

TB 9-5975-219-24

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR MAINTENANCE SUPPORT DEVICE – INTERNAL COMBUSTION ENGINE APN 13608010

Headquarters, Department of the Army, Washington, DC
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Distribution Statement A: Approved for public release; distribution is unlimited.

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.

SECTION		Paragraph	Page
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	4
	Accessories required	5	4
III.	CALIBRATION PROCESS		
	Preliminary instructions	6	5
	Equipment setup.....	7	5
	Dc voltage	8	7
	Ac voltage	9	9
	Resistance.....	10	10
	Final procedure	11	11
IV.	ALIGNMENT PROCESS		
	Field calibration.....	12	11
	Final procedure	13	11

SECTION I IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Maintenance Support Device – Internal Combustion Engine APN 13608010. TM 9-6625-2301-14&P was 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. None.

b. Time and Technique. The time required for this calibration is approximately 1 hour, 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 applications that pertain to this calibration are in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications
Dc voltage	
Engine Oil Temp (k_m)	Range: ± 90 mV dc Accuracy: ± 2% FS
Coolant Temp (n_p)	Range: ± 90 mV dc Accuracy: ± 2% FS
Fuel Supply Pressure (u_v)	Range: ± 90 mV dc Accuracy: ± 2% FS
Turbo Pressure (w_x)	Range: ± 90 mV dc Accuracy: ± 2% FS
Air Box Pressure (y_z)	Range: ± 90 mV dc Accuracy: ± 2% FS
Air Cleaner Pressure (AA_AB)	Range: ± 90 mV dc Accuracy: ± 2% FS
Fuel Return Pressure (AC_AD)	Range: ± 90 mV dc Accuracy: ± 2% FS
TK Pressure (J2A_B)	Range: ± 90 mV dc Accuracy: ± 2% FS
TK Pressure (J3A_B)	Range: ± 90 mV dc Accuracy: ± 2% FS
Battery Current (X_Y)	Range: ± 90 mV dc Accuracy: ± 2% FS
Alt/Gen Volts (N_W)	Range: ± 32 V dc Accuracy: ± 1.5%FS

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Dc voltage - continued	
Alt/Gen Field Volts (O_M)	Range: ± 32 V dc Accuracy: $\pm 1.5\%$ FS
Fuel Solenoid (R_M)	Range: ± 32 V dc Accuracy: $\pm 1.5\%$ FS
Starter Solenoid (S_M)	Range: ± 32 V dc Accuracy: $\pm 1.5\%$ FS
Starter Volts (T_W)	Range: ± 32 V dc Accuracy: $\pm 1.5\%$ FS
Vehicle Specific (L_W)	Range: ± 32 V dc Accuracy: $\pm 1.5\%$ FS
Battery Volts (V_W)	Range: ± 32 V dc Accuracy: $\pm 1.5\%$ FS
TK DC Volts (J4A_B)	Range: ± 32 Vdc Accuracy: $\pm 1.5\%$ FS
Tach Indicator (D_g)	Range: ± 5 Vdc Accuracy: $\pm 2\%$ FS
Battery Neg. Cable Drop (M_W)	Range: ± 3.2 Vdc Accuracy: $\pm 2\%$ FS
TK Current (J2A_B)	Range: ± 3.2 V dc Accuracy: $\pm 2\%$ FS
TK Current (J3A_B)	Range: ± 3.2 V dc Accuracy: $\pm 2\%$ FS
Reference 12V (f_g) ¹	Range: $+12$ Vdc Accuracy: $\pm 2\%$ FS
10K TK Pressure (J2A_B)	Range: ± 333 mV dc Accuracy: $\pm 2\%$ FS
10K TK Pressure (J3A_B)	Range: ± 333 mV dc Accuracy: $\pm 2\%$ FS
Reference 15V (U_g) ²	Range: -15 V dc Accuracy: $\pm 2\%$ FS
Alt/Gen Neg. Cable Drop (W_P)	Range: ± 5 V dc Accuracy: $\pm 2\%$ FS
Ac voltage	
TK AC Volts (J4A_B)	Range: 21 Vac Accuracy: $\pm 6\%$ FS
Vehicle Specific ACV (L_W)	Range: 21 Vac Accuracy: $\pm 6\%$ FS
TK AC Current (J2A_B:)	Range: 2.1 Vac Accuracy: $\pm 6\%$ FS
TK AC Current (J3A_B:)	Range: 2.1 Vac Accuracy: $\pm 6\%$ FS
Alt. Output Current Sense (n_p)	Range: 2.1 Vac Accuracy: $\pm 6\%$ FS
Resistance	
DCA ID Resistance (h_j)	Range: 1500 Ω Accuracy: $\pm 5\%$ FS
TK ID Resistor (J2E_V)	Range: 1500 Ω Accuracy: $\pm 5\%$ FS
TK ID Resistor (J3E_V)	Range: 1500 Ω Accuracy: $\pm 5\%$ FS
TK Resistance (J4A_B)	Range: 5 k Ω Accuracy: $\pm 5\%$ FS

