*TB 9-4931-287-40

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR PORTABLE MILLIVOLT POTENTIOMETER, HONEYWELL MODEL 2707 AND JAMES BIDDLE MODELS 72-310 AND 72-311

Headquarters, Department of the Army, Washington, DC
22 May 2008

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can improve this manual. If you find any mistakes or if you know of a way to improve these procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to: Commander, U.S. Army Aviation and Missile Command, ATTN: AMSAM-MMC-MA-NP, Redstone Arsenal, AL 35898-5000. A reply will be furnished to you. You may also send in your comments electronically to our E-mail address: 2028@redstone.army.mil or by fax 256-842-6546/DSN 788-6546. For the World Wide Web use: https://amcom2028.redstone.army.mil. Instructions for sending an electronic 2028 can be found at the back of this manual.

*This bulletin supersedes TB 9-4931-287-50, dated 8 June 1979, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test instrument Identification. This bulletin provides instructions for the calibration of Portable Millivolt Potentiometer, Honeywell Model 2707 and James Biddle Models 72-310 and 72-311. The manufacturers' manuals were used as the prime data source in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. Model variations are described in text.

b. Time and Technique. The time required for this calibration is approximately 2 hours per instrument, using the dc (direct current) and low frequency technique.

2. Forms, Records, and Reports

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

b. Adjustments to be reported 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
Honeywell Model 2707 Dc millivolts	Range: 0 to 182 mV Accuracy: 0 to 18.2 mV ±(0.05% of reading +5 μV) 0 to 182 mV ±(0.05% of reading +50 μV)
James Biddle Model 72-310 Dc millivolts	Range: 0 to 111 mV Accuracy: 0 to 11.1 mV ±(0.05% of reading +5 μV) 0 to 111 mV ±(0.05% of reading +20 μV)
James Biddle Model 72-311 Dc millivolts	Range: 0 to 111 mV Accuracy: 0 to 11.1 mV, ±(0.05% +2 μV) 0 to 111 mV, ±(0.05% +20 μV)

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Dc milliamperes	Range: 0 to 111 mA Accuracy: 0 to 11.1 mA, ±(0. 1% +2 μA) 0 to 111 mA, ±(0.1% +20 μA)

SECTION II
EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment used in this calibration procedure. This equipment is issued with Secondary Reference Calibration Standards Set, NSN 4931-00-621-7878. Alternate items may be used by the calibrating activity. 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. Where the four-to-one ratio cannot be met, the actual accuracy of the equipment selected is shown in parenthesis.

5. Accessories Required. The accessories required for this calibration are common usage accessories, issued as indicated in paragraph **4** above, and are not listed in this calibration procedure. The following peculiar accessory is also required for this calibration: Hookup wire, shielded pair, untinned copper, solid conductors, No. 18 to 22 AWG (MIS-10312).

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
CALIBRATOR	Range: 0 to 1.85 V Accuracy: ±0.013%	Fluke, Model 5720A (5720A) (p/o MIS-35947); w amplifier, Fluke 5725A/AR (5725A/AR)
DC CURRENT SHUNT	Range: 10 to 111 mA dc Accuracy: ±0.03%	Guildline, Model 9711 (7912323)
DC POWER SUPPLY	Range: 10 to 111 mA dc	Elgar, Model DCS40-30EM10 (13589313)
DC VOLTAGE DIVIDER	Input - output ratio: 10:1 Accuracy: ±0.013%	General Resistance, Model DV4107C (MIS-10274)
DECADE RESISTOR	Range: 0 to 500 Ω	Winslow, Model 336 (7907234) or Clarostat, Model 240C (240C)
MULTIMETER	Range: 0 to 112 mV dc Accuracy: ±0.03%	Hewlett Packard, Model 3458A (3458A)
NULL DETECTOR	Range: 0 to 185 mV dc Resolution: ±3 μV	John Fluke, Model 845AB (845AB)

SECTION III
CALIBRATION PROCESS FOR HONEYWELL MODEL 2707

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 as listed in table 2.

c. 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 manual for this TI.

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

7. Equipment Setup

a. Turn **FUNCTION** switch to **OFF**.

b. Mechanically zero TI galvanometer using adjustment screw on meter cover.

c. Insure that TI contains fresh batteries.

d. Connect equipment as shown in figure 1, connection A.

