

# **\*TB 9-6695-281-35**

SUPERSEDED COPY DATED 26 FEBRUARY 1973

## **DEPARTMENT OF THE ARMY TECHNICAL BULLETIN**

# **CALIBRATION PROCEDURE FOR PYROMETER AND THERMOCOUPLE TESTER, TYPE N-3A (MIL-T-58082)**

Headquarters, Department of the Army, Washington, DC  
24 September 1986

### **REPORTING OF ERRORS**

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		<b>Paragraph</b>	<b>Page</b>
SECTION	I. IDENTIFICATION AND DESCRIPTION		
	Test instrument identification.....	1	2
	Forms, records, and reports .....	2	2
	Calibration description.....	3	2
	II. EQUIPMENT REQUIREMENTS		
	Equipment required .....	4	2
	Accessories required.....	5	3
	III. CALIBRATION PROCESS		
	Preliminary instructions .....	6	3
	Equipment Setup.....	7	4
	Circuit resistance.....	8	4
	Voltage.....	9	5
	Thermocouple thermometer .....	10	7
	Thermocouple thermometer lead resistance .....	11	9
	Resistance type thermometer.....	12	9
	Final procedure.....	13	10

\*This bulletin supersedes TB 55-6695-217-50, 26 February 1973, including all changes.

**SECTION I  
IDENTIFICATION AND DESCRIPTION**

**1. Test Instrument Identification.** This bulletin provides instructions for the calibration of Pyrometer and Thermocouple Tester, Type N-3A (MIL-T-58082). The manufacturers' manuals and MIL-T-58082 were used as the prime data sources in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

**a. Model Variations.** Variations among models are described in text.

**b. Time and Technique.** The time required for this calibration is approximately 4 hours, using the dc and low frequency technique.

**2. DA Form 2416 (Calibration Data Card)**

**a.** Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25. DA Form 2416 must be annotated in accordance with TB 750-25 for each calibration performed.

**b.** Adjustments to be reported on DA Form 2416 are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) follows the designated adjustment. Report only those adjustments made and designated with (R).

**3. Calibration Description.** TI parameters and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications
Circuit performance	$\pm 0.04 \Omega$
Voltage check	$\pm 0.5 \text{ V dc}$
Thermocouple thermometer calibration	0 to 20 mV $\pm 0.04 \text{ mV}$ 20 to 49 mV $\pm 0.06 \text{ mV}$
Thermocouple thermometer lead resistance calibration	$\pm 0.04 \Omega$
Resistance type thermometer calibration	$\pm 0.05 \Omega$

**SECTION II  
EQUIPMENT REQUIREMENTS**

**4. Equipment Required.** Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with Secondary Transfer Calibration Standards Set AN/GSM-286. Alternate items may be used by the calibrating activity when the equipment listed in table 2 is not available. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI.

**5. Accessories Required.** The accessories listed in table 3 are issued as indicated in paragraph 4 above and are used in this calibration procedure. When necessary, these items may be substituted by equivalent items, unless specifically prohibited.

Table 2. Minimum Specifications of Equipment Required

Item	Common name	Minimum Use specifications	Manufacturer and model (part number)
A1	DIGITAL VOLTMETER	Range: 3.61 mV dc to 29 V dc Accuracy: $\pm 0.03$	Hewlett-Packard, Model 3490AOPT060 (3490AOPT060) Dana, Model 5000, or Dana, Model 5000 w/641
A2	RESISTANCE MEASUREMENT SYSTEM	Range: 0 to 242.75 $\Omega$ Accuracy: $\pm 0.18\%$	ESI, Model 801 (7912151-2) w/ESI, Model 230B (7912150-2)
A3	RESISTANCE STANDARD	Range: 0 to 500 $\Omega$ Accuracy: $\pm 0.03\%$	Biddle-Gray, Model 71-631 (71-631)

Table 3. Accessories Required

Item	Common name	Description (part number)
B1	ADAPTER	Single banana jack to pin plug (red) (7907517)
B2	ADAPTER	Single banana jack to pin plug (black) (7907528)
B3	LEAD <sup>1</sup>	24-in., No. 18; single banana plug terminations (black) (7907497-2)
B4	LEAD <sup>1</sup>	24-in., No. 18; single banana plug terminations (red) (7907497-1)

<sup>1</sup>Two required.