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Resistance - continued	
TK Resistance (J4A_B)	Range: 50 kΩ Accuracy: ± 5% FS
TK Resistance (J4A_B)	Range: 100 kΩ Accuracy: ±5% FS

¹To prevent damage to ICE or test equipment, do not go above 12 Vdc or below 0 Vdc.

²To prevent damage to ICE or test equipment, do not go above 0 Vdc or below -15 Vdc.

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; AN/GSM 287; or AN/GMS 705. Alternate items may be used by the calibrating activity. The item 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 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: Acceptance Test Equipment (ATE) PN# 13625170, Instrument controller or any computer with a standard serial port.

Table 2. Minimum Specifications of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
CALIBRATOR	Range: ± 32 V dc Accuracy: ±0.5% Range: 21 V ac Accuracy: ±1.5% Frequency: 1000 Hz	Fluke, Model 5720A (p/o MIS-35947)
MULTIMETER	Range: ± 45 V dc Accuracy: ±0.25% Range: 21 V ac Accuracy: ±1.125% Range: 2 kΩ to 1 MΩ Accuracy: ±0.125%	Fluke, Model 8840A/AF05 (AN/GSM-64D)
RESISTANCE STANDARD	Range: 0 to 100 kΩ Accuracy: ± 1.25%	Biddle-Gray, Model 71-631 (7910328)

SECTION III CALIBRATION PROCESS

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.

e. Unless otherwise specified, on screen controls will be accessed by using the trackball controls to move the arrow over the icon, virtual instrument controls, etc., and clicking the left button.

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.

NOTE

Field-Calibration in Section IV should be performed if TI fails any parameter.

a. Connect TI connectors to ATE connectors as listed in (1) through (5) below:

(1) TI **J1** to ATE **J1 DCA**.

(2) TI **J2** to ATE **J2 TK**.

(3) TI **J3** to ATE **J3**.

(4) TI **J5** and TI **J6** to ATE **J6 ICE Box**.

(5) TI **J4** to ATE **J4 Probe A** and **B** using probe cable (1358045). (Red probe to **A** and black probe to **B**.)

b. Connect ATE **INSTRUMENT CONTROLLER** connector to Instrument controller COM1 serial port and ATE **J6 ICE BOX COMM3** connector to TI serial connector.

c. Insure that the **PROGRAMMING ON/OFF** switch located on the side of the ATE is set to **OFF**.

d. Start Hyper Terminal with settings 19200 bits per second, 8 data bits, none parity, 1 stop bit, and none flow control as shown in (1) through (8) below.

(1) Click on the Windows **Start** button on the Instrument controller.

(2) Select **All Programs**.

(3) Select **Accessories**.

(4) Select **Communications**.

(5) Click on **Hyperterminal**.

(6) On the Connection Description window type **MSDICE** in the **Name:** field and click on the **OK** button.

(7) On the **Connect To** window, ensure that **COM1** is selected in the **Connect using:** field, and click on the **OK** button.

(8) On the COM1 Properties window make the following entries in the appropriate fields as listed in (a) through (f) below:

(a) Bits per second: 19200.

(b) Data bits: 8.

(c) Parity: None.

(d) Stop Bits: 1.

(e) Flow control: None.

(f) Click on the OK button.

e. Turn on Power switch on TI.

f. Connect ATE to 115 V ac power source and turn ATE POWER switch (rear panel) to on.

NOTE

It will take about 45 to 50 seconds for the unit to boot up. At that time, the red LED on the side of the Ice box will stop flashing and shortly after that a menu will appear in Hyper Terminal on the laptop.

g. The Hyper Terminal will display:

A: Serial Ice Box

B: Wireless Ice Box

h. Type **A** on the controller keyboard.

i. The Menu will appear as follows:

Serial Ice Menu

X: Auto Alignment, Auto References

Y: Auto Alignment, Manual References

Snn: External Verify, continuous, pin-pair nn

Znn: Present Stem nn

H: Test Controller Card
I: Test I/O Card
J: Test Power Supply Card
N: NATO Power Test
L: J4AB Probe Test
U: Unit Verify
A: J7 & DCA Reverse Diode Test
E: NATO Reverse Diode Test
K: W1 (DCA)Cable Loopback Test
F: W4 (TK) Cable Loopback Test
O: ICE S06 Serial Cable Test
R: Reset Power Supply Trip
T: ICE Frequency, +12V, and -15V Test
?: Display this menu
[: Return to Previous Menu

8. Dc Voltage

a. Performance Check

NOTE

It takes a couple seconds for the readings to be displayed after entering the HyperTerminal commands.

