

Troubleshooting for Military Standard Instrument Cluster Gauges

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Included here is most of Army TB 9-2300-228-20 Tactical Transport and Combat Vehicles: Troubleshooting for Instrument Cluster Gages, Switches, Circuit Breakers, Sending Units and Related Wiring dated 8 July 1960. The title seems a bit optimistic for the amount of information included. I also included a chart, at the end, showing actual resistance values I measured on operational components. If you have any comments, problems, or additional information please E-mail me. [Click here for contact information.](#)

Thanks Bob W.

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1. Purpose and Scope. This bulletin provides organizational maintenance personnel with proper instructions for troubleshooting defective ammeters, battery indicators, fuel gages, oil pressure gages, temperature gages, sending units, and related electrical wiring. These instructions will supplement data contained in pertinent technical manuals.

2. Procedure. When any of the instrument gages, switches, circuit breakers, sending units, or related electrical wiring becomes inoperative, troubleshooting will be accomplished, as prescribed herein, to isolate the defective component or circuit.

3. Ammeter.

- a. Check vehicle battery voltage. Charge or replace battery if voltage is not as prescribed in pertinent technical manual.
- b. Check position of ammeter indicator hand, with all switches off. Ammeter indicator hand should indicate ZERO position of ammeter dial.
- c. Turn headlights and any other accessories ON. Ammeter indicator hand should move to the left (discharge) side of ammeter dial.
- d. Turn headlights and accessories OFF.

e. Turn ignition switch ON. Start and run engine at approximately 1,200 rpm. Ammeter indicator hand should move to the right (charge) side of ammeter dial.

f. If ammeter does not conform to reading outlined above, proceed as follows:

(1). Check generating system for amperage and voltage output, as listed in vehicle technical manuals. Adjust or replace components as necessary as prescribed in pertinent technical manuals.

(2) Disconnect either wire from ammeter and connect it to the positive lead of a voltmeter and ground the negative lead of voltmeter. Voltmeter should indicate battery voltage.

(3) Disconnect wire from voltmeter and connect it to ammeter.

(4) Disconnect the other wire from ammeter and perform the same test. If either or both wires do not indicate battery voltage, repair or replace voltage regulator or ammeter lead as necessary. **Caution: The circuit from the voltage regulator to the ammeter is not protected by a circuit breaker. Therefore, when removing wires from ammeter do not allow them to contact vehicle ground as damage to the wires will occur.** If ammeter does not conform to readings indicated above at conclusion of tests, replace ammeter as prescribed in pertinent technical manual.

4. Battery Indicator

a. Check vehicle battery voltage. Charge or replace battery if voltage is not as prescribed in pertinent technical manual.

b. With ignition switch OFF battery indicator should bear to extreme left side of dial.

c. With ignition switch ON battery indicator should move to the yellow portion of the dial.

d. Start and run engine at approximately 1200 rpm or higher, battery indicator needle should move to the green portion of the dial.

e. If battery indicator does not conform to reading outlined above, proceed as follows:

(1) Turn ignition switch OFF.

(2) Disconnect wire at battery indicator and connect it to the positive lead of a voltmeter. With the negative lead of the voltmeter grounded and the ignition switch ON, voltmeter should indicate battery voltage.

(3) Start and run engine at high revolutions per minute, voltmeter should indicate generator voltage charge as specified in vehicle technical manual.

(4) If voltmeter does not indicate generator voltage charge as specified in vehicle technical manual, adjust or replace components of the

generating system, as necessary, as prescribed in pertinent technical manual.

(5) If voltmeter indicates generator voltage charge as specified in the vehicle technical manual and battery indicator does not conform to test in *a* through *d* above, replace battery indicator as prescribed in pertinent technical manual.

