*TB 9-6625-788-40

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR HIGH-RESISTANCE MEASUREMENT STANDARD, GUILDLINE INSTRUMENTS MODEL 9520 AND HIGH-RESISTANCE STANDARD SET, PENN AIRBORNE PRODUCTS MODEL 9A-5120

Headquarters, Department of the Army, Washington, DC
27 November 2007

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 9-6625-788-50, dated 11 May 1982, including all changes.

SECTION I
IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of High-Resistance Measurement Standard, Guildline Instruments Model 9520 and High-Resistance Standard Set, Penn Airborne Products Model 9A-5120. 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. 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. 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
Guildline Instruments Model 9520	
Line voltage regulation	Satisfactory performance with line voltage between 105 and 125 V ac
Dc voltage:	Range: 0 to 1000 V dc Accuracy: ± 1%
Resistance:[1]	Range: 1 X 10^7 to 1 X 10^{13}[2] Accuracy: ± 0.025% (1 X 10^7) ± 0.035% (1 X 10^8) ± 0.05% (1 X 10^9) ± 0.07% (1 X 10^{10})
Penn Airborne Products Model 9A-5120	
MIS-10412-3:	Range: 1 GΩ Accuracy: ± 1%
MIS-10412-4:	Range: 10 GΩ Accuracy: ± 1%

[1]TI certified to manufacturer's specification on 1 X 10^7 and 1 X 10^8 ranges. Ranges 1 X 10^9 and 1 X 10^{10} are calibrated to twice the test report accuracy of resistance standard (A4). Example: If the standard is ± 0.01 percent, then TI will be ± 0.02 percent.
[2]TI not checked above 10^{10} ohms.

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 Reference Calibration Standards Set NSN 4931-00-621-7878 and is to be used in performing this procedure. 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. 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.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
AUTOTRANSFORMER	Range: 105 to 125 V ac Accuracy: ± 1%	Ridge, Model 9020A (9020A)
MULTIMETER	Range: -1010 to +1010 V Accuracy: ± 0.25%	Agilent, Model 3458A (3458A)
RESISTANCE BRIDGE	Range: 10 to 100 MΩ Accuracy: ± 0.0062%	Electro Scientific, Model SP2980 (MIS-10281)

Table 2. Minimum Specifications of Equipment Required - Continued

Common name	Minimum use specifications	Manufacturer and model (part number)
RESISTANCE STANDARD SET	Range: 1 to 10 G Ω Accuracy:[1]	Penn Airborne, Model 9A-5120-102 & 103 (MIS-10412, -3 & -4)
RESISTANCE STANDARD	Range: 10 to 100 M Ω Accuracy: ± 0.25%	International Resistance Model CR100M (8598966)
TERAOHMMETER (RESISTANCE MEASUREMENT STANDARD)	Range: 10 M Ω to 10 G Ω Resolution: 0.1%	Guildline Instruments, Model 9520 (MIS-10549)

[1]Test report accuracy.

SECTION III
PRELIMINARY OPERATIONS

6. Preliminary Instructions

a. The instructions outlined in paragraph **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

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. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

a. Remove front cover only to make adjustments and replace immediately upon completion.

b. Set **TEST VOLTS** switch to **0** (zero) and insure that all pushbuttons are released (out).

NOTE

Insure that **RESET** pushbutton is pressed after each change of function.

c. Set voltage selector switch on TI rear panel to 115 VAC.

d. Connect TI to autotransformer.

e. Connect autotransformer to a 115 V ac source and adjust controls for a 115 V ac output.

f. Press **LINE** pushbutton and allow 30 minutes for TI to warm-up and stabilize.

g. Press and hold **RESET** pushbutton. Display will indicate 18.8888E18. Release **RESET** pushbutton.

h. Connect adapter (furnished with TI) to TI as shown in figure 1.