### **SECTION III CALIBRATION PROCESS**

#### **6. Preliminary Instructions**

**a.** The instructions outlined in paragraphs **6** and **7** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

**b.** Items of equipment used in this procedure are referenced within the text by common name and item identification number as listed in tables 2 and 3. For the identification of equipment referenced by item numbers prefixed with A, see table 2, and for prefix B, see table 3.

#### **WARNING**

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions.

**TB 9-6695-281-35**

**NOTE**

Unless otherwise specified, verify the result of each test and, whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturer's manuals, TM 55-6695-200-15, and TM 55-6695-203-13 for this TI.

**NOTE**

Unless otherwise specified, all controls and control settings refer to the TI.

**7. Equipment Setup**

- a.** Zero TI voltmeter, using mechanical zero located below meter.
- b.** Position controls as listed in (1) through (5) below:
  - (1) Temperature selector switch to OFF.
  - (2) OHMS selector switch (lead resistance on some models) to 2  $\Omega$ .
  - (3) ADJUST INDICATOR control to 0.2 LOW.
  - (4) Resistance and voltage selector switch to LEAD RES CHECK.
  - (5) LEFT and RIGHT switch to LEFT and SINGLE.

**8. Circuit Resistance**

**a. Performance Check**

- (1) Connect resistance measurement system (A2) to resistance standard (A3), using leads (B3 and B4). Measure and record the zero resistance of resistance standard.
- (2) Connect TI to resistance standard high and low terminals, using thermocouple thermometer (red and black) leads.
- (3) Adjust resistance standard for 2 ohms.
- (4) Press and hold TI PUSH FOR OHMS pushbutton while adjusting resistance standard X1, X.1, and X.01 controls until TI voltmeter indicates a null (zero).
- (5) Release PUSH FOR OHMS pushbutton. Resistance standard indication, plus value recorded in (1) above will be between 1.76 and 1.84 ohms. If not, perform **b** below.

**NOTE**

Do not press TI PUSH FOR OHMS pushbutton until resistance standard is adjusted for the same resistance indication as TI OHMS selector switch indication.

(6) Repeat technique of (3) through (5) above for settings listed in table 4. If resistance standard does not indicate within limits specified, perform **b** below.

Table 4. Resistance Measuring - Circuit

Test instrument		Resistance standard indications plus zero value (ohms)	
OHMS selector switch settings	ADJUST INDICATOR control settings	Min	Max
2	.4 LOW	1.56	1.64
2	.6 LOW	1.36	1.44
2	.8 LOW	1.16	1.24
8	.5 LOW	7.46	7.54
22	.2 LOW	21.76	21.84
22	.8 HIGH	22.76	22.84
8	.5 HIGH	8.46	8.54
2	.5 HIGH	2.46	2.54

**b. Adjustments**

(1) Set TI OHMS selector switch to 8 ohms and adjust resistance standard for 7.50 ohms.

(2) Press PUSH FOR OHMS pushbutton and adjust ADJUST INDICATOR control for zero indication on TI voltmeter.

(3) Maintain zero indication on TI voltmeter; loosen knob on ADJUST INDICATOR control, turn knob to 0.5 LOW and secure knob.

(4) Adjust resistance standard for 8.50 ohms.

(5) Repeat (2) above.

(6) Maintain zero indication on TI voltmeter; loosen knob on adjust indicator control, turn knob half way between its position at completion of (5) above and 0.5 HIGH and secure knob.

**9. Voltage**

**a. Performance Check**

(1) Connect equipment as shown in figure 1.