- (1) Connect calibrator **HI** and **LO** terminals to the ATE **SINGLE POINT + and -** banana connectors located on the side of the ATE.
- (2) Disconnect the calibrator **V-GUARD/GROUND** shorting strap.

NOTE

When entering the TI hyper-terminal range setting commands do not press **ENTER** until instructed. Enter terminates the command.

- (3) Select the HyperTerminal window and at the ? prompt enter **S00** on the instrument controller keyboard (do not press enter).
- (4) Set calibrator output to the first values listed in table 3. If TI indications are not within the limits in table 3, perform **b** below.
- (5) Set the calibrator output to standby.
- (6) Select the HyperTerminal window and press the instrument controller keyboard Enter key.
- (7) Repeat technique of (3) through (6) above for remaining TI hyper-terminal range setting commands and calibrator output settings in table 3.

Table 3. Dc Voltage

Test description (pin numbers)	Test instrument hyper-terminal range setting command	Calibrator output settings (V)		Hyper-terminal Test instrument indications (V)	
				Min	Max
Engine Oil Temp (k_m)	S00	90	m	0.08820	0.09180
-----	-----	-90	m	-0.09180	-0.08820
Coolant Temp (n-p)	S01	90	m	0.08820	0.09180
-----	-----	-90	m	-0.09180	-0.08820
Fuel Supply Pressure (u_v)	S02	90	m	0.08820	0.09180
-----	-----	-90	m	-0.09180	-0.08820
Turbo Pressure (w_x)	S03	90	m	0.08820	0.09180
-----	-----	-90	m	-0.09180	-0.08820
Air Box Pressure (y_z)	S04	90	m	0.08820	0.09180
-----	-----	-90	m	-0.09180	-0.08820
Air Cleaner Pressure (AA_AB)	S05	90	m	0.08820	0.09180
-----	-----	-90	m	-0.09180	-0.08820
Fuel Return Pressure (AC_AD)	S06	90	m	0.08820	0.09180
-----	-----	-90	m	-0.09180	-0.08820
TK Pressure (J2A_B)	S07	90	m	0.08820	0.09180
-----	-----	-90	m	-0.09180	-0.08820
TK Pressure (J3A_B)	S08	90	m	0.08820	0.09180
-----	-----	-90	m	-0.09180	-0.08820
Battery Current (X_Y)	S09	90	m	0.08820	0.09180
-----	-----	-90	m	-0.09180	-0.08820
Alt/Gen Volts (N_W)	S10	32		31.52	32.48
-----	-----	-32		-32.48	-31.52
AltGen Field Volts (O_M)	S11	32		31.52	32.48
-----	-----	-32		-32.48	-31.52
Fuel Solenoid (R_M)	S12	32		31.52	32.48
-----	-----	-32		-32.48	-31.52
Starter Solenoid (S_M)	S13	32		31.52	32.48
-----	-----	-32		-32.48	-31.52
Starter Volts (T_W)	S14	32		31.52	32.48
-----	-----	-32		-32.48	-31.52
Vehicle Specific (L_W)	S15	32		31.52	32.48
-----	-----	-32		-32.48	-31.52
Battery Volts (V_W)	S16	32		31.52	32.48
-----	-----	-32		-32.48	-31.52

Table 3. Dc Voltage - Continued

Test description (pin numbers)	Test instrument hyper-terminal range setting command	Calibrator output settings (V)	Hyper-terminal Test instrument indications (V)	
			Min	Max
TK DC Volts (J4A_B)	S17	32	31.52	32.48
-----	-----	-32	-32.48	-31.52
Tach Indicator (D_g)	S21	5	4.9	5.1
-----	-----	-5	-5.1	-4.9
Battery Neg. Cable Drop (M_W)	S22	5	4.9	5.1
-----	-----	-5	-5.1	-4.9
TK Current (J2A_B)	S23	3.2	3.136	3.264
-----	-----	-3.2	-3.264	-3.136
TK Current (J3A_B)	S24	3.2	3.136	3.264
-----	-----	-3.2	-3.264	-3.136
Reference 12V (f_g)	S25	11	10.76	11.24
10 TK Pressure (J2A_B)	S27	333 m	0.32634	0.33966
-----	-----	-333 m	-0.33966	-0.32634
10 TK Pressure (J3A_B)	S28	333 m	0.32634	0.33966
-----	-----	-333 m	-0.33966	-0.32634
Reference 15V (U_g)	S29	-14	-14.3	-13.7
Alt/Gen (W-P)	S30	5	4.9	5.1
-----	-----	-5	-5.1	-4.9

(8) Set calibrator to standby.

b. Adjustments. Field-Calibration in Section IV should be performed if TI fails any parameter.