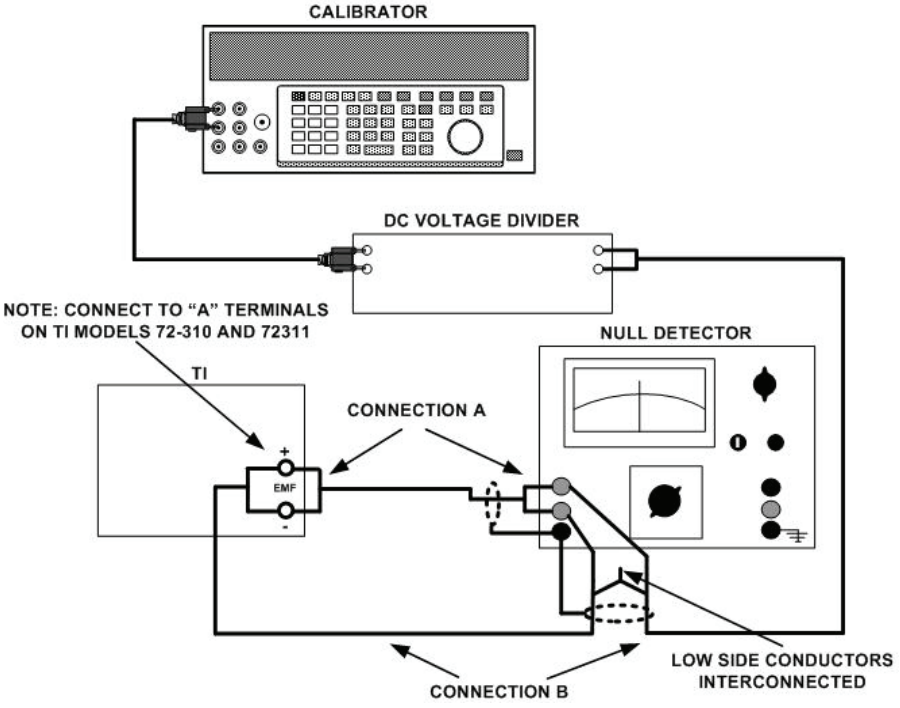

Figure 1. Output accuracy - equipment setup.

8. Output Accuracy

a. Performance Check

(1) Turn **MILLIVOLT** switch to **0** (zero) and **MILLIVOLT** control to **0** (zero).

(2) Press and lock **GA** switch.

(3) Set **FUNCTION** switch to **SC** and adjust **STD** control for null indication on galvanometer.

NOTE

Repeat (3) above as necessary during remainder of this procedure to assure stability of TI. Instability is often caused by internal batteries and/or internal standard cell and should be corrected before continuing with the calibration.

(4) Turn **FUNCTION** switch to **OUTPUT 1**. Null detector will indicate between 0 and 50 μV.

(5) Connect equipment as shown in figure 1, connection B.

(6) Set dc voltage divider controls to **.1000000**.

(7) Set **MILLIVOLTS** switch to **20** and adjust calibrator for **0.20000 V**.

(8) While increasing sensitivity of null detector, readjust output of calibrator to obtain best null on null detector. Output of calibrator will be between 0.1994 and 0.2006 V.

(9) Repeat technique of (7) and (8) above, using values in tables 3. Calibrator output will be within limits specified.

Table 3. Output 1 Accuracy

Test instrument		Calibrator		
MILLIVOLT switch setting	**MILLIVOLT** control setting	Initial setting (V)	Final setting (V)	
			Min	Max
40	0	0.4	0.3993	0.4007
60	0	0.6	0.5992	0.6008
80	0	0.8	0.7991	0.8009
100	0	1.0	0.9990	1.0010
120	0	1.2	1.1989	1.2011
140	0	1.4	1.3988	1.4012
160[1]	0	1.6	1.5987	1.6013
	2	1.62	1.6187	1.6213
	4	1.64	1.6387	1.6413
	6	1.66	1.6587	1.6613
	8	1.68	1.6787	1.6813
	10	1.70	1.6986	1.7014
	12	1.72	1.7186	1.7214
	14	1.74	1.7386	1.7414
	16	1.76	1.7586	1.7614
	18	1.78	1.7786	1.7814
	20	1.80	1.7986	1.8014
	22	1.82	1.8186	1.8214

[1]Do not change **MILLIVOLT** switch setting.

