



# **INSTRUCTION MANUAL**

**DIGITAL**

**TURBINE TEMPERATURE**

**TEST SET**

**TT-1000A**

**P/N 101-00901**



## INSTRUCTION MANUAL TT-1000A

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## REVISION RECORD

Date of Revision	Affected Pages
May 5, 1995	Initial Release
Feb. 16, 2002	Updated to latest format. Added List of Figures/Tables page.

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# DESCRIPTION

### 1. **PURPOSE OF MANUAL**

A. This publication contains the description, operating procedures for the:

TT-1000A DIGITAL TURBINE TEMPERATURE TEST SET, P/N 101-00901  
(Refer to Figure 1.)

Manufactured by:

Barfield Inc.  
4101 NW 29th Street  
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USA

B. This manual is released to address the TT-1000A which is designed to test and calibrate Chromel-Alumel (CH-AL) temperature indicating systems.

### 2. **GENERAL DESCRIPTION**

The TT-1000A provides the means for quickly troubleshooting aircraft temperature indicating systems. 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 multi-functional versatility.

A. TT-1000A Features;

- (1) Specifically designed to meet all requirements for testing aircraft Chromel-Alumel (CH-AL) temperature measuring systems and provides an accurate display of thermocouple outputs in degrees Celsius ( $^{\circ}\text{C}$ ).
- (2) Thermocouple and lead resistance measurements to  $0.01\ \Omega$  and insulation measurements up to  $2\ \text{M}\Omega$ .
- (3) Simulates thermocouple outputs and system lead resistances from 0 to  $25\ \Omega$ .



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- (4) Completely self-contained, self-monitoring, easily portable temperature and resistance measuring and simulating device for all CH-AL systems with the capability to bench test indicators.
- (5) Human engineered for maximum ease of operation and maintenance with state of the art low battery drain circuitry with automatic ambient test point temperature correction.
- (6) A large, 0.35 in. (9mm) high characters, 3 1/2 digit Liquid Crystal Display (LCD) with preprogrammed legends.
- (7) Carrying Case features;
  - (a) Fabricated from drawn aluminum for maximum strength.
  - (b) The lid has been fitted with a bracket which, when the lid is closed, contacts the "ON/OFF" switch, in the "ON" position and moves it to the "OFF" position.
  - (c) Provides, on the right hand side, space for test lead storage.
  - (d) The lid also contains a placard presenting abridged operating instructions for the experienced technician.

**NOTE:** For personnel without experience, it is advisable to become familiar with this publication, the TT-1000A, and the equipment with which it is to be used **BEFORE** performing any test or checks.

### 3. **SWITCHING FUNCTIONS** (Refer to Figure. 1)

- A. The "ON/OFF" switch (1) applies power for all functions.
- B. The "TEMP. ADJ." control knob (3), a ten turn potentiometer permits exact adjustment of the millivoltage generator for temperatures which are displayed on the LCD (2) as °C when the "FUNCTION" switch (4) is in the "INDICATOR TEST" position.
- C. The "FUNCTION" switch, a three position rotary switch that permits selection of the three principal test functions, "RESISTANCE MEASURE", "INDICATOR TEST" and "TEMP. MEASURE".

