SERVICE MANUAL SECTION

INSTRUMENTS — 1000 SERIES

Truck Model: 1000
Start Date: 02/08/2004

S082064

08/06/2004

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DESCRIPTION

INSTRUMENTS

GENERAL

Use this manual with Circuit Diagram Book CTS-5272 or S08209Y. or S08294.

All instruments (with the exception of the transmission temperature gauge) are located on the instrument panel in a removable instrument cluster (Figure 1). Controls, gauges and panel lights of the cluster are connected to the vehicle electrical system by two connectors on the back of the cluster. The speedometer, odometer, hourmeter, voltmeter, engine oil pressure, and engine coolant temperature gauges are microprocessor driven by information, on the data link, from the combined engine control module (ECM). The fuel gauge and the transmission temperature gauge (the transmission gauge is only used on the automatic transmission and is not located in the cluster) are directly driven by a sensor. Gauges and meters are free floating at power off and may not return to zero when electrical power is removed.

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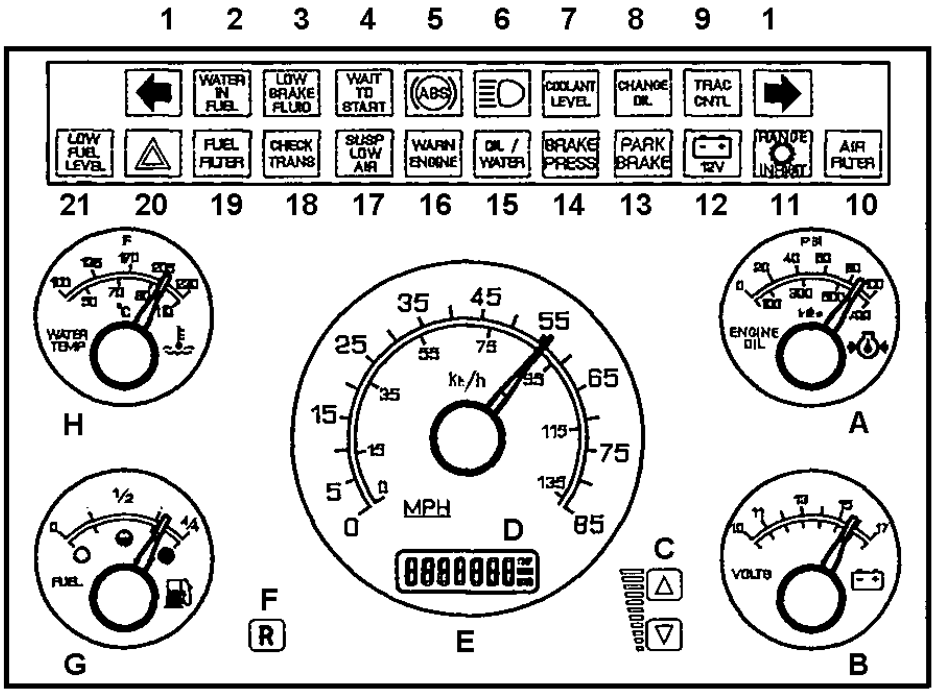

Figure 1 Instrument Cluster

Table 1 Figure 1 Callouts

1. TURN SIGNAL INDICATOR	11. RANGE INHIBIT	21. LOW FUEL LEVEL
2. WATER- IN- FUEL	12. LOW BATTERY	A. OIL PRESSURE
3. LOW BRAKE FLUID	13. PARK BRAKE	B. VOLTMETER
4. WAIT-TO-START	14. BRAKE PRESSURE	C. PANEL LIGHT DIMMER
5. ABS	15. OIL/WATER	D. ODOMETER/ HOURMETER

Table 1 Figure 1 Callouts (cont.)