(10) Adjust output of calibrator to **0.182 V** and set **FUNCTION** switch to **OUTPUT .1**.

(11) Readjust calibrator to obtain best null on null detector. Calibrator output will be between 0.18186 and 0.18214 V.

b. Adjustments. No adjustments can be made.

9. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA label/form in accordance with TB 750-25.

SECTION IV
CALIBRATION PROCESS FOR JAMES BIDDLE MODEL 72-310

10. Preliminary Instructions

a. The instructions outlined in paragraphs **10** and **11** 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 as listed in table 2.

c. 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 manual for this TI.

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

11. Equipment Setup

a. Turn **FUNCTION** switch to **OFF**.

b. Mechanically zero TI galvanometer, using adjustment screw on meter cover.

c. Insure that TI contains fresh batteries.

12. Output Accuracy

a. Performance Check

(1) Position controls as listed in (a) through (c) below:

(a) **EMF** switch to **A**.
(b) **MILLIVOLT** switch to **0**.
(c) **MILLIVOLT** control to **0**.

(2) Press and lock **DET** switch.

(3) Turn **FUNCTION** switch to **STD** and adjust **STD** control for null on TI galvanometer.

NOTE

Repeat (3) above as necessary during the remainder of the procedure to assure stability of TI. Instability is often caused by internal batteries and/or standard cell and should be corrected before proceeding with the calibration.

(4) Connect equipment as shown in figure 1, connection A.

(5) Turn **FUNCTION** switch to **COMP SET** and **COMP** switch to **ON**. Adjust **COMP** control for null indication on TI galvanometer. Turn **COMP** switch to **OFF**.

(6) Turn **FUNCTION** switch to **OUTPUT X1**. Null detector will be between 0 and 20 μV.

(7) Connect equipment as shown in figure 1, connection B.

(8) Repeat (5) above.

(9) Set dc voltage divider controls to **.1000000**.

(10) Adjust output of calibrator to **0.10000 V** and set **MILLIVOLT** switch to **10**.

(11) Readjust calibrator to obtain best null on null detector. Calibrator will indicate between 0.09975 and 0.10025 V.

(12) Repeat technique of (10) and (11) above, using values listed in table 4. Calibrator output will be within limits specified.

Table 4. Output Accuracy

Test instrument		Calibrator		
MILLIVOLT switch setting	**MILLIVOLT** control setting	Initial setting (V)	Final setting (V)	
			Min	Max
20	0	0.2	0.19970	0.20030
30	0	0.3	0.29965	0.30035
40	0	0.4	0.39960	0.40040
50	0	0.5	0.49955	0.50045
60	0	0.6	0.59950	0.60050
70	0	0.7	0.69945	0.70055
80	0	0.8	0.79940	0.80060
90	0	0.9	0.89935	0.90065
100 [1]	0	1.0	0.99930	1.00070
	2	1.02	1.01929	1.02071
	4	1.04	1.03928	1.04072
	6	1.06	1.05927	1.06073
	8	1.08	1.07926	1.08074
	10	1.10	1.09925	1.10075
	11	1.11	1.10924	1.11076

[1]Do not change **MILLIVOLT** switch setting.

(13) Adjust output of calibrator to **0.111 V** and set TI **FUNCTION** switch to **OUTPUT X.1**.

(14) Readjust calibrator to obtain best null-on-null detector. Calibrator output will be between 0.11089 and 0.11111 V.

b. Adjustments. No adjustments can be made.

13. Final Procedure

a. Deenergize and disconnect all equipment.

b. Annotate and affix DA label/form in accordance with TB 750-25.

SECTION V
CALIBRATION PROCESS FOR JAMES BIDDLE MODEL 72-311

14. Preliminary Instructions

a. The instructions outlined in paragraphs **14** and **15** 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 as listed in table 2.

c. 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 manual for this TI.

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

15. Equipment Setup

a. Turn **FUNCTION** switch to OFF.

b. Mechanically zero TI galvanometer, using adjustment screw on meter cover.

c. Insure that TI contains fresh batteries.