**TB 9-6695-281-35**

- (2) Set TI RESISTANCE and VOLTAGE selector switch to 12V.
- (3) Adjust resistance standard (A3) for 500.00 ohms.
- (4) Adjust COARSE rheostat for full- scale (red line) indication on TI voltmeter. If digital voltmeter (A1) does not indicate between 13.750 and 14.750 V, perform **b** below.
- (5) Repeat technique of (3) and (4) above for resistance and voltage selector switch positions listed in table 5. Digital voltmeter will indicate within limits specified.
- (6) Set TI RESISTANCE and VOLTAGE selector switch to OFF.

**b. Adjustments**

- (1) Set TI COARSE rheostat for a 14.25 V indication on digital voltmeter (A1) and adjust magnetic shunt (located on back of meter on some models) or R10 (located on circuit board behind meter on other models) for red line indication on TI meter.
- (2) Repeat **9a** above.

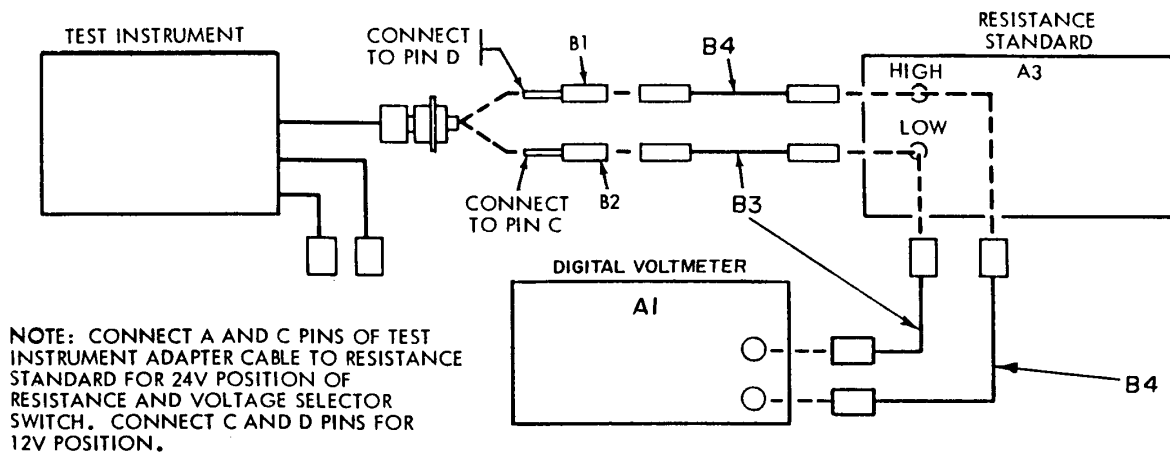


Figure 1. Voltage test - equipment setup.

Table 5. Voltage Check

Test instrument		Digital voltmeter indications (V)	
RESISTANCE and VOLTAGE selector switch positions	TI voltmeter indications (V)	Min	Max
12 V	11.25	10.750	11.750
24 V <sup>1</sup>	Full scale (red line)	28.000	29.000
24 V	22.50	22.000	23.000

<sup>1</sup>Remove connection from pin D and connect to pin A.

## 10. Thermocouple Thermometer

### a. Performance Check

#### NOTE

A full-scale (red line) indication is required for all measurements.

- (1) Remove TI TESTER STANDARDIZING ONLY cover.
- (2) Connect equipment as shown in figure 2.
- (3) Set TI RESISTANCE and VOLTAGE selector switch to THERMOCOUPLE BENCH TEST 8 OHMS.
- (4) Adjust resistance standard (A3) for 17 OHMS.
- (5) Adjust TI COARSE and FINE rheostats for full-scale (red line) indication on TI voltmeter.
- (6) Set TEMPERATURE selector switch to -50 on IRON-CONSTANTAN (degrees) C outer scale. If digital voltmeter (A1) does not indicate between -3.53 and -3.61 mV dc, perform **b** below.
- (7) Repeat technique of (4) through (6) above for switch positions listed in table 6. Digital voltmeter will indicate within limits specified.