5. Gages and Related Wiring

- a. Check vehicle battery voltage. Charge or replace battery if voltage is not as prescribed in pertinent technical manual.
- b. Check battery cables and terminals for good condition. Repair or replace battery cables and terminals, as required. Be sure that they are properly secured.
- c. Disconnect wire from ignition switch to gage being tested at gage, and connect wire to positive lead of voltmeter.
- d. With ignition switch ON, ground negative lead of voltmeter (B, fig 1) to vehicle ground, voltmeter should indicate battery voltage. *Note.* If lower or zero reading is indicated, check circuit for loose or broken connections. Repair as required.
- e. Remove voltmeters negative lead from vehicle ground and connect to case of gage (C, fig. 1), voltmeter should indicate battery voltage. *Note.* This check is important. If case of gage is not properly grounded, gage will not operate.
- f. Turn ignition switch OFF.
- g. Disconnect voltmeter positive lead from ignition switch-to-gage wire and connect wire to gage.
- h. Disconnect wire from gage to sending unit at gage.
- i. Connect suitable jumper wire to sending unit side of gage.
- j. Turn ignition switch ON.
- k. With jumper wire grounded to vehicle (D, fig. 1), the gages should indicate the following:

Temperature gage	Maximum temperature
Oil pressure gage	Zero pressure
Fuel gage	Empty

- l. Remove jumper wire from ground (E, fig. 1), the gages should indicate the following:

Temperature gage	Zero temperature
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Oil pressure gage

Maximum pressure

Fuel gage

Full

Note: If gage does not conform to reading outlined in k and l above, replace gage in accordance with pertinent technical manual. If gage readings conform with this test, proceed with steps m through r below.

m. Turn ignition switch OFF.

n. Remove jumper wire from gage and connect wire from sending unit to gage.

o. Disconnect wire from sending unit to gage at sending unit.

p. Turn ignition ON.

q. Ground wire removed from sending unit (F, fig. 1), the gage should indicate the following:

Temperature gage

Maximum temperature

Oil pressure gage

Zero pressure

Fuel gage

Empty

If gage does not conform to reading outlined above, repair or replace wire from gage to sending unit.

r. Turn ignition switch OFF. Connect wire from gage to sending unit.

Note: Electrical gages indicate an approximate reading, for accurate readings, it is recommended using master gages connected to vehicle.

6. Sending Units.

a. To test function of sending units, an ohmmeter with 0- to 7,000-ohm range is recommended. The following procedure applies to any sending unit being tested.

b. Disconnect wire from gage to sending unit at sending unit.

*c. Connect positive lead of ohmmeter to sending unit and negative lead of ohmmeter to vehicle ground. (G, fig. 1). **Caution: Do not connect ohmmeter to ignition circuit and turn ignition switch ON as ohmmeter will be damaged.***

(1)Temperature gage sending unit.

(a) If ohmmeter indicates a zero reading when engine is cold, replace sending unit. Sending unit should indicate high resistance.

(b) Start engine, ohmmeter will indicate a lower reading as engine is warming up.

(c) Stop engine, ohmmeter will indicate a high reading as engine is cooling.

(d) Replace sending unit if readings are not as indicated in b and c above.

(2) Oil pressure gage sending unit.

(a) The ohmmeter should indicate 0 to 1 ohm reading with engine stopped, if ohmmeter does not indicate this reading or excess 1 ohm, replace sending unit.

(b) Start engine, ohmmeter should indicate a higher reading, if a higher reading is not indicated, replace sending unit.

(3) Fuel gage sending unit.

(a) Check ground between fuel tank and vehicle with an ohmmeter, zero reading should be obtained. If the fuel tank is not grounded to the vehicle, the sending unit will not operate.

(b) The ohmmeter should indicate a reading between zero and 40 ohms, depending on the amount of fuel in the tank. If the ohmmeter indicates a reading higher than 40 ohms replace the sending unit.

(c) The ohmmeter should indicate a higher reading as fuel tank is filled and a lower reading as the fuel is withdrawn. If the sending unit does not conform to this test, replace the sending unit.

