.

### 6. INDICATOR TEST PROCEDURE

- A. Insure indicator-to-be-tested has remained in the temperature environment sufficiently to stabilize to the ambient temperature at which testing is to be done.
- B. Disconnect at least one thermocouple lead from temperature indicator.
- C. Set meter pointer to ambient temperature with meter bezel knob.
- D. Rotate the “FUNCTION” selector to “IND.”
- E. Connect test lead clips to indicator terminals. Observe polarity: alumel is negative (-) and connects to the 2312G BLACK clip. Chromel is positive (+) and connects to the 2312G RED clip.
- F. Press and hold the BLACK “TEST” pushbutton while positioning the “CAL. ADJUST” control for desired test points as read on the 2312G meter’s “C” scale.



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G. Compare readings of indicator-under-test with 2312G indications.

NOTE: Indicator must agree with 2312G reading to within manufacturers' specifications.

### **7. "POTENTIOMETRIC" OR "SERVOED" TYPE INDICATOR TEST PROCEDURE**

#### A. General

- (1) The "Potentiometric" or "Servoed" indicator, as they are generally referred to, may be recognized by its multiple pin electrical connector and the requirement of aircraft electrical power to operate.
- (2) The 2312G may be used to test this type of system subject only to the applicable 2312G indicator test accuracy limitations. (Refer to Engine Maintenance Manual and to Chapter 2 of this Manual.) On those aircraft that specify greater test set accuracy for certifying the system, the 2312G may be used only for troubleshooting and general system performance tests.
- (3) Thermocouple lead resistance is not critical with this type of indicator, and usually need not be measured.

#### B. Thermocouple Resistance Measurement

- (1) Disconnect aircraft power to indicator. (Refer to Aircraft Maintenance Manual).
- (2) Set meter pointer to zero ("0") using meter bezel knob.
- (3) Disconnect electrical connector at rear of indicator. Follow section 2, Thermocouple Resistance Test Procedure, paragraphs C. through E.

#### C. System Lead Resistance Measurement

- (1) Disconnect aircraft power to indicator (Refer to Aircraft Maintenance Manual).
- (2) Disconnect electrical connector at rear of indicator.
- (3) Connect 2312G leads to probe pins sized to fit chromel and alumel pin sockets of aircraft plug removed from indicator.
- (4) Follow section 3, Approximate System Lead Resistance Test, paragraphs B through F.

NOTE: Lead resistance is not critical, generally in the order of 5 to 100 ohms. No precision measurement need be made.





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### D. Insulation Testing

- (1) Disconnect aircraft power to indicator. (Refer to Aircraft Maintenance Manual).
- (2) Disconnect electrical connector at rear of indicator.
- (3) Follow section 5, Insulation Testing, paragraphs A. through C. and E. Use probe pins at aircraft plug or make connection at engine thermocouple terminal block.

### E. Indicator Test

- (1) Disconnect aircraft power to indicator. (Refer to Aircraft Maintenance Manual).
- (2) Disconnect leads from indicator at engine thermocouple terminal block.
- (3) Set meter pointer to ambient with meter bezel knob.
- (4) Rotate the "FUNCTION" selector to "IND."
- (5) Connect test lead clips to indicator leads. Observe polarity: alumel is negative (-) and connects to the 2312G BLACK clip. Chromel is positive (+) and connects to the 2312G RED clip.
- (6) Turn aircraft temperature indicating system power to "ON".
- (7) Press and hold the "TEST" switch while positioning the "CAL. ADJUST" control for desired test points as read on the 2312G meter's "°C" scale.
- (8) Compare readings of indicator under test with 2312G indications.

NOTE: Indicator must agree with 2312G reading to within manufacturers' specifications.



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### **CHAPTER 4: RECEIVING, SHIPPING, AND STORAGE**

#### **1. RECEIVING**

No special unpacking procedures are necessary. It is recommended that the factory-shipping container and packing materials be retained should it become necessary to reship the 2312G.

It is also recommended that the 2312G and its carrying case be carefully inspected for damage. If damaged, immediately notify the carrier and the manufacturer.

#### **2. SHIPPING**

Use standard delicate electronic equipment packaging procedures when packing the 2312G for reshipment.

#### **3. STORAGE**

- A. Remove the batteries and store separately.
- B. Place a four- (4-) ounce bag of desiccant inside the case.
- C. Replace the cover.
- D. Store in a cool dry place.