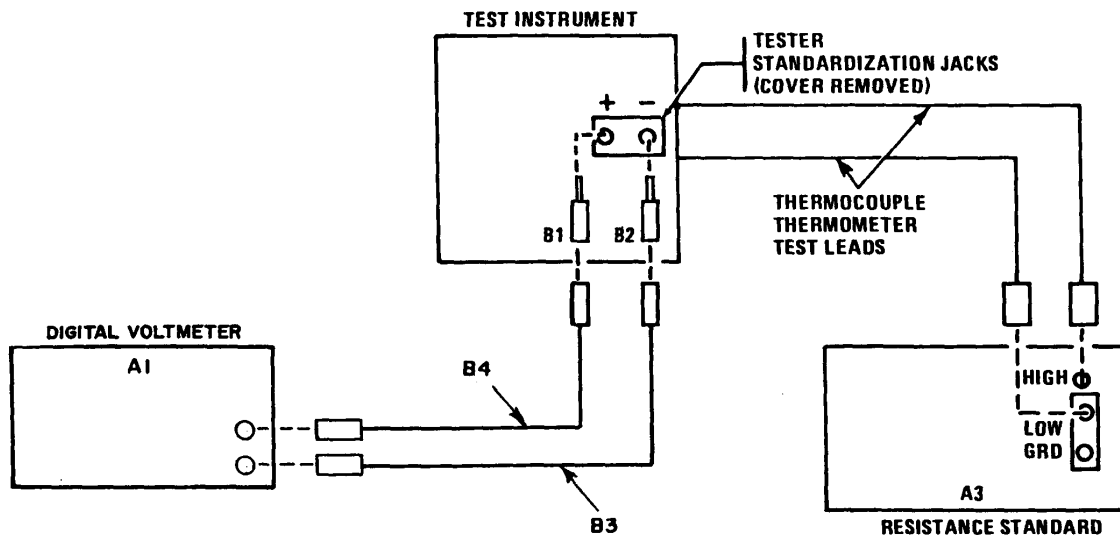


Figure 2. Thermocouple thermometer - equipment setup.

Table 6. Thermocouple Thermometer

Resistance standard settings (oms)	Test instrument <b>TEMPERATURE</b> selector switch positions (outer scale)	Digital voltmeter indications	
		Min	Max
	<b>IRON CONSTANTAN °C</b>		
17.00	0	-1.01	-1.09
17.00	+20	-0.04	+0.04
17.00	+50	+1.57	+1.65
17.00	+100	+4.31	+4.39
17.00	+150	+7.10	+7.18
17.00	+200	+9.90	+9.98
17.00	+250	+12.70	+12.78
17.00	+300	+15.47	+15.55
17.00	+350	+18.23	+18.31
	<b>COPPER CONSTANTAN °C</b>		
17.00	-50	-2.55	-2.63
17.00	0	-0.75	-0.83
17.00	+20	-0.04	+0.04
17.00	+50	+1.21	+1.29
17.00	+100	+3.45	+3.53
17.00	+150	+5.87	+5.95
17.00	+200	+8.46	+8.54
17.00	+250	+11.18	+11.26
17.00	+300	+14.03	+14.11
17.00	+350	+16.99	+17.07
	<b>CHROMEL ALUMEL °C</b>		
42.00	0	-0.04	+0.04
42.00	+200	+8.09	+8.17
42.00	+400	+16.35	+16.43
42.00	+500	+20.58	+20.70
42.00	+600	+24.84	+24.96
42.00	+700	+29.08	+29.20
42.00	+800	+33.25	+33.37
42.00	+1000	+41.25	+41.37
42.00	+1200	+48.83	+48.95

**b. Adjustments**

(1) Adjust magnetic shunt or R10 (see 9b above) to bring digital voltmeter indication within the limits specified.

