

ENGINE GAUGES (Fuel, Pressure, & Temperature Instruments):

Basic Theory of Operation:

There are two basic types of Engine Instrument Gauges:

- a. The VOLTMETER, which requires an outside Voltage Source. This is the most common type Engine Gauge used on boats.
- b. The AMMETER, which does NOT require external power.

The standard Voltmeter type Gauge receives its reference voltage from a Sender unit, mounted on the Engine. The Sender is a device, whose resistance varies with changes in Level, Pressure, or Temperature. As the sender resistance increases, the reference voltage transmitted to the Gauge decreases.

Temperature Senders are often Bi-Metallic Thermo-Couple devices, whose resistance decreases as Temperature rises; resulting in a higher reference voltage at the gauge. Other Senders (Level, Pressure, Vacuum, etc.) employ differing methods of varying their resistance (ie: Varistors) in response to the measured stimuli.

Alarm Switches are "On-Off" devices, either Normally-Open or Normally-Closed; which switch 'On' or 'Off' in response to a pre-set condition. Switches are utilized to operate Warning Lights and/or Buzzers.

All Resistance values noted are for Single Station Senders.

Dual Station Senders, operating two Gauges, will have One-Half the Resistance values noted below.

If one Gauge (of a Dual Station Pair) fails, the Other Gauge will read much Higher than expected.

Pipe Extensions, Tees, etc., utilized to connect both a Gauge Sender & a Warning Light/Buzzer Switch to the same Engine Block Port are NOT recommended. Sender values could read Cooler or Lower Pressure than exists, and the added weight & moment could cause fatigue failures.

Basic Troubleshooting of Gauges:

All Gauges:

1. Remove Sender Wire from "S" Terminal on Gauge, and Turn ON Instruments Circuit.

2. Test Voltage between "I" Terminal (External Power Supply) and Ground Terminal "G".

Tested voltage must match nominal voltage of the Gauge (ie: 12V Gauge must test between 10 - 16VDC), and the Battery Voltage.

If no voltage - check Ignition or Instrument Switch(s) and/or Fuses.

If tests less than battery voltage, repair or replace (Violet) wire from Ignition or Instrument Switch.

If a Sender fails "Open" (Infinite Resistance), one or both (if Dual Station) Gauges will read Zero Scale.

If a Sender Fails "Closed" (shorted - Zero Resistance), one or both Gauges will read Full Scale.

Other confusing Ohmmeter results, such as readings lower than expected, could indicate a poor Ground Connection at the Sender Body (Sender to Engine Block). Check for pipe dope or tape on Sender Threads.

Temperature Gauges:

1. Disconnect Tan Sender Wire from Gauge (Terminal "S") and turn Instrument Power ON.

The Temperature Gauge should indicate ZERO Scale (< Low Temperature).

2. Short the Gauge Sender Terminal "S" to Ground Terminal "G".

The Gauge should deflect to FULL Scale (> High Temperature).

3. Measure Resistance from Tan Sender Wire (disconnected from Gauge) to Ground.

American Temp. Senders will read: 450 Ohms (Engine Cold @ 1000F)

or 29.6 Ohms (Engine Hot @ 2500F)

European Temp. Senders will read: 281 Ohms (Cold @ 400C) and 22 Ohms (Hot @ 1200C)

4. Disconnect Tan Wire from Sender on Engine Block.

5. Test continuity of Tan Wire.

Zero Ohms from Block End to Gauge End - If not, repair or replace Wire.

6. Measure Resistance from Sender Terminal (on Block) to Ground on Block.

Should read as per (3) above - If not, replace Sender.

Pressure Gauges:

1. Disconnect Dark Blue Sender Wire from Gauge, and turn power ON.

The Pressure Gauge should read ZERO Scale (Low Pressure).

2. Short the Gauge Sender Terminal to Ground.

The Gauge should deflect to FULL Scale (>High Pressure).

3. Measure Resistance from Dark Blue Sender Wire to Ground.

American Press. Sender: 240 Ohms (Zero Pressure) 33.5 Ohms (Full Pressure @ 80 psi)

European Press. Sender: 10 Ohms (Zero Press.) & 180 Ohms (Full Press. @ 150 Bar)

See 4, 5, & 6 above (but Dk. Blue Wire)

Fuel Gauges:

1. Disconnect Pink Sender Wire from Gauge, and turn power ON.

The Fuel Gauge should read ZERO Scale (< Empty)

2. Short the Gauge Sender Terminal to Ground.

The Gauge should read FULL Scale (> Full).