16. Output Accuracy

a. Performance Check

(1) Position controls as listed in (a) through (g) below:

(a) **MILLIVOLT** control to **0**.
(b) **MILLIVOLT** switch to **0**.
(c) **BIND POSTS** switch to **A**.
(d) **LEAD RES** control to **OFF**.
(e) **TC COMP** switch to **OFF**.
(f) **SENS** control fully cw (clockwise).
(g) **DET** switch pressed and locked.

(2) Turn **FUNCTION** switch to **SET COMP** and adjust **ZERO** control to obtain 0 indication on TI meter.

NOTE

Repeat (2) above as necessary during remainder of this procedure to assure stability of TI. Instability is often caused by internal batteries and should be corrected before proceeding with the calibration.

(3) Connect equipment as shown in figure 1, connection A.

(4) Set **FUNCTION** switch to **OUTPUT X1**. Null detector will indicate between 0 and 20 μV.

(5) Connect equipment as shown in figure 1, connection B.

(6) Set dc voltage divider controls to **.1000000**.

(7) Adjust output of calibrator to **0.10000 V** and set **MILLIVOLT** switch to **10**.

(8) Readjust calibrator to obtain best null on null detector. Calibrator will indicate between 0.09975 and 0.10025 V.

(9) Repeat technique of (7) and (8) above, using values listed in table 5. Calibrator will indicate within limits specified.

Table 5. Output Accuracy

Test instrument		Calibrator		
MILLIVOLT switch setting	**MILLIVOLT** control setting	Initial setting (V)	Final setting (V)	
			Min	Max
20	0	0.2	0.19970	0.20030
30	0	0.3	0.29965	0.30035
40	0	0.4	0.39960	0.40040
50	0	0.5	0.49955	0.50045
60	0	0.6	0.59950	0.60050
70	0	0.7	0.69945	0.70055
80	0	0.8	0.79940	0.80060
90	0	0.9	0.89935	0.90065
100 [1]	0	1.0	0.99930	1.00070
	2	1.02	1.01929	1.02071
	4	1.04	1.03928	1.04072
	6	1.06	1.05927	1.06073
	8	1.08	1.07926	1.08074
	10	1.10	1.09925	1.10075
	11	1.11	1.10924	1.11076

[1]Do not change **MILLIVOLT** switch setting.

(10) Adjust output of calibrator to **0.111 V** and set **FUNCTION** switch to **OUTPUT X.1**.

(11) Readjust calibrator to obtain best null on null detector. Calibrator output will be between 0.11089 and 0.11111 V.

b. Adjustments. No adjustments can be made.

17. Milliamperes

a. Performance Check

(1) Connect equipment as shown in figure 2.

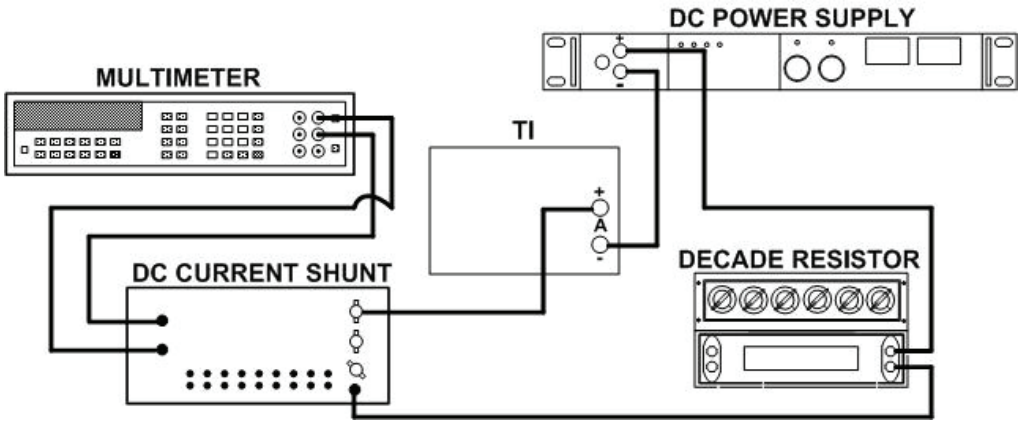

Figure 2. Milliampere measurement - equipment setup.

(2) Adjust decade resistor to 500 ohms.