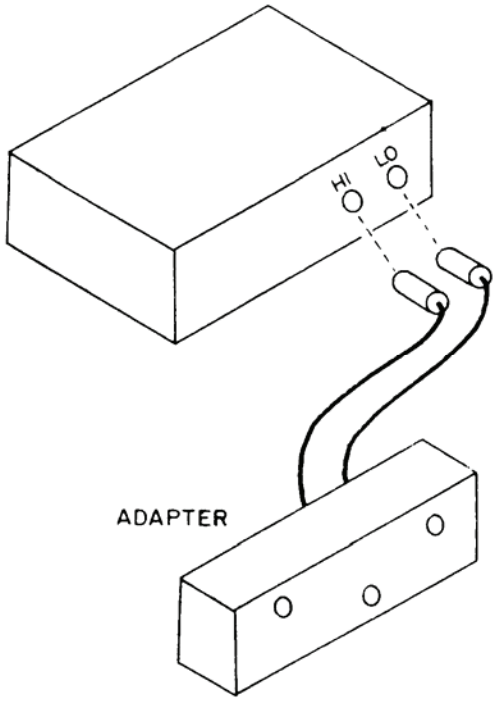

Figure 1. Adapter connection-equipment setup.

SECTION IV
CALIBRATION PROCESS FOR HIGH-RESISTANCE MEASUREMENT STANDARD, GUILDLINE INSTRUMENTS MODEL 9520

8. Validity Indicator

a. Performance Check

(1) Connect lead between **HI** (red) and **COMMON** (green) terminals of adapter furnished with TI.

WARNING

1000 V are present at **HI** terminal during the following test.

(2) Press **MODE CONT** pushbutton and set **TEST VOLTS** switch to **1000**.

(3) Press and hold **RESET** pushbutton. Red validity light will extinguish. Release **RESET** pushbutton. Light will illuminate.

(4) Set **TEST VOLTS** switch to **25**.

(5) Remove lead connected in (1) above.

b. Adjustments. No adjustments can be made.

9. Display Blanking

a. Performance Check

CAUTION

Do not ground **HI** (red) or **LO** (black) terminals of adapter supplied with TI.

(1) Connect 100 MΩ resistance standard between **HI** (red) and **LO** (black) terminals of adapter furnished with TI.

(2) Press **RATE 100** pushbutton.

(3) Press and release **RESET** pushbutton. Total display will blank, except E.

b. Adjustments. No adjustment can be made.

10. Test Voltage Accuracy

a. Performance Check

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

(a) **ALL RATE** pushbuttons released.

(b) **MODE CONT** pushbutton released.

(c) **-TV** pushbutton released.

(d) **TEST VOLTS** switch to **0** (zero).

(2) Connect multimeter between **LO** (black) and **COMMON** (green) terminals of adapter furnished with TI.

(3) Momentarily press **RESET** pushbutton. If multimeter indicates more than 50 μV dc, perform **b** (1) below.

(4) Connect multimeter between **HI** (red) and **LO** (black) terminals of adapter furnished with TI.

WARNING

1000 V are present at **HI** connector during the following checks.

(5) Set **TEST VOLTS** switch to **1000**.

(6) Momentarily press **RESET** pushbutton. If multimeter does not indicate between +990.0 V and +1010.0 V, perform **b** (2) below.

(7) Set **TEST VOLTS** switch to settings listed in table 3. If multimeter does not indicate within limits specified, and **b** (2) was not performed in (6) above, perform **b** (2) below.

Table 3. Test Voltage Accuracy

Test instrument **TEST VOLTS** switch settings	Multimeter indications (V)	
	Min	Max
500	495.0	505.0
250	247.5	252.5
100	99.0	101.0
50	49.5	50.5
25	24.75	25.25
10	9.9	10.1
5	4.95	5.05
2.5	2.475	2.525
1	.99	1.01

(8) Press **-TV** pushbutton.

(9) Set **TEST VOLTS** switch to **1000**.

(10) Momentarily press **RESET** pushbutton. If multimeter does not indicate between -990.0 and -1010 V dc, perform **b** (3) below.