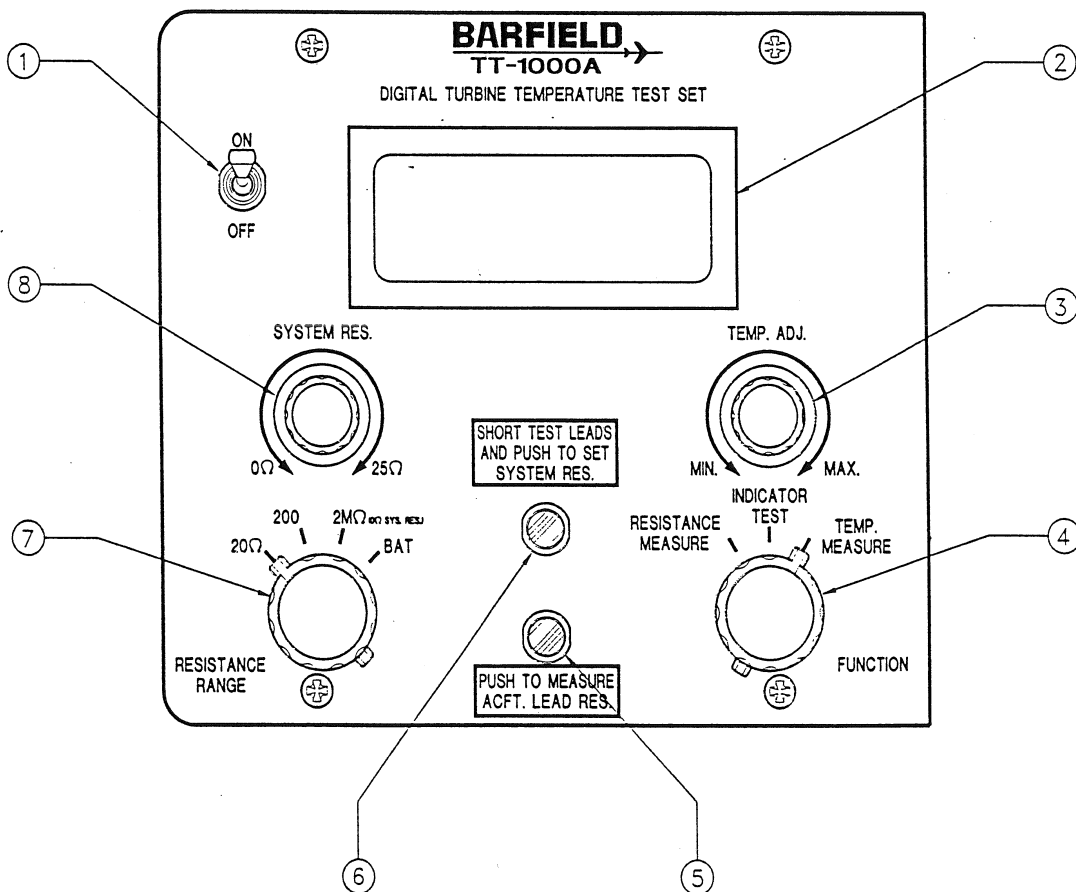




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- D. The "PUSH TO MEASURE ACFT. LEAD RES." **BLACK** pushbutton (5), when depressed with test leads connected to aircraft system and "FUNCTION" switch in "RESISTANCE MEASURE" position produces a display of the resistance in the system.
- E. The "SHORT TEST LEADS AND PUSH TO SET SYSTEM RES." **RED** pushbutton (6), when depressed with test leads shorted and the "FUNCTION" switch in the "RESISTANCE MEASURE" position connects the "SYSTEM RES." potentiometer for system resistance adjustment.
- F. The "RESISTANCE RANGE" switch (7), a four position rotary switch, permits selection of the resistance range, 20  $\Omega$ , 200  $\Omega$  or 2 M $\Omega$  - (0  $\Omega$  system resistance) and "BAT" position for monitoring the 45-volt battery.
- G. The "SYSTEM RES." control knob (8), a ten turn potentiometer used to adjust system lead resistance 2 to 25  $\Omega$ , when test leads are shorted and the **RED** pushbutton is depressed.

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TT-1000A FRONT PANEL LAYOUT  
**Figure 1**



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# OPERATION

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

Consult temperature indicator system and/or engine manufacturer's instructions for procedures and specifications. Read complete TT-1000A operation procedures before attempting to use the TT-1000A.

#### A. Protective Circuits;

- (1) PCB1 F1 (AGC 1/2A) protects the TT-1000A from overloads through the test leads.
- (2) PCB1 D1 across the 9 volt supply prevents accidental application of reverse polarity at battery replacement.