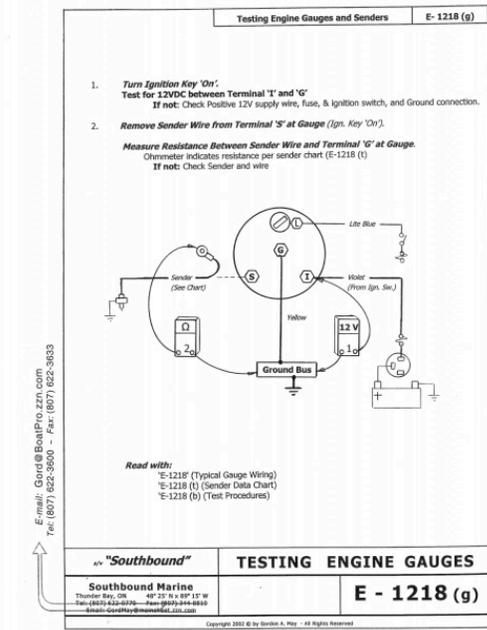
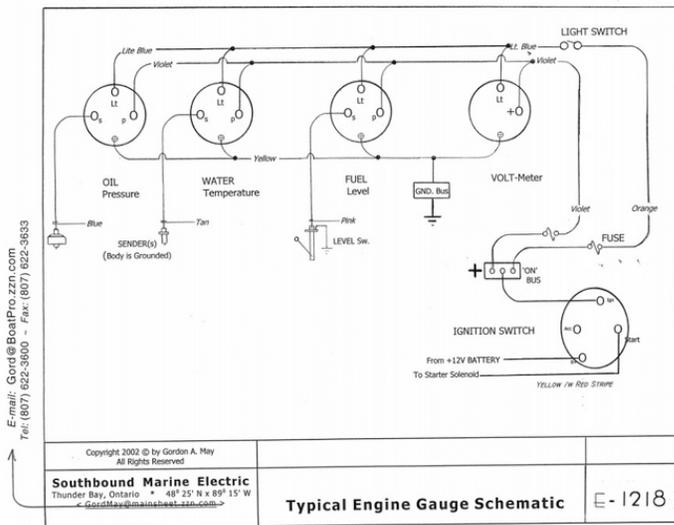
3. Measure resistance of Pink Sender Wire to Ground.

American Floats: 240 Ohms (Empty), 103 Ohms (½ Full), & 33 Ohms (Full)

European Floats: 10 Ohms (Empty), 95 Ohms (Half), & 180 Ohms (Full)

Automotive & other Float Switches may use other resistances such as 0 - 90 Ohm, 73 - 10 Ohm, & etc.

See 4, 5, & 6 above (but Pink Wire)



E-1218 (t)

American Gauges - U.S.A. - Sender Resistance Values

| GAUGE TYPE | LOW ↘ | | MID ↑ | | HIGH ↗ | |
|---|--------|-------|---------|-------|---------|--------|
| | Value | Ω | Value | Ω | Value | Ω |
| Oil Pressure Dark Blue - Disconnected ↗ | 0 PSI | 240 Ω | 40 PSI | 103 Ω | 80 PSI | 33.5 Ω |
| Oil Pressure Dark Blue - Disconnected ↗ | 0 PSI | 1 Ω | 200 PSI | 44 Ω | 400 PSI | 88 Ω |
| Water Temperature Tan - Disconnected ↗ | 100° F | 450 Ω | 175° F | 99 Ω | 250° F | 29.6 Ω |
| Water Temperature Tan - Disconnected ↗ | 40° C | 450 Ω | 65° C | 99 Ω | 65° C | 29.6 Ω |
| Fuel Level Pink - Disconnected ↘ | Empty | 240 Ω | Half | 103 Ω | Full | 33.5 Ω |

European Gauges - Int'l - Sender Resistance Values

| GAUGE TYPE | LOW ↘ | | MID ↑ | | HIGH ↗ | |
|---|-------|-------|--------|------|--------|-------|
| | Value | Ω | Value | Ω | Value | Ω |
| Oil Pressure Dark Blue - Disconnected ↗ | 0 PSI | 10 Ω | 40 PSI | 95 Ω | 80 PSI | 180 Ω |
| Water Temperature Tan - Disconnected ↗ | 40° C | 281 Ω | 80° C | 68 Ω | 120° C | 22 Ω |
| Fuel Level Pink - Disconnected ↘ | Empty | 10 Ω | Half | 95 Ω | Full | 180 Ω |

See Also Drawings: E-1218 and E-1218(b) and E-1218(g)

Typical Gauge Sender Data Table

| | | |
|---|--|------------|
| Southbound Marine Thunder Bay, ON 48° 25' N x 89° 15' W Tel: (807) 622-0770 • Fax: (807) 344-8810 Email: GordMay@mainstreet.zzn.com | Copyright 2002 © by Gordon A. May All Rights Reserved | E-1218 (t) |
|---|--|------------|