6. HEADLIGHT HI-BEAM	16. WARN ENGINE	E. SPEEDOMETER
7. COOLANT LEVEL	17. SUSP. LOW AIR	F. “R” TOGGLE SW. (MI/HRS)
8. CHANGE OIL	18. CHECK TRANS	G. FUEL LEVEL
9. TRAC CNTL	19. FUEL FILTER	H. COOLANT TEMPERATURE
10. AIR FILTER	20. Not Currently Used	

CONTROLS

Panel Light Dimmer

The panel light dimmer (Figure 1, Item C) controls the intensity of all of the indicators in the cluster as well as several other panel lights. The dimmer is adjustable from 0 to 100% on.

Toggle Switch (“R” Button)

The “R" button (Figure 1, Item F) on the cluster scrolls through the following features.

- Odometer
- “Trip" Odometer
- Total vehicle “Hours"
- “Trip" “Hours"

The trip features are reset by pressing and holding the button until the display clears (approximately 6 seconds).

SPEEDOMETER

An electronic speedometer (Figure 1, Item E) indicates miles and kilometers traveled per hour. The speedometer circuit consists of the gauge, microprocessor, transmission mounted vehicle speed sensor (VSS), ECM, data link, and the circuits which connect the units.

ODOMETER/HOURMETER

The odometer/hourmeter (Figure 1, Item D) is an LCD digital display. It can be toggled to display total miles on the vehicle, trip miles, operating hours on the engine or time traveled.

VOLTMETER

An electronic voltage gauge (Figure 1, Item B) is used to indicate the voltage available to the vehicle.

OIL PRESSURE GAUGE

An electronic oil pressure gauge (Figure 1, Item A) is used to indicate the engine oil pressure.

COOLANT TEMPERATURE GAUGE

An electronic engine coolant temperature gauge (Figure 1, Item H) is used to display the operating temperature of the engine.

FUEL LEVEL GAUGE

An electric fuel gauge (Figure 1, Item G) indicates the amount of fuel contained in the vehicle fuel tank.

TRANSMISSION TEMPERATURE GAUGE (AUTOMATIC TRANSMISSION OPTION)

An electric transmission temperature gauge is used in vehicles with automatic transmissions. The gauge displays the operating temperature of the vehicle transmission. The gauge is not in the main cluster.

INDICATOR AND WARNING LIGHTS

Turn Signal Indicators

The turn signal indicators (Figure 1, Item 1) provide an indication to the operator that the left or right turn signals have been activated.

Water-In-Fuel

The “WATER-IN-FUEL" warning indicator (Figure 1, Item 2) provides a warning that water has been detected by the probe in the fuel filter. This lets the driver know that the fuel filter must be drained or changed to prevent water from getting into the engine.

Low Brake Fluid

The “LOW BRAKE FLUID" warning indicator (Figure 1, Item 3) signals the driver to check the brake hydraulic fluid level.

Wait-to-Start

The “WAIT-TO-START" warning indicator (Figure 1, Item 4) signals the driver to wait for the glow plugs to heat up before cranking the engine.

ABS

The “ABS" indicator (Figure 1, Item 5) warns the operator that there is an abnormal condition detected by the Anti—Lock Brake HCU module.

Headlight Hi-Beam

The headlight hi-beam indicator (Figure 1, Item 6) signals the driver that the headlights are on and the hi-beams have been selected.

Coolant Level

The “COOLANT LEVEL" indicator (Figure 1, Item 7) signals the driver that the coolant level is low in the coolant surge tank.

Change Oil

The “CHANGE OIL" indicator (Figure 1, Item 8) signals the driver that it is time to have the oil changed.

TRAC CNTL

The “TRAC CNTL" indicator (Figure 1, Item 9) signals the driver that the traction control is engaged.

Air Filter

The “AIR FILTER" indicator (Figure 1, Item 10) provides a warning that the air filter is becoming restricted. The filter should be changed to prevent hard starting, power limiting, or stalling.

Range Inhibit

The “RANGE INHIBIT" indicator (Figure 1, Item 11) signals the driver that the range inhibit is engaged by the ECON mode switch from the Allison TCM module.

Low Battery

The low battery indicator (Figure 1, Item 12) alerts the operator that the charging voltage to the battery is low.