(11) Set **TEST VOLTS** switch to settings listed in table 4. If multimeter indications are not within limits specified, but of - (negative) polarity and **b** (3) was not performed in (10) above, perform **b** (3) below.

b. Adjustments

(1) Adjust **ZERO** control until multimeter indicates 0 V.

(2) Set **TEST VOLTS** switch to **1000** and adjust R41 (fig. 2) for a +1000 V indication on multimeter (R).

(3) Set **TEST VOLTS** switch to **1000** and adjust R42 (fig. 2) for a -1000 V indication on multimeter (R).

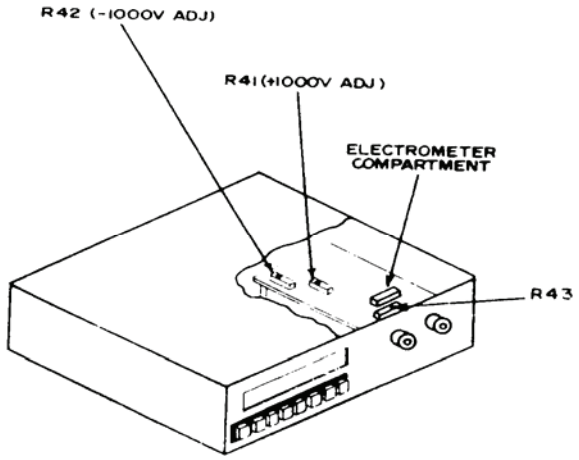

Figure 2. High resistance standard-top interior view.

11. Range and Linearity

a. Performance Check

NOTE

The green indicator light must be illuminated during measurement periods.

(1) Measure and record resistance value for each terminal (example: 1 and 2, 1 and 3, 1 and 4, etc.) of resistance standard, using resistance bridge set to 60 V.

(2) Connect terminals 1 and 11 of resistance standard to **HI** and **LO** terminals.

(3) Connect ground side of **LOW** terminal lead to resistance standard case ground.

(4) Position controls as listed in **(a)** through **(e)** below:

(a) **RATE 10** pushbutton pressed.

(b) **MODE CONT** pushbutton pressed.

(c) **TEST VOLTS** switch to **1**.

(d) **-TV** pushbutton released.

(e) **RESET** pushbutton pressed and released.

NOTE

Allow sufficient time for TI indication to stabilize before taking measurement.

NOTE

When measuring resistance standard, TI is susceptible to electrostatic forces. Personnel movement should be kept to a minimum near the resistance standard when it is being used.

(5) Record three TI indications (not necessarily three consecutive indications).

(6) Press **-TV** pushbutton.

(7) Repeat (5) above.

(8) Determine average of the six indications recorded in (5) and (7) above. If average value is not within ± 0.035 percent of value recorded in (1) above for terminals 1 and 11, perform **b** (1) below.

(9) Release **RATE 10** pushbutton.

(10) Repeat technique of (2) through (8) above for resistance standard terminals 1 through 10 (example: 1 and 2, 1 and 3, and 1 and 4, etc.). Position controls as listed in table 4 to correspond to resistor being measured. If average value for each set of terminals is not within ± 0.025 percent of value measured in (1) above, perform **b** (2) below.

Table 4. Resistance Measurement

Resistor being measured	Test instrument	
	RATE pushbutton	**TEST VOLTS** switch
10 to 100 MΩ	**RX1**[1]	**1** to **5**
1 GΩ	**RX1**[1]	**50**
10 GΩ	**RX1**[1]	**500**

[1]**ALL RATE** pushbutton released.

(11) Connect adapter (furnished with TI) to TI as shown in figure 1.

(12) Connect the 1 GΩ resistor of resistance standard set to adapter furnished with TI.

(13) Repeat technique of (2) through (8) above. Position controls as listed in table 4 to correspond to resistor being measured. If average value in (8) above is not within twice the calibration test report accuracy (see footnote, table 1) for the 1 GΩ resistor, perform **b** below.

