Thermal Instrument System Operation and Fault Diagnosis Holden HQ & Torana LH

Following the introduction of the thermal fuel gauge system on Holden HQ during September 1973 production, it has been requested that the additional information be released to promote understanding of the new type instrument system and effective fault diagnosis.

Thermal Instrument system Application

Holden HQ Fuel Gauge systems only.

Breakpoints of introduction vehicle serial

Nos H290116, H785378, J398107, L252435.

Torana LH

Thermal instruments are used in the Fuel Gauge. Temperature and Oil pressure gauges and the volt meter from model inception.

Thermal Gauge Systems Operations

The instrument pointer is moved through its' operating range by deflection of a bi-metal lever, which is heated by a resistance winding. The bi-metal is fixed at one end and linked to the pointer at its' free end.

The bi-metal heater winding is connected in series with the sender unit for oil and temperature gauges and the fuel gauge tank unit for the fuel gauge system. Variations in oil pressure, temperature

or fuel level varies the resistance of the relevant sender unit. This results in current flow changes through the bi-metal winding, varying the heating effect and hence bi-metal deflection and pointer movement.

The bi-metal lever design is self compensating for ambient temperature changes.

To compensate for the normally occurring voltage fluctuations on vehicle electrical systems, the instruments are not directly connected to the vehicle system but fed from a voltage regulator.

The voltage regulator consists of a pair of points one of which one contact is fixed and the other contact fitted to a bi-metal lever. This bi-metal lever also carries a heater winding connected across the battery. After ignition switch-on, current flows through this winding heating the bi-metal lever which deflects and breaks the contact cooling the bi-metal lever and closing again. This cycling is continuous and varies its' frequency depending on the system voltage. The instruments are connected to the voltage regulator bi-metal and receive a pulsing current with an average voltage of approximately 5.5 volts.

Depending on the supplier the voltage regulator it may be built in or attached externally. On the HQ model each thermal fuel gauge carries a voltage regulator. On the LH Torana models each combined instrument assembly carries a voltage regulator to operate the fuel gauge, together with oil pressure and temperature gauges if these are fitted.

Thermal Gauge Characteristics

Thermal gauge reactions depend on the rate of heating and cooling of the bi-metal and are therefore, slow. When checking instruments a few minutes must be allowed for the instruments to stabilise. For fuel gauge checks, the vehicle must be level.

Slight vibrations help to stabilise gauge indication and light finger-tapping is permissible in stationary checks. Running the engine during system stabilisation can provide sufficient light vibration and ensure the system is near the 13.5volt calibration voltage.

Instrument Calibration

Fuel, oil pressure and temperature; These instruments are calibrated at 13.5 volt to achieve full scale deflection at 10 ohms sender resistance.

Empty or zero position is calibrated at 73 ohms sender resistance. Half deflection occurs at 25.5 ohms. For practical checks a fuel tank unit can be used as a sender for the subject gauges. Readings are taken from centre line of pointer to centre line of graduation. Tolerances vary between vehicle models but the following may be used with a tank unit.

Instrument Tolerances

Instrument Tolerances	Calibration Resistance	Tank Unit Tolerance
Empty Position +0.010, -0.080	**73 ohms**	**72-79 ohms**
Half position ±0.080	**25.5 ohms**	**23.5 – 27.5 ohms**
Full Position -0.010, +0.080	**10.0 ohms**	**9.0 - 11.0 ohms**

Common Problems

Fuel gauge system: Fuel gauge system complaints are the most frequent and the fault diagnosis technique for this system is described which is equally applicable to the oil pressure, temperature gauge.

Voltage Regulator Earth Connection Open Circuit

Operation of the thermal instruments with voltage regulator earth path interrupted even for a moment can cause immediate burn-out of the instrument pointer bi-metal winding due to the fact that the voltage regulator in this case simply does not operate, allowing continuous full voltage current through the instrument(s). Symptoms: Erratic operation, incorrect read out, pointer sticking.

Calibrations Complaints

Check instrument by connecting a slave tank unit to the instrument sender terminal with the body of the slave unit connected to a ground on the vehicle to complete the circuit. (Do not leave the vehicle hooked up in parallel.) Where an instrument is found defective, ensure that the instrument earth is in order. Check between the black lead and earth with an ohm meter or insert a volt meter between the pink and the black leads in the connector for the body and switch on the ignition. A test light may be used in place of a volt meter. A bright glowing lamp indicates a good circuit, a dim glow – poor earth, no light open circuit in the supply or earth path.