#### B. Preparation For Use:

- (1) Battery Installation / Replacement;
  - (a) Place the TT-1000A on a clean area. (A clean cloth or paper pad placed next to the TT-1000A to receive the panel is desirable.) Remove the four corner panel screws. Lift the panel high enough (approx. 2 in.) to disconnect the 45 volt battery connector located under "ON/OFF" switch (if required). Withdraw the panel and bulkhead assembly.
  - (b) Insert six (6) 1.5 volt size AA (NEDA 15A) batteries by grasping the ends and pushing straight down. **Observe polarity.** The plus (+) terminal is positive.
  - (c) Connect the 45 volt No. 415 (NEDA 213) battery. to the battery connector terminals, place battery into lower holder clips and rotate upward until it is seated. **Observe polarity,**

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



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(d) The "coin" battery has a minimum life expectancy of five years and is installed at time of manufacture. To remove the "coin" battery, do the following;

- 1 Insert screwdriver between face of cell and holder spring clip through one of the slots.
- 2 Pry up and remove with fingers or insulated tweezers.

**CAUTION:** IF A SCREWDRIVER OR OTHER METAL TOOL IS USED TO PRY OUT CELLS, TAKE CARE NOT TO SHORT CIRCUIT OR DAMAGE CELL INSULATION.

(e) Carefully place bulkhead of panel assembly between vertical guides in the carrying case, and slide assembly downward until 45V battery connector can be connected and connect, then slide panel assembly downward into place.

(2) Perform the TT-1000A Battery check prior to testing as follows:

- (a) To check the 45 volt battery used for insulation testing, rotate the "FUNCTION" selector switch to "RESISTANCE MEASURE" position and the "RESISTANCE RANGE" selector to "BAT".
- (b) If voltage is below 45 volts, replace the 45-volt battery as outlined in paragraph (1) a, **Battery Installation/Replacement**.
- (c) To check the six 1.5 volt batteries used for all functions rotate the "RESISTANCE RANGE" selector switch to 20 ohm position and short test lead clips together.
- (d) Depress the **BLACK** pushbutton switch. If "**BAT**" is displayed replace the six 1.5 volt batteries as outlined above.

**NOTE:** After removal, test each cell individually (under load) as one or more defective cells mixed with good ones may produce a low battery warning.



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### C. Precautions

- (1) Do **NOT** press either pushbutton with test clips connected to the aircraft indicator. The current applied may damage the indicator.
- (2) Do **NOT** connect test clips to an energized circuit. Although the TT- 1000A is provided with protective devices, not all damaging potentials can be made completely safe.
- (3) Allow sufficient time for test clips to stabilize to the temperature of the terminals to which they are connected for temperature tests.
- (4) Measure system and thermocouple resistance with a cold engine for greatest accuracy.
- (5) To conserve battery power, place "ON/OFF" switch to "OFF" when the test set is not in use.
- (6) "**BAT**" warning displayed indicates that about 10% battery life of the six 1.5V batteries remains and the batteries should be replaced.
- (7) Perform insulation battery check, (Refer to. paragraph (2) (a) & (b) in this section before taking measurements. Voltage should be 45 volts or greater.

### D. Hot Engine Testing

**A hot engine will cause thermocouple to generate a small potential which will produce errors in measured resistance values.** This effect is inherent in any type of resistance measuring instrument.

The 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 thermocouple are too hot, the readings will be too far from nominal to provide sufficient accuracy. In this case, wait for the engine to further cool.



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**2. SYSTEM LEAD RESISTANCE TEST PROCEDURE**

- A. Disconnect thermocouple leads from system temperature indicator.
- B. Carefully connect test lead clips to each of the lead wires insuring a good electrical connection.
- C. Rotate the "FUNCTION" selector to "RESISTANCE MEASURE".
- D. Rotate the "RESISTANCE RANGE" selector to 20  $\Omega$ .
- E. Place "ON/OFF" switch to "ON" and depress the **BLACK** pushbutton switch.
- F. Display will indicate resistance in ohms to within  $\pm 0.01 \Omega$ . If a "**1 .**" is displayed, select 200  $\Omega$  on the "RESISTANCE RANGE" switch.  
  
If a "**1 .**" is displayed, resistance is greater than 199.9  $\Omega$  or there is an open circuit.
- G. Swap the **RED** and **BLACK** test clip connections and the display should repeat when the **BLACK** pushbutton is depressed. If the reading does not repeat, the engine thermocouple may be hot. (Refer to paragraph. 1. D, **Hot Engine Testing** this section.)  
  