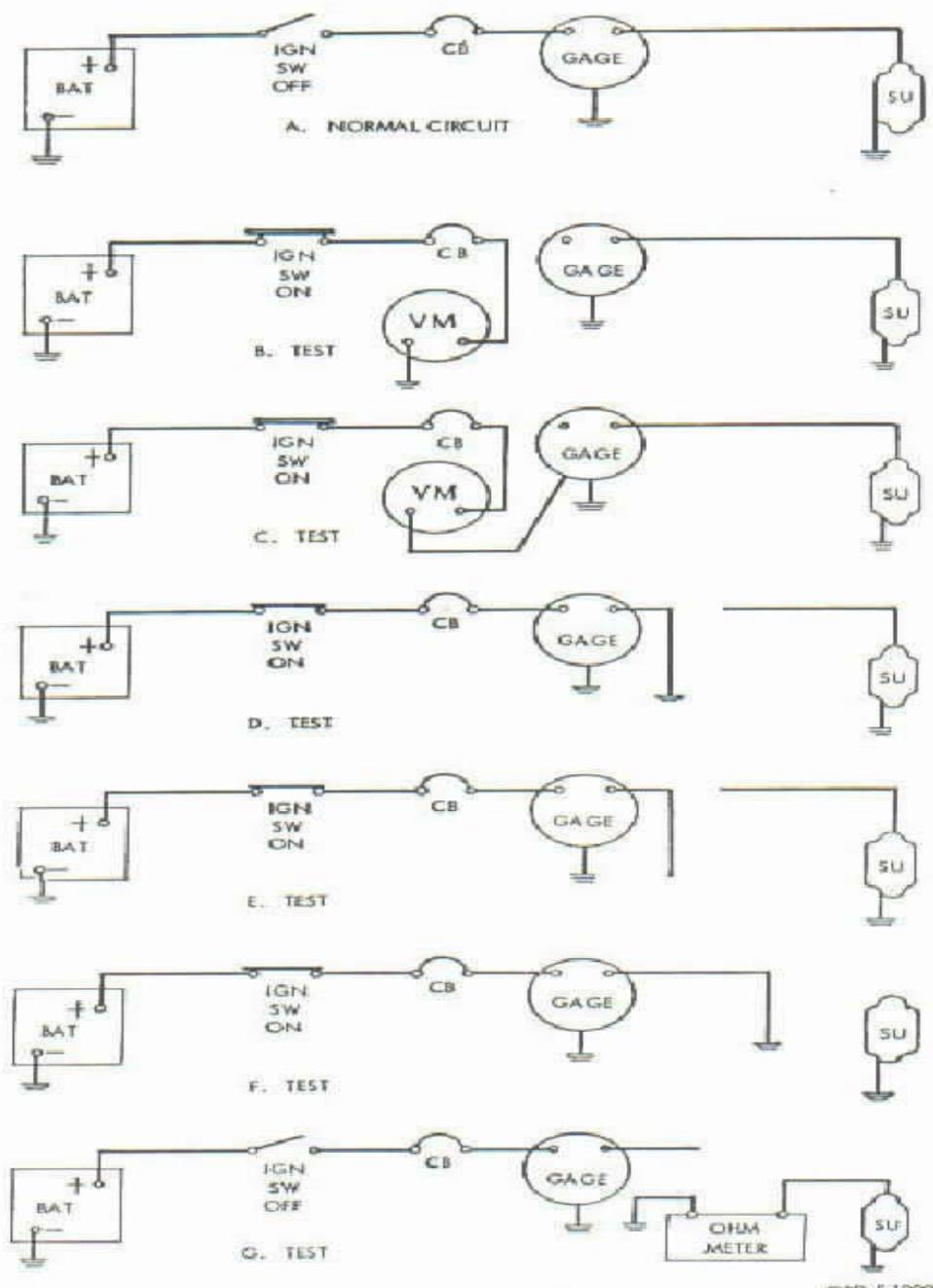
(d) To test inaccessible sending units and electrical wire from gage to sending unit, omit procedure in b and c above and proceed as follows:

1 Disconnect wire from gage to sending unit at gage.

2 Connect positive lead of ohmmeter to wire from sending unit and ohmmeter negative lead to vehicle ground.

3 Follow procedures outlined in c(1) through (3) above for sending unit being tested.

(e) Defective sending units will be replaced as prescribed in pertinent technical manuals.



Test diagram symbols
 BAT—Battery VM—Voltmeter
 IGN—Ignition SU—Sending unit
 SW—Switch CB—Circuit breaker

ORD E 1000

Figure 1. Electrical testing diagram.

Chart of resistance checks done on operational components. All resistance checks are done with the component out of the circuit.

Temperature Sending Unit - resistance to yield corresponding gauge readings	2000 ohms = 120F 900 ohms = 180F 450 ohms = 220F 300 ohms = 260F
Fuel Level Sending Unit - resistance to yield corresponding gauge readings	30 ohms = Full 15 ohms = Half 0 ohms = Empty
Oil Pressure Sending Unit (120 psi gauge) - resistance to yield corresponding gauge readings	0 ohms = 0psi 12 ohms = 30psi 30 ohms = 60psi 50 ohms = 90psi 90 ohms = 120psi Divide psi readings by 2 for 60 psi gauges