If the instrument is proved to be okay, connect an ohm meter between the tank sender lead and earth to check the tank unit; an empty tank should show a resistance of 72-79 ohms, a full tank should read 9-11 ohms. Tank units not conforming to either of these readings are unsatisfactory and should be replaced.

For salvage of incorrectly calibrated tank units refer to notes below.

When a fuel reads erratic or empty irrespective of the tank fill, check for intermittent or open circuit at the tank unit connection, the body wiring to instrument wiring connector and the instrument itself.

Fuel gauge reads full with less than full tank; Suspect short circuit in sender wire to tank unit. Check sender wire with ohm meter to earth after disconnecting the sender wire at the instrument and tank unit. Where a short circuit in the sender wire has been detected, the instrument should always be checked for calibration, since such a short circuit can cause the pointer bi-metal winding to overheat causing permanent instrument damage.

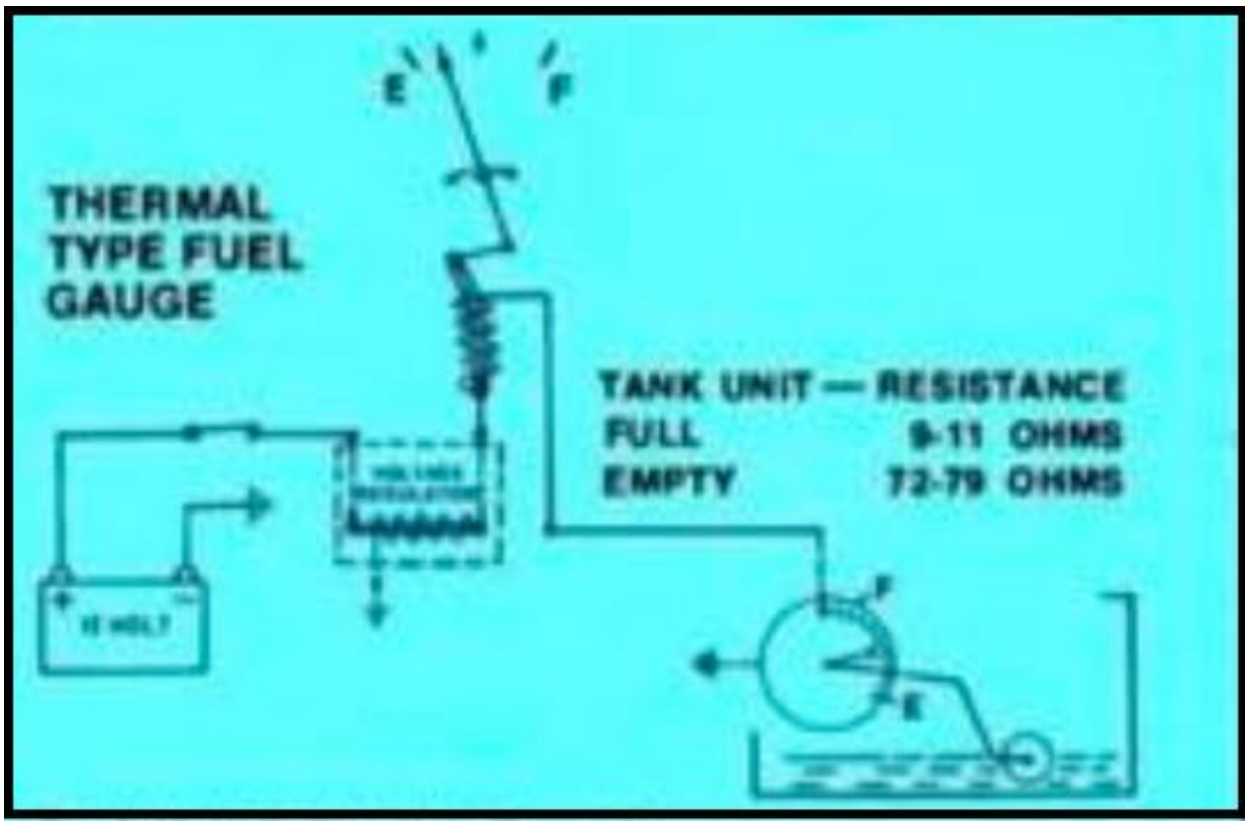
Volt Meter

The volt meter introduced with the thermal instruments on Torana LH works similarly to the instruments described. The winding in this instrument is however not fed via the voltage regulator but is designed to operate directly across the full system voltage indicating the average level.

This unit operates without a sender unit and should not present any difficulties in trouble diagnosis which would either directly relate to wiring connections or defective operation of the unit itself.