**NOTE:** Resistance must be within manufacturer's specifications. If results are slightly outside limits, repeat entire procedure to insure test failure is not due to human error.
- H. Place "ON/OFF" switch to "OFF", disconnect the TT-1000A and return aircraft to original configuration.



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**3. THERMOCOUPLE RESISTANCE TEST PROCEDURE**

- A. Disconnect lead wires from the engine thermocouple terminals.
- B. Carefully connect test lead clips to each of the terminals insuring a good electrical connection.
- C. Rotate the "FUNCTION" selector to "RESISTANCE MEASURE".
- D. Rotate the "RESISTANCE RANGE" selector to 20  $\Omega$ .
- E. Place "ON/OFF" switch to "ON" and depress the **BLACK** pushbutton switch.
- F. Display will indicate resistance in ohms to within  $\pm 0.01 \Omega$ . If a "**1** ." is displayed, select 200  $\Omega$  on the "RESISTANCE RANGE" switch.

If a "**1** ." is displayed, resistance is greater than 199.9  $\Omega$  or there is an open circuit.

- G. Swap the **RED** and **BLACK** test clip connections and the display should repeat when the **BLACK** pushbutton is depressed. If the reading does not repeat, the engine thermocouple may be hot. (Refer to. paragraph 1. D, **Hot Engine Testing** this section.)

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

- H. Place "ON/OFF" switch to "OFF", disconnect the TT-1000A and return aircraft to original configuration.



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**4. INSULATION TESTING PROCEDURE**

- A. Disconnect one or both leads at system temperature indicator. Then connect the **BLACK** lead clip to ground and the **RED** lead clip to one or both thermocouple system lead wires. (Refer to engine manufacturers' Maintenance Manual for specific connections.)
- B. Rotate the "FUNCTION" selector to "RESISTANCE MEASURE".
- C. Rotate the "RESISTANCE RANGE" selector to 2 M $\Omega$  (0  $\Omega$  SYS. RES.).
- D. Place "ON/OFF" switch to "ON" and depress the **BLACK** pushbutton switch.
- E. Display will indicate insulation resistance in 1,000,000's of ohms (M $\Omega$ ). If a "**1.** " is displayed, insulation resistance is above 2 M $\Omega$ . (Refer to the Aircraft Maintenance Manual for low limit.)

NOTE: Resistance to ground must not be less than manufacturer's specifications.

- F. Place "ON/OFF" switch to "OFF", disconnect the TT-1000A and return aircraft to original configuration.





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**5. INDICATOR TEST PROCEDURE (With Specified Lead Resistance)**

- A. Rotate the "FUNCTION" selector to "RESISTANCE MEASURE".
- B. Rotate the "RESISTANCE RANGE" selector to 20  $\Omega$  for a resistance under 20  $\Omega$ , or to 200  $\Omega$  for 0 to 200  $\Omega$ .
- C. Place "ON/OFF" switch to "ON".
- D. Short test lead clips together and depress the **RED** pushbutton while adjusting "SYSTEM RES." control knob for displayed system resistance to be simulated.
- E. Rotate the "FUNCTION" selector to "INDICATOR TEST".
- F. Disconnect aircraft thermocouple leads from temperature indicator.
- G. Connect test lead clips to indicator terminals. **OBSERVE POLARITY**. Alumel is negative (-) and connects to the TT-1000A **BLACK** clip; Chromel is positive (+) and connects to the TT-1000A **RED** clip.
- H. Set "TEMP. ADJ." control for the desired test temperature as displayed on the digital indicator.
- I. Compare readings of indicator under test with TT-1000A indications. Units with **Mod "B"** incorporated must use the conversion table (Table 1).

NOTE: Indicator must agree with TT-1000A reading to within manufacturers' specifications.



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- J. Place "ON/OFF" switch to "OFF", disconnect the TT-1000A and return aircraft to original configuration.

TT-1000A	INDICATOR
000	0
99	50
201	100
302	150
396	200
492	250
588	300
687	350
789	400
892	450
1000	500
1109	550
1217	600
1325	650
1432	700
1538	750
1642	800
1746	850
1848	900
1949	950

16  $\Omega$  INDICATOR TEST CONVERSION TABLE (Mod "B" ONLY)  
**Table 1**



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6. **"POTENTIOMETRIC" OR "SERVO" TYPE INDICATOR TEST PROCEDURE**  
**(Without Lead Resistance)**

A. General

- (1) The **"Potentiometric"** or **"Servo"** indicator, as it is generally referred, may be recognized by its multiple pin electrical connector and the requirement of aircraft electrical power to operate.
- (2) Thermocouple lead resistance is not critical with this type of indicator, and usually need not be measured.