Park Brake

The “PARK BRAKE" indicator (Figure 1, Item 13) signals the driver that the parking brake is engaged.

Brake Pressure

The “BRAKE PRESS" indicator (Figure 1, Item 14) warns the operator that there is an abnormal condition detected by the hydraulic brake module.

Oil/Water

The “OIL/WATER" indicator (Figure 1, Item 15) warns the operator that the engine oil pressure is too low or the coolant temperature is too high. It is also used with the engine diagnostics to display flash codes.

Warning Engine

The “WARN ENGINE" indicator (Figure 1, Item 16) warns the operator that a sensor or system of the engine is not performing as it should. The vehicle should be serviced as soon as possible. It is also used with the engine diagnostics to display flash codes.

Susp Low Air (Optional)

If the vehicle is equipped with the air suspension system, the “SUSP LOW AIR” indicator (Figure 1, Item 17) warns the operator that the air suspension system has not pumped up to a safe level for operation or that a leak has developed in the system. An alarm (not located in the instrument cluster) will also sound when the suspension air pressure is low.

Check Trans

The “CHECK TRANS" indicator (Figure 1, Item 18) warns the operator that there is a fault condition detected by the Allison TCM module.

Fuel Filter

The “FUEL FILTER" indicator (Figure 1, Item 19) provides a warning that the fuel filter is becoming plugged or restricted. The filter should be changed to prevent hard starting, power limiting, or stalling.

Low Fuel Level

The “LOW FUEL LEVEL" indicator (Figure 1, Item 21) signals the driver that the fuel level is below three to four gallons in the tank.

1. OPERATION

1.1. SPEEDOMETER

The sensor (Figure 2) is a magnetic pickup which senses the rotation of the speedometer gear mounted in the transmission. A permanent magnet located in the sensor establishes a magnetic field at the tip of the sensor. The field is repeatedly interrupted by the teeth of the speedometer gear in the transmission, creating voltage impulses from the vehicle speed sensor (VSS). When manual transmission, these are transmitted through connector (303), on circuits 47 and 47A, to connector (6021) on the ECM2. When automatic transmission, these are transmitted from the Allison LCT XMSN control module connector (3031), on circuits 126, to connector (6021) on the ECM2. The ECM2 converts the sensor signal to a digital data signal. This signal is transferred over the data link on circuits 98E(+) and 98F(-) to pins 7 and 9 of connector (27), into the instrument cluster. The instrument cluster's microprocessor drives the speedometer.

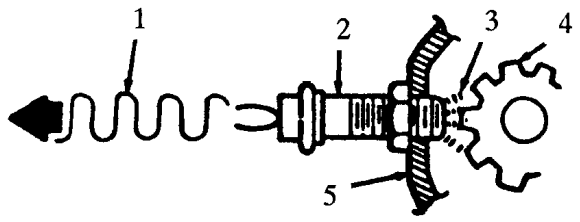

Figure 2 Speedometer Sensor

1. SENSOR OUTPUT VOLTAGE
2. SENSOR
3. MAGNETIC FIELD
4. SPEEDOMETER GEAR
5. TRANSMISSION

NOTE – The greatest variable in determining speedometer accuracy is tire revolutions per mile. Factors which can affect tire revolutions per mile are tire manufacturing tolerances, tire load, tire pressure, vehicle speed and tire wear.

1.2. ODOMETER/HOURMETER

The vehicle mileage and engine hours are up loaded to the instrument cluster microprocessor from the ECM2 on the data link. The trip meter information is produced in the cluster microprocessor.

1.3. VOLTMETER

The battery voltage is measured by the ECM2, converted to a data signal, and transferred over the data link to the instrument cluster's microprocessor. The microprocessor drives the voltmeter display gauge.

1.4. OIL PRESSURE GAUGE

The engine oil pressure is sensed by an electrical sending unit that sends a voltage to the ECM2. The ECM2 converts the electrical voltage into a data signal and transfers it, via the data link, to the microprocessor in the instrument cluster. The microprocessor drives the oil pressure gauge.