Volt Meter Calibration Tolerances

Volts	Pointer Reading	Tolerances at Pointer Tip
10.0	Low	±0.04
12.0	Quater	±0.05
13.4	Half	±0.05
14.7	Three-Quater	±0.05
16.0	High	±0.05



Tank Calibration Rework

Where the tank unit calibration is found to be incorrect, salvage may be attempted on units less than 2 ohms in error at the full position.

Units exceeding 2 ohms error at the full position are not considered to produce a satisfactory rework. An accurate ohm meter is essential.

Bending of the float arm must occur between the arm **pivot and the travel stops** on the resistor housing to change the resistance range.

This may be best achieved by gripping the float arm at the pivot point with a pair of pliers and with a second pair of pliers setting the float arm a little to achieve correct calibration. When reworking a unit originally having high resistance at the full position, it should be realised that the adjustment is effective over the whole operating range and the empty resistance must be watched to ensure this remains within specifications. A small change may well be tolerated in most cases; a substantial reduction could cause the undesirable complaint of vehicles running out of fuel while the gauge system indicates at or near empty. To prevent this, a second bending operation may be required to restore correct float arm geometry by bending the float arm between the float and the travel stops in a direction opposite to the bend made to achieve correct resistance. Measurement of the float position at full and empty relative to the float pivot point, before and after rework attempts, ensures correct geometry is maintained. After re-assembly of the tank unit to the fuel tank, ensure approximately 6 litres of fuel can be accommodated

without lifting the float. This can be checked by connecting the ohm meter to the tank unit; no change in resistance should have occurred when the reserve fuel has been added.

Repair or recalibration of instruments should not be attempted; defective units must be replaced.

HQ FUEL GAUGE IDENTIFICATION (DASH)			
TYPE	MAGNETIC	THERMAL	
EMPTY MARK CALIBRATION COLOURS	RED	WHITE	
STICKER COLOUR (ON BACK)	WHITE	RED	
DASH TYPE	PART NUMBER	PART NUMBER	NOTES
TYPE 1	2815749	9929574	FLEX DRIVE THERMAL 9929572
TYPE 2	2815204	9929573	
TYPE 3	9929575 9931611 with ADR 18	2815738 before ADR 18	
TYPE 4 (GTS)	2815736 before ADR 18 9931612 with ADR 18	9929576	
TYPE 5	2815749	9929574	FLEX DRIVE THERMAL 9929572
NEEDLE SWEEP 60° 90° 120°	90	60	* EVEN HOLDEN CONFUSED INFO ON THE NEEDLE SWEEP
Tank unit sticker colour	WHITE	RED	
OHM TEST	0 , OMHS EMPTY 30 OHMS FULL	73 OHMS EMPTY 10 OHMS FULL	
	SOMETIMES CALLED THERMO ELECTRIC OR ELECTRO MAGNETIC		RZR

This chart has been added as learnings can be applied to some of the listed vehicles.

Gauge Check List

Vehicle Model	FUEL			TEMP			OIL		
	Empty	Half	Full	Cold	Mid	Hot	Low	Mid	High
HOLDEN									
ASTRA LB-LC	110	97	3	282	—	40	—	—	—
BARINA	110	33	3	133	—	27	—	—	—
CAMIRA JB-JE	282	97	40	282	—	40	10	—	180
CAMIRA JD	282	97	40	282	—	40	130	54	26
FX-EH-HD-HR	0	15	30	24	—	179	10	—	193
GEMINI TF-TG	95	32	7	232	49	27	10	—	180
HQ (73/76)	190	25	10	315	—	22	10	—	190
HJ-HX-HZ	73	25	10	73	25	10	73	25	10
HK-HG-HT-HQ(9/73)	0	15	30	315	—	22	10	—	193
JACKAROO 7V	130	45	20	120	—	20	240	—	50
RODEO PETROL	1230	—	17	282	—	40	—	—	—
TORANA LC-LJ	0	15	30	315	—	18	10	—	193
TORANA LH-LX-S/B	73	25	10	73	25	10	73	25	10
TORANA UC	282	97	40	282	74	40	10	—	180
COMMODORE VB-VC-VH-VK-VL-VN	282	97	40	282	74	40	10	—	180
COMMODORE VN-VR V8	282	97	40	282	74	40	10	—	180
COMMODORE VP-VR-VS	282	97	40	282	74	40	—	—	—
COMMODORE VT-VX-VY	40	—	254	Can Bus	—	—	—	—	—
WB	282	97	40	282	74	40	10	—	193