’63-’67 FUEL GAUGE DIAGNOSTICS

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One of the most common problems that drives midyear owners up the wall is fuel gauges that either don’t work at all or that are inaccurate or just plain show flaky readings that don’t relate in any way to the actual level of fuel in the tank.

There are plenty of sources of diagnostic information for all the other GM fuel gauge systems, but almost none for ’63-’67 Corvettes; the Shop Manual isn’t much help either – it says to get another known-good sending unit, plug it in, and see if that solves the problem. My “Tech Bench” column in the December, 2004 issue covered simple diagnostic procedures for C1 and C3 Corvette fuel gauge systems, including instructions on how to build a diagnostic tool for less than $5.00.

The “Standard” System: The C1/C3 cars used the simple “GM Standard” one-wire system that just has a tan wire from the gauge to the sending unit and a ground at each end of the circuit, and diagnosing problems with this system is quite simple. As background, here’s how the “GM Standard” fuel gauge system works (see diagram).

Dash Gauge: The dash fuel gauge has two coils in it – the limiting coil on the left, and the operating coil on the right, each with different resistance; the pivoting needle has a counterweight on it that holds the needle at “empty” unless magnetic attraction from the operating coil moves it. The limiting coil gets 12 volts from the ignition switch, and passes it to the operating coil, which is grounded through the gauge case.

Tank Sending Unit: The sending unit contains a wirewound variable resistor, and a contact wiper arm connected to the float rod and to ground; when the tank is empty, the wiper contact is at the beginning of the resistance, providing zero ohms to ground, and when the tank is full, the wiper contact is at the end of the resistance, providing 30 ohms (C1) or 90 ohms (C3) of resistance to ground.

How It Works: When the key is “on”, current is supplied to the limiting coil, and to the operating coil, through their common connection. From here, the current can go two ways – through the operating coil to ground, or through the tan wire to the variable resistor in the sending unit to ground.

When the tank is empty, the contact wiper in the sending unit cuts out the variable resistor entirely, so most of the current from the gauge will pass to the sending unit and directly to ground while very little current will pass through the operating coil in the gauge, causing the gauge to show “empty”.

When the tank is full, the contact wiper in the sending unit is at the other end of the variable resistor, placing more resistance between the tan wire and ground; this forces more current through the operating coil in the gauge to ground, which attracts the gauge needle and moves it to the “full” side of the gauge. This is a simple resistance circuit, dependent only on power to the gauge, variable resistance in the tank unit, and good grounds at both ends.

The Midyear System: However, the ’63-’67 Corvette had to be different (we don’t know why), and used a two-wire system with a powered sending unit and a Whetstone bridge voltage-divider circuit that fed 12 volts to the sending unit as well as to the dash gauge. This system was apparently something of an experiment, as it was only used on the ’63-’67 Corvette and some mid-60’s Cadillacs, and was never seen again – but, we have to deal with it.

Referring to the midyear diagram, you can see that the dash gauge has two coils with identical resistance, one of which is grounded to the case, they get current through a light green (1963), black/pink (’64-‘65) or pink (’66-’67) wire from the ignition switch, and there’s a brown or tan wire from the common coil connection that goes to the sending unit.

The added circuitry occurs at the tank sending unit – it not only has the brown or tan wire from the gauge, but it also gets current from the same ignition switch source through the gauge power wire, which feeds the 90-ohm variable resistance unit, which is grounded. The contact wiper attached to the float arm works against the variable resistor, but instead of being connected to ground, it feeds back to the gauge coils, creating a voltage-divider circuit with power on both sides instead of a single resistance-to-ground circuit. Operation of the float arm provides zero ohms of resistance at one extreme, and 90 ohms at the other extreme.