(14) Repeat technique of (12) and (13) above for the 10 GΩ resistor of resistance standard set, except no adjustment can be made.

b. Adjustments

(1) Adjust **CAL** (front panel) control for TI indication of measured resistance value for terminals 1 and 11 (100 MΩ) recorded in **a** (1) above at 1 V and **RATE 10**.

(2) Release all **RATE** pushbuttons. Adjust R43 (fig. 2) for TI indication equal to value recorded in **a** (1) above (R).

12. 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 HIGH-RESISTANCE STANDARD SET, PENN AIRBORNE PRODUCTS MODEL 9A-5120

13. Resistance Accuracy

a. Performance Check

(1) Connect the 1 GΩ standard resistor from resistance standard set into adapter furnished with teraohmmeter.

(2) Set teraohmmeter **TEST VOLTS** switch to **50**.

(3) Measure and record 1 GΩ standard resistor value as A (average of six readings).

(4) Subtract value A from calibration test report value for 1 GΩ standard resistor. Record algebraic difference as B.

(5) Substitute the 1 GΩ standard resistor with TI MIS-10412-3.

(6) Measure and record TI resistance (average of six readings) as C.

(7) Find D (actual value of TI), using the following formula:

D = C + B
Where:
D = actual value of TI
C = measured value of TI
B = algebraic difference between test report value of standard resistor and value measured by teraohmmeter
Example:
C = 1.002 GΩ
B = (-.001 GΩ)
D = 1.002 + (-.001)
D = 1.001 GΩ

(8) Record computed D value on test report prepared, using sample shown in figure 3.

(9) Set teraohmmeter **TEST VOLTS** switch to **500** and repeat (3) through (8) above.

(10) Repeat technique of (1) through (9) above for TI MIS-10412-4.

b. Adjustments. No adjustments can be made.

14. Calibration Test Report. A calibration test report is required for these TI's. The purpose of the test report is to allow utilization of:

a. Instruments whose value has drifted outside manufacturer's specifications when referenced to nominal values, yet the drift rate is sufficiently low to allow use within manufacturer's specified accuracy of the previous test report value.

b. Instruments that have values and stability better than the manufacturer's specifications and may be utilized at greater accuracies when test report values are used.

The performance specifications will be ascertained by referencing present measured values to previous measured values in lieu of present to nominal values. If present measured values are not within manufacturer's accuracy specification of last measured value, the TI must be red-tagged. Calibration activities will maintain a case history file of test reports for the TI. The file will contain an accumulation of at least six of the most recent test reports. If in four successive calibrations the measured value drifts from the nominal value as much as three times the manufacturer's accuracy specification, the instrument must be red-tagged. An example of calibration data to be annotated on the test report is shown on the sample test report.

15. Final Procedure

a. Deenergize and disconnect all equipment.

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

CALIBRATION TEST REPORT FOR COMPARISON RESISTOR SET

(**ORGANIZATION**)_____

REPORT OF CALIBRATION FOR

COMPARISON RESISTOR SET

_____
(NOMENCLATURE)

_____
(MANUFACTURER)

_____
(IDENTIFICATION)

(MODEL AND SERIAL NO.)

SUBMITTED BY

(ACTIVITY _____
AND _____
UIC) _____

CALIBRATION MEASUREMENT VALUES

MODEL	SERIAL NUMBER	NOMINAL VALUE (MEGOHMS)	MEASURED VALUE (MEGOHMS)		LIMIT OF ERROR (%)
			50V	500V	
					± 1
					± 1
					± 3
					± 3
					± 3

THIS CALIBRATION IS TRACEABLE TO AND COMPATIBLE WITH NATIONAL BUREAU OF STANDARDS MEASUREMENTS.

CALIBRATION REPORT NO:_____
TEMPERATURE:_____ _____
REL HUMIDITY:_____ CALIBRATING TECHNICIAN
PAGE 1 OF 1 PAGES
DATE:_____ _____
FACILITY CHIEF

Figure 3. Sample test report.

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

0726902

Distribution:

To be distributed in accordance with STD IDS No. RLC-1500, 2 January 2003, requirements for calibration procedure TB 9-6625-788-40.

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.