1.5. COOLANT TEMPERATURE GAUGE

The engine coolant temperature is sensed by an electrical sending unit that sends a voltage to the ECM2. The ECM2 converts the voltage into a digital signal. This signal is transferred, via the data link, to the microprocessor in the instrument cluster. The microprocessor drives the temperature gauge.

1.6. FUEL LEVEL GAUGE

The battery voltage is through the ignition relay (4G), circuit 13A, fuse F13, circuit 28, the green instrument cluster (27), pin 10 to the fuel gauge. The level of fuel in the vehicle fuel tank is sensed by the fuel gauge sending unit. The sending unit feeds an electrical voltage through pin A of connector (196), pin M of connector (2) and pin 3 of connector (27) to the fuel gauge, which displays the fuel level. The fuel sender (196) is grounded through circuits 36–G, 11–GJ to the engine block ground. The fuel gauge is grounded through pin 2 of connector (27) circuits 28–GB, 11–GA to the cab ground.

1.7. TRANSMISSION TEMPERATURE GAUGE

The transmission temperature is sensed by the transmission temperature sending unit. The sending unit feeds an electrical voltage through pin A of connector (345), to pin A of connector (476), to the transmission temperature gauge, which displays the transmission temperature.

1.8. INDICATOR AND WARNING LIGHTS

Turn Signal Indicators — Left Turn Signal

When the left turn signal is selected, power is applied from fuse F3 through flasher 4A to pin A of connector (193). The circuit continues on circuits 56 and 56C through pin 6 of connector (27). This causes the left turn indicator, which is grounded through pin 2 of connector (27) and circuit 28-GB, to illuminate when the flasher makes the turn signal blink.

Turn Signal Indicators — Right Turn Signal

When the right turn signal is selected, power is applied from fuse F3 through flasher 4A to pin A of connector (193). The circuit continues on circuits 57 and 57C through pin 12 of connector (27). This causes the right turn indicator, which is grounded through pin 2 of connector (27) and circuit 28-GB, to illuminate as the flasher makes the turn signal blink.

Water-In-Fuel

The battery voltage is through the ignition relay (4G), circuit 13A, fuse F16, circuits 13E, 19K, to the water-in-fuel module (470), pin A. When the fuel filter (6708) has water in it, the water probe provides a ground at pin A of connector (2) on circuit 19C to pin D of the water-in-fuel module. The water-in-fuel module supplies 12 volts on circuit 19L through pin 11 of connector (28) to illuminate the “WATER-IN-FUEL" indicator. (Includes blub check at power-up.)

Low Brake Fluid (Option)

The brake hydraulic fluid level is low.

Wait-to-Start

The battery voltage is through the ignition relay (4G), circuit 13A, fuse F13, circuit 28, the green instrument cluster (27), pin 10 to the “WAIT-TO-START" indicator. The “WAIT-TO-START" indicator is controlled by the ECM2 (6020). The control from ECM2 connector (6020), pins 12 and 13, is transferred over the data link on circuits 5V(+) and 5W(-) through pins 18 and 19 of connector (3), to the MSM connector (3040) pins 5 and

6. A ground is sent from the MSM connector (3040) through pin 10, circuit 18–G, to pin 5 of connector (28). This causes the indicator to illuminate.

ABS

When the Anti—Lock Brake HCU module (279) detects a problem with the brake system, it provides a ground on circuit 94E to pin 16 of connector (27). The battery voltage is through the key switch (63), circuit 13J, fuse 22, circuit 94D, energizing the ABS warning light relay (4F), circuit 94H, connector (3), circuit 94H, connector (261), circuit 94H, with a ground at the HCU module connector (279). The ABS warning light will illuminate through the open contacts of relay (4F), circuit 94–GB, to cab ground.