Sending Units: The accompanying photos show the sending unit out of the tank; the good folks at Corvette Central provided both an NOS AC sender (on loan from their vault ☺) and the Fargo Automotive reproduction sending unit they carry. Some of the other reproductions have a spotty reputation, but the Fargo unit appears very well-made and has hex-nut-secured sealed terminals at the baseplate just like the original Delco unit. I bench-tested both units, and the reproduction only showed slightly higher resistance at the “full” position, which would make it slightly optimistic at the ¾-full level and above; otherwise it read the same as the original AC sender.

Diagnostic Tools: Due to the powered voltage-divider circuit, diagnostics are a little more complicated than the C1/C3 resistance circuit, but are easily done at home with little more than a digital multimeter and a jumper wire. Every home mechanic should have a digital multimeter anyway for accurate diagnosis of

electrical issues, and they have become very reasonably priced; if you don't have one, get one – it's an essential tool.

We'll do a "quick-check" first to determine which end of the system is on the fritz, then a check of the entire system to isolate the nature of the problem.

Quick-Check: For the "quick-check", remove the (brown or tan) gauge wire from its "S" terminal on the sending unit, use a jumper wire to ground the connector, and turn the key on – the fuel gauge should peg to "Full"; then disconnect the light green (63), black/pink (64-65) or pink (66-67) power wire connector from the "I" terminal on the sender and use the jumper wire from the connector on the tan wire to the connector on the power wire, and the gauge should peg to "Empty". If this occurs, the problem is in the sending unit, not in the gauge; if your results are different, the problem is in the gauge or the wiring to the gauge.

Full System Check: The step-by-step full system check is as follows;

1. Check the dash gauge power terminal (light green-63, black/pink 64-65 or pink 66-67 wire) at the gauge connector to ground with the key on (with the multimeter set for "volts", not with a test light) to verify that you have 12 volts to the gauge.

2. Check the power wire connector terminal (light green-63, black/pink 64-65, or pink 66-67) at the sending unit to ground in the same manner with the key on to verify that you have 12 volts to the sending unit (this terminal is marked "I", for "ignition", on original sending units).

3. Same check as the "quick-check" outlined earlier.

4. Remove the black plastic ground connector from the spade on the sending unit and use the multimeter (set on "ohms") to check from that wire connector to a known good ground on the frame; you should show zero ohms (no resistance). If you don't, there's a problem in that ground circuit, which runs forward through the body harness and the multiple body connector above the driver's side kickpad where it connects to the instrument panel harness. That wire finally grounds through the black pigtail that that comes out of the 3-cavity radio connector and screws to the bottom of the dash cross-brace with a star washer to the left of the radio; this one point grounds EVERYTHING at the rear of the car, including the dome light, and grounds the cluster as well.

5. If everything checks OK to this point, it's time to check the sending unit. With the key "off", disconnect all three wires at the sender, and connect the multimeter (set on "ohms") to the two pin terminals on the sender (power and gauge terminals). Have a helper with small hands or a wooden stick with a hook in the end work the float up and down slowly in the tank,

and the multimeter should read zero ohms with the float all the way down (empty), and 90 ohms with the float all the way up (full), with a smooth, linear progression between the extremes. Now connect the multimeter to the gauge pin terminal (marked “S”, for “sender”, on original sending units) and to the ground spade, and repeat the float arm movement; you should see the reverse of the first test, with zero ohms with the float all the way up (full) and 90 ohms with the float all the way down (empty). This verifies that both sides of the voltage divider circuit are working properly. This same routine can be used to bench-check a sending unit before installing it in the tank.

Summary: The diagnostic process outlined above will isolate the problem either to the dash gauge, tank sending unit, or the wiring. Dash gauges can be either rebuilt by instrument specialists or replaced, and failed tank sending units generally aren’t repairable and must be replaced.

The GM AC-Delco sending unit is still available from your GM dealer under part number 6428065 and lists for a spendy $319.00, although you may be able to negotiate a discount; it’s also available from GMPartsDirect.com for $171.00 plus shipping. The Fargo Automotive reproduction sending unit is available from Corvette Central as their #362206 for $79.95, and CC also carries replacement dash gauges for $89.95.