B. System Lead Resistance Measurement:

- (1) Disconnect aircraft power to indicator. (Refer to the Aircraft Maintenance Manual.)
- (2) Disconnect electrical connector at rear of indicator.
- (3) Connect TT-1000A leads to probe pins sized to fit chromel and alumel pin sockets of aircraft plug removed from indicator.
- (4) Follow paragraph 2, **System Lead Resistance Test Procedure**, steps C. through H this section..

**NOTE:** Lead resistance is not critical, generally in the order of 5 to 100 ohms. (Refer to the Aircraft Maintenance Manual for specific values.)

C. Thermocouple Resistance Measurement:

- (1) Disconnect aircraft power to indicator. (Refer to the Aircraft Maintenance Manual)
- (2) Follow steps listed in paragraph 3, **Thermocouple Resistance Test Procedure** this section.

D. Insulation Testing:

- (1) Disconnect aircraft power to indicator. (Refer to the Aircraft Maintenance Manual)
- (2) Disconnect electrical connector at rear of indicator



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- (3) Follow paragraph 4. **Insulation Testing Procedure**, steps B. thru F, using probe pins at aircraft plug or make connection at engine thermocouple terminal blocks.

### E. Indicator Test:

- (1) Disconnect aircraft power to indicator. (Refer to the Aircraft Maintenance Manual.)
- (2) Disconnect leads from indicator at engine thermocouple terminal block.
- (3) Rotate the "FUNCTION" selector to "INDICATOR TEST".
- (4) Rotate the "RESISTANCE RANGE" selector to 2 M $\Omega$  (0  $\Omega$  SYS. RES.)
- (5) Connect test lead clips to indicator leads **OBSERVING POLARITY**. Alumel is negative (-) and connects to the TT-1000A **BLACK** clip: Chromel is positive (+) and connects to the TT-1000A **RED** clip.
- (6) Place aircraft temperature indicating system power to "ON".
- (7) Place "ON/OFF" switch to "ON".
- (8) Rotate the "TEMP. ADJ." control for desired test points as read on the TT-1000A digital display.
- (9) Compare readings of indicator under test with TT-1000A indications.

NOTE: Indicator must agree with TT-1000A reading to within manufacturer's specifications.

- (10) Place aircraft temperature indicating system power to "OFF".
- (11) Place "ON/OFF" switch to "OFF", disconnect the TT-1000A and return aircraft to original configuration.



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7. **TEMPERATURE MEASUREMENT TEST PROCEDURE**

A. Rotate the "FUNCTION" selector to "TEMP. MEASURE".

**CAUTION:** AIRCRAFT INDICATORS OF THE D'ARSONVAL TYPE MUST **NOT** BE CONNECTED DURING THIS TEST. D'ARSONVAL INDICATORS MAY GENERALLY BE RECOGNIZED BY THE ABSENCE OF A MULTI-PIN CONNECTOR AND WILL USUALLY HAVE TWO TERMINAL POSTS OR TERMINAL SCREWS.

B. Connect test lead clips to thermocouple leads **OBSERVING POLARITY**. Alumel is negative (-) and connects to the TT-1000A **BLACK** clip; Chromel is positive (+) and connects to the TT-1000A **RED** clip. Units with Mod "B" incorporated must connect to only one thermocouple lead pair at a time.