(2) Repeat **9a** above.

**NOTE**

The thermocouple thermometer check and the voltage check interact.



## **11. Thermocouple Thermometer Lead Resistance**

### **a. Performance Check**

(1) Short resistance measurement system (A2) UNKNOWN terminal 1 to UNKNOWN terminal 2. Measure and record zero resistance value

(2) Disconnect TI batteries and connect TI thermocouple leads (red and black) to resistance measurement system UNKNOWN terminals.

(3) Set TI TEMPERATURE selector switch to 0 REF on CHROMEL-ALUMEL (degrees) C. outer scale and RESISTANCE and VOLTAGE selector switch to 2. Resistance measurement system indication minus value recorded in (1) above will be between 1.96 and 2.04 ohms.

(4) Repeat technique of (3) above for 8 and 22 ohm switch positions. Resistance measurement system will indicate between 7.96 and 8.04 and 21.96 and 22.04 respectively.

**b. Adjustments.** No adjustments can be made.

## **12. Resistance Type Thermometer**

### **a. Performance Check**

#### **NOTE**

TI batteries should be disconnected for this check.

(1) Connect leads and adapters (B1, B2, B3, and B4) to resistance measurement system (A2) UNKNOWN terminals and short leads. Measure and record the zero resistance.

(2) Connect resistance measurement system to TI thermometer test cable pins B and C, using leads and adapters (B1, B2, B3, and B4).

(3) Set TI TEMPERATURE selector switch to -70 on 9638 OHMS RES inner scale. Resistance measuring system minus zero resistance value recorded in (2) above will indicate between 68.22 and 68.32 ohms.

(4) Repeat technique of (3) above for TEMPERATURE selector switch positions listed in table 7. Resistance measuring system will indicate within limits specified.

Table 7. Resistance Type Thermometer Check

Test instrument TEMPERATURE selector switch positions (inner scale) <b>90.38 (OHMS) RES.</b>	Resistance measuring system indications minus zero resistance value (Ohms)	
	Min	Max
-50	74.19	74.29
-30	80.51	80.61
-10	86.99	87.09
0	90.33	90.43
+10	93.75	93.85
+30	100.86	100.96
+50	108.34	108.44
+80	120.31	120.41
+100	128.80	128.90
+120	137.73	137.83
+150	151.86	151.96
+200	177.90	178.00
+250	207.95	208.05
+300	242.65	242.75
<b>50.00 (OHMS) RES.</b>		
+300	164.45	164.55
+250	138.95	139.05
+200	116.45	116.55
+150	96.45	96.55
+100	78.95	79.05
+50	63.50	63.60
0	49.95	50.05
-50	37.90	38.00

(5) Set TI LEFT and RIGHT switch to RIGHT.

(6) Connect resistance measurement system to TI thermometer test cable pins E and C Repeat technique of (1) through (4) above.

**b. Adjustments.** No adjustments can be made.

**13. Final Procedure**

**a.** Deenergize and disconnect all equipment and reinstall protective cover on TI.

**b.** When all parameters are within tolerance, annotate and affix DA Label 80 (U.S. Army Calibrated Instrument). When the TI receives limited or special calibration, annotate and affix DA Label 163 (U.S. Army Limited or Special Calibration). When the TI cannot be adjusted within tolerance, repair the TI in accordance with the maintenance manual. When repair is delayed for any reason or the TI cannot be repaired with local resources, annotate and affix DA Form 2417 (U.S. Army Calibration System Rejected Instrument) and inform the owner/user accordingly in accordance with TB 750-25.

**TB 9-6695-281-35**

By Order of the Secretary of the Army:

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Distribution:

To be distributed in accordance with DA Form 12-34C, Block No. 319, requirements for calibration procedures publications.

US GOVERNMENT PRINTING OFFICE: 1987 - 731-583/40335 REGION #4

**PIN: 060843-000**