Headlight Hi-Beam

When the headlight switch (60) is in the on position, power is supplied to the dimmer relay (4J) on pins 1 and 3. When the high beam switch (15) is activated, the ground on circuits 11–GA and 51-G through pin A of connector (192) to the switch is removed as the switch is opened. This removes the ground on circuit 51D to contact 2 of dimmer relay (4J), causing the relay to de-energize. This applies 12 volts to contact 4 of the relay on circuits 52C and 52A, through pin 4 of connector (27), to illuminate the high beam indicator on the instrument panel.

Coolant Level

The battery voltage is through the green instrument cluster (27), pin 17 to the “COOLANT LEVEL" indicator. The “COOLANT LEVEL" indicator is controlled by the ECM2 (6020). When the coolant level is low in the coolant surge tank, the MAG switch (400) closes its contacts, a ground, circuit 34–G, through circuit 34B, to ECM2 connector (6020), pin 4. This causes the indicator to illuminate.

Change Oil

The battery voltage is through the ignition relay (4G), circuit 13A, fuse F13, circuit 28, the green instrument cluster (27), pin 10 to the “CHANGE OIL" indicator. The “CHANGE OIL" indicator is controlled by the ECM2 (6020). The control from ECM2 connector (6020), pins 12 and 13, is transferred over the data link on circuits 5V(+) and 5W(-) through pins 18 and 19 of connector (3), to the MSM connector (3040) pins 5 and 6. A ground is sent from the MSM connector (3041) through pin 2, circuit 97AA, to pin 7 of connector (28). This causes the indicator to illuminate.

NOTE – The Change Oil/Service interval light default setting is off. The customer can use the service tool to activate the light and enter their own parameters into the ECM2 memory. The STI button (diagnostics flash button) is used to reset the service interval reminder light.

TRAC CNTL (Option)

The “TRAC CNTL" indicator signals the driver that the traction control is engaged.

Air Filter

The battery voltage is through the ignition relay (4G), circuit 13A, fuse F13, circuit 28, the green instrument cluster (27), pin 10 to the “AIR FILTER" indicator. The “AIR FILTER" indicator is controlled by the filter minder switch (3110), on the air filter, pin A and B, circuit 95–G, to cab ground. A ground is sent through pin 16 of connector (3), circuit 95, to pin 14 of connector (27). This causes the indicator to illuminate.

Range Inhibit

The battery voltage is through the ignition relay (R20), circuit 13L, fuse F36, circuit 13K, through split, circuits 102 and 104, to the Allison TCM connector (3031), pins 2 and 4 (respective). The “CHECK TRANS" indicator is controlled by the Allison TCM. A ground is sent from the Allison TCM connector (3031), pin 23, circuit 123,

through pin 17 of connector (3), circuit 123, to pin 5 of connector (27). This causes the “RANGE INHIBIT" indicator to illuminate.

Low Voltage

When the voltage output of the alternator is low, a ground will be provided on terminal (1) of the alternator. This ground will be present on circuit 1C to pin 16 of connector (28) and will cause the “Low Voltage” indicator to illuminate.

Park Brake

When the parking brake is engaged the park brake switch (1PB) will close providing a ground on circuit 44A and 44 to pin 17 of connector (28). The battery voltage is through the ignition relay (4G), circuit 13A, fuse F13, circuit 28, the green instrument cluster (27), pin 10 to the “PARK BRAKE" indicator. The “PARK BRAKE" indicator will illuminate.

Brake Pressure

When the hydraulic brake module (49) detects a problem with the brake system, it provides a ground on circuit 90T to pin 9 of connector (28). The battery voltage is through the ignition relay (4G), circuit 13A, fuse F13, circuit 28, the green instrument cluster (27), pin 10 to the “BRAKE PRESSURE" indicator. The “BRAKE PRESSURE" warning light will illuminate and an audible alarm will sound.