C. Display will indicate thermocouple temperature directly in C.

**NOTE:** If the word "OPEN" is displayed, there is an open circuit in the thermocouple or lead wires.

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# SPECIFICATIONS AND CAPABILITIES

### 1. PHYSICAL DATA

- A. Length - 8.0 in (20.3 cm)
- B. Width - 5.5 in (14.0 cm)
- C. Height - 5.0 in (12.7 cm)
- D. Weight - 4.0 lbs (1.8 kg)

### 2. SPECIFICATIONS

#### A. Temperature Measurement:

- (1) Type: K (CH-AL Thermocouple).
- (2) Range: 0 to 1000°C certified, -60 to +1160°C extended.  
0 to 1200°C certified, -60 to +1225°C extended with option D.
- (3) Accuracy: Typical measurement error at 25°C ambient: less than  $\pm 1^{\circ}\text{C}$ .
- (4) National Institute of Standards & Technology (NIST) Conformity: Refer to **Table 2**.
- (5) Reference Junction Compensation: Refer to **Table 3**.
- (6) Error: Refer to **Table 4**.

#### B. Lead Resistance:

- (1) 20  $\Omega$  Range; 0-19.99  $\Omega$  in 0.01  $\Omega$  increments.
- (2) 200  $\Omega$  Range; 0-199.9  $\Omega$  in 0.1  $\Omega$  increments.
- (3) Accuracy;  $\pm 0.1\%$  of reading  $\pm 0.01 \Omega$  (20  $\Omega$  Range).  
 $\pm 0.1\%$  of reading  $\pm 0.1 \Omega$  (200  $\Omega$  Range).



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### C. Insulation:

- (1) Range; 0-1.999 M $\Omega$  in 1 k $\Omega$  increments.
- (2) Accuracy;  $\pm 3\%$  of reading  $\pm 1$  k $\Omega$ .
- (3) Excitation; 45V DC nominal.

### D. Simulated System Resistance:

- (1) Adjustment Range; Less than 2.0  $\Omega$  to greater than 25  $\Omega$ .
- (2) Fixed Setting; Less than 0.1  $\Omega$ .

## 3. **CAPABILITIES**

- A. Measures and displays resistance of thermocouple, thermocouple rings and system lead circuits.
- B. Measures and displays insulation resistance of system wiring and other components.
- C. Simulates CH-AL thermocouple with or without simulated system lead resistance.
- D. Measures and displays values of CH-AL thermocouple in terms of degrees Celsius temperature.
- E. Automatically compensates for ambient temperature at test lead connection junction point or indicates this "cold junction" temperature.
- F. Also refer to section 1-1, 2. A. and 3. A. through G.





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<b>NIST CONFORMITY: (TEST CLIP LINEARIZATION)</b>	
<b>RANGE °C</b>	<b>ERROR ± °C</b>
* 0 TO -20	LESS THAN 1.0
* -21 TO -35	LESS THAN 2.0
* -36 TO -60	LESS THAN 5.0
0 TO 90	LESS THAN 0.6
91 TO 169	LESS THAN 1.0
170 TO 1000	LESS THAN 0.6
* 1001 TO 1050	LESS THAN 1.0
* 1051 TO 1090	LESS THAN 2.0
* 1091 TO 1160	LESS THAN 5.0

\* EXTENDED RANGE

THERMOCOUPLE LINEARIZATION  
**Table 2**



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<b>* REFERENCE JUNCTION COMPENSATION</b>	
TEMPERATURE °C	ERROR ± °C
0 TO 30	LESS THAN 0.1
31 TO 40	LESS THAN 0.3
41 TO 50	LESS THAN 0.6
51 TO 60	LESS THAN 0.9

\* AT TEST CLIPS

REFERENCE JUNCTION COMPENSATION  
**Table 3**

<b>0 TO 1000°C AT 25°C AMBIENT</b>	
ERROR SOURCE	ERROR ± °C
CALIBRATION ERROR	LESS THAN 0.5
RESOLUTION & REPEATABILITY	1.0
TOTAL (INCLUDING REF. JCT.)	1.5 (+ NIST CONFORMITY)
TEMPERATURE COEFFICIENT	0.005% OF READING PER °C

ERROR TABLE  
**Table 4**

#### **4. RECERTIFICATION**

The Test Set P/N 101-00901 has a one-year recertification requirement.



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# SHIPPING

### 1. **RECEIVING**

Special unpacking procedures are unnecessary. It is recommended that the factory-shipping container and packing materials be retained should it become necessary, for any reason, to reship the TT-1000A.

It is also recommended that the TT-1000A 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 TT-1000A for reshipment.

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# STORAGE

### 1. **PROCEDURE**

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