9. Ac Voltage

a. Performance Check

(1) Select the HyperTerminal window and at the ? prompt enter **S32** on the instrument controller keyboard (do not press enter).

(2) Set calibrator output to 60 Hz, the first values listed in table 4. If TI indications are not within the limits in table 4, perform **b** below.

(3) Set the calibrator output to standby.

(4) Select the HyperTerminal window and press the instrument controller keyboard Enter key.

(5) Repeat technique of (1) through (4) above for remaining TI hyper-terminal range setting commands and calibrator output settings in table 4.

Table 4. AC Voltage

Test description (pin numbers)	Test instrument hyper-terminal range setting command	Calibrator output settings (Vac)	Hyper-terminal Test instrument indications (V)	
			Min	Max
TK AC Volts (J4A_B)	S32	21	19.74	22.26
Vehicle Specific ACV (L_W)	S33	21	19.74	22.26
TK AC Current (J2A_B)	S34	2.1	1.974	2.226
TK AC Current (J3A_B)	S35	2.1	1.974	2.226
Alt. Output Current Sense (n_p)	S36	2.1	1.974	2.226

(6) Set calibrator to standby, and disconnect equipment setup.

b. Adjustments. Field-Calibration in Section IV should be performed if TI fails any parameter.

10. Resistance

a. Performance Check

(1) Select the HyperTerminal window and at the ? prompt enter **S18** on the instrument controller keyboard (do not press enter).

(2) Connect resistance standard **HIGH** and **LOW** connectors to the ATE **SINGLE POINT + and -** banana connectors located on the side of the ATE.

(3) Set resistance standard to the first values listed in table 5. If TI indications are not within the limits in table 5, perform **b** below.

(4) Repeat technique of (1) through (3) above for remaining settings in table 5.

Table 5. Resistance

Test description (pin numbers)	Test instrument hyper-terminal range setting command	Resistance standard settings (kΩ)	Hyper-terminal Test instrument indications (Ω)	
			Min	Max
DCA ID Resistance (h_j)	S18	1.5	1425	1575
TK ID Resistor (J2E_V)	S19	1.5	1425	1575
TK ID Resistor (J3E_V)	S20	1.5	1425	1575
TK Resistance (J4A_B)	S26	5	4750	5250
TK Resistance (J4A_B)	S31	50	47500	52500
TK Resistance (J4A_B)	S37	100	95000	10500

(5) Set calibrator to standby, and disconnect equipment setup.

b. Adjustments. Field-Calibration in Section IV should be performed if TI fails any parameter.

11. Final Procedure

- a. Deenergize and disconnect all equipment.
- b. Annotate and affix DA label/form in accordance with TB 750-25.

SECTION IV ALIGNMENT PROCESS

12. Field-Calibration

NOTE

Field-calibration should be performed only if TI fails any parameter in the performance verification. The entire Field-Calibration should be documented as a reportable adjustment.

a. Insure that the TI is connected to the calibrator and instrument controller as described in paragraph **7 a** through **7 f**.

b. Connect multimeter **HI** and **LO** terminals to the ATE **SINGLE POINT + and -** banana connectors located on the side of the ATE calibrator.

c. Select the HyperTerminal window and at the **?** prompt enter **Y** on the instrument controller keyboard do not press enter until you have completed instruction on the HyperTerminal window.

d. Press Enter and follow the instruction displayed on the instrument controller HyperTerminal window.

NOTE

Enter the multimeter displayed values carefully. Enter all values in base units of volts or ohms. 100 mV would be entered as .100. Enter AC and DC voltage to a 1 mV resolution, and resistance to a 1 ohm resolution minimum.

e. Press instrument controller keyboard **Enter** key and the program will send back an R for read.

f. When alignment and verification are complete repeat paragraphs **7** through **13** to verify proper calibration.

13. Final Procedure

- a. Deenergize and disconnect all equipment.
- b. Annotate and affix DA label/form in accordance with TB 750-25.

By Order of the Secretary of the Army:

Official:



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

0812109

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

Distribution:

To be distributed in accordance with the initial distribution number (IDN) 344919 requirements for calibration procedure TB 9-5975-219-24.

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.