(3) Position controls as listed in (a) through (c) below:

(a) **MILLIVOLT** switch to **100**.
(b) **MILLIVOLT** control to **0**.
(c) **FUNCTION** switch to **MEASURE X1 mA**.

(4) Position plugs in dc current shunt (A1) for **10 mA** (milliamperes).

(5) Press **DET** switch and adjust output of dc power supply to obtain null on TI meter. If multimeter does not indicate between 99.88 and 100.12 mV, perform **b** below.

(6) Turn **MILLIVOLT** switch to **10** and **FUNCTION** switch to **MEASURE X1 mA**.

(7) Repeat technique of (5) above. If multimeter does not indicate between 99.70 and 100. 30 mV and no adjustments were previously made, perform **b** below.

(8) Position plugs in dc current shunt for 100 mA.

(9) Turn **MILLIVOLT** switch to **20**.

(10) Press **DET** switch and adjust dc power supply to obtain null on TI meter. If multimeter does not indicate between 19.96 and 20.04 mV, and no adjustments were previously made, perform **b** below.

(11) Repeat technique of (8) through (10) above, using value listed in table 6. If multimeter does not indicate within limits specified, and no adjustments were previously made, perform **b** below.

NOTE

Readjust value of decade resistor as required.

Table 6. Milliamperes

Test instrument		Multimeter indications (mV)	
MILLIVOLT switch	**MILLIVOLT** control	Min	Max
30	0	29.95	30.05
40	0	39.94	40.06
50	0	49.93	50.07
60	0	59.92	60.08
70	0	69.91	70.09
80	0	79.90	80.10
90	0	89.89	90.11
100[1]	0	99.88	100.12
	1	100.87	101.121
	3	102.87	103.123
	5	104.87	105.125
	7	106.87	107.127
	9	108.87	109.129
	11	110.86	111.131

[1]Do not change **MILLIVOLT** switch setting.

b. Adjustments

(1) Position controls as listed in (a) through (c) below:

(a) **MILLIVOLT** switch to **100**.
(b) **MILLIVOLT** control to **0**.
(c) **FUNCTION** switch to **MEASURE X1 mA**.

(2) Position plugs in dc current shunt for 100 mA.

(3) Adjust output of dc power supply to obtain multimeter indication of **100.00 mV**.

(4) Adjust **CAL** potentiometer (fig. 3) while pressing **DET** switch until TI meter indicates a null (R).

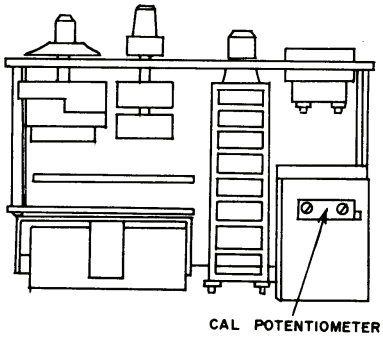

Figure 3. Model 72-311 - top chassis review.

18. Final Procedure

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

b. Annotate and affix DA label/form in accordance with TB 750-25.

By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army

0808503

Distribution:

To be distributed in accordance with STD IDS No. RLC-1500, 2 January 2003, requirements for calibration procedure TB 9-4931-287-40.

Instructions for Submitting an Electronic 2028

The following format must be used if submitting an electronic 2028. The subject line must be exactly the same and all fields must be included; however, only the following fields are mandatory: 1, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 16, 17, and 27.

From: "Whomever" whomever@redstone.army.mil
To: <2028@redstone.army.mil

Subject: DA Form 2028

1. **From**: Joe Smith
2. Unit: home
3. **Address**: 4300 Park
4. **City**: Hometown
5. **St**: MO
6. **Zip**: 77777
7. **Date Sent**: 19-OCT –93
8. **Pub no:** 55-2840-229-23
9. **Pub Title**: TM
10. **Publication Date**: 04-JUL-85
11. Change Number: 7
12. Submitter Rank: MSG
13. **Submitter FName**: Joe
14. Submitter MName: T
15. **Submitter LName**: Smith
16. **Submitter Phone**: 123-123-1234
17. **Problem**: 1
18. Page: 2
19. Paragraph: 3
20. Line: 4
21. NSN: 5
22. Reference: 6
23. Figure: 7
24. Table: 8
25. Item: 9
26. Total: 123
27. **Text**

This is the text for the problem below line 27.