Oil/Water

The battery voltage is through the ignition relay (4G), circuit 13A, fuse F13, circuit 28, the green instrument cluster (27), pin 10 to the “OIL/WATER" indicator. The “OIL/WATER" indicator is controlled by the ECM2 (6020). The control from ECM2 connector (6020), pins 12 and 13, is transferred over the data link on circuits 5V(+) and 5W(-) through pins 18 and 19 of connector (3), to the MSM connector (3040) pins 5 and 6. A ground is sent from the MSM connector (3040) through pin 1, circuit 97AF, to pin 14 of connector (28). This causes the indicator to illuminate.

Warning Engine

The battery voltage is through the ignition relay (4G), circuit 13A, fuse F13, circuit 28, the green instrument cluster (27), pin 10 to the “WARN ENGINE" indicator. The “WARN ENGINE" indicator is controlled by the ECM2 (6020). The control from ECM2 connector (6020), pins 12 and 13, is transferred over the data link on circuits 5V(+) and 5W(-) through pins 18 and 19 of connector (3), to the MSM connector (3040) pins 5 and 6. A ground is sent from the MSM connector (3040) through pin 9, circuit 97T, to pin 15 of connector (28). This causes the indicator to illuminate and the audible alarm to sound.

Suspension Low Air

A ground from circuits 11–GB and 61-G through pin A of connector (475) is present at the air pressure sensor. When the suspension air pressure is low, the air pressure sensor will close applying ground through pin C of connector (475) on circuits 40 and 40A to pin 13 of connector (28). This causes the suspension low air indicator to illuminate and the alarm, which receives power and the ground through connector (474), to sound. The battery voltage is through the ignition relay (4G), circuit 13A, fuse F15, circuits 13A, 61, to the low air alarm (474).

Check Trans

The battery voltage is through the ignition relay (R20), circuit 13L, fuse F36, circuit 13K, through split, circuits 102 and 104, to the Allison TCM connector (3031), pins 2 and 4 (respective). The “CHECK TRANS" indicator is controlled by the Allison TCM. A ground is sent from the Allison TCM connector (3031), pin 25, circuit 125,

through pin 31 of connector (3), circuit 125, to pin 7 of connector (28). This causes the “CHECK TRANS" indicator to illuminate.

Fuel Filter (Option)

When the fuel filter becomes clogged or restricted, the fuel filter vacuum switch (2FF) will close applying a ground on circuit 19B through pin B of connector (401), on circuit 19E to pin R of connector (2), on circuit 19B to pin 3 of connector (28), which illuminates the “FUEL FILTER" indicator.

Low Fuel Level (Option)

The “LOW FUEL LEVEL" indicator signals the driver that the fuel level is below three to four gallons in the tank.

2. REMOVE AND INSTALL

2.1. INSTRUMENT CLUSTER

The cluster is attached to the instrument panel by 8 screws. The cluster body can be detached from the instrument panel for quick access to its components. Either the complete assembly or any of 3 subassemblies can be replaced.

CAUTION – Always place the ignition in the off position (not ACC) prior to removing or installing the cluster. This will prevent damage to the cluster.

CAUTION – Static electricity can cause permanent damage to the cluster. Before working on the cluster, be sure to discharge all static from your body by touching metal that is grounded. Do not wear clothing that causes static buildup (such as nylon). Do not touch any pin connectors during removal and installation of gauges. Work on the cluster in a clean environment to avoid dust.

Remove

1. Protect the front bezel during removal by placing a soft cloth on any items that might get in the way.
2. Remove the eight mounting screws located around the outer edges of the cluster.
3. Pull the cluster away from the instrument panel.
4. Remove the two wiring harness connectors from the back of the cluster.

Install

1. Connect the two wiring harness connectors to the back of the cluster. These connectors are color-coded for proper orientation.
2. Align the cluster in the instrument panel frame and align it with the eight mounting holes.
3. Install the eight mounting screws.

2.2. INSTRUMENT CLUSTER COMPONENTS

A. The instrument cluster can be broken down to the front panel, rear panel and the printed circuit assembly (Figure 3).

B. Light bulbs on the printed circuit assembly can be replaced after removing the rear panel.

C. The individual gauges are not replaceable. A gauge failure warrants printed circuit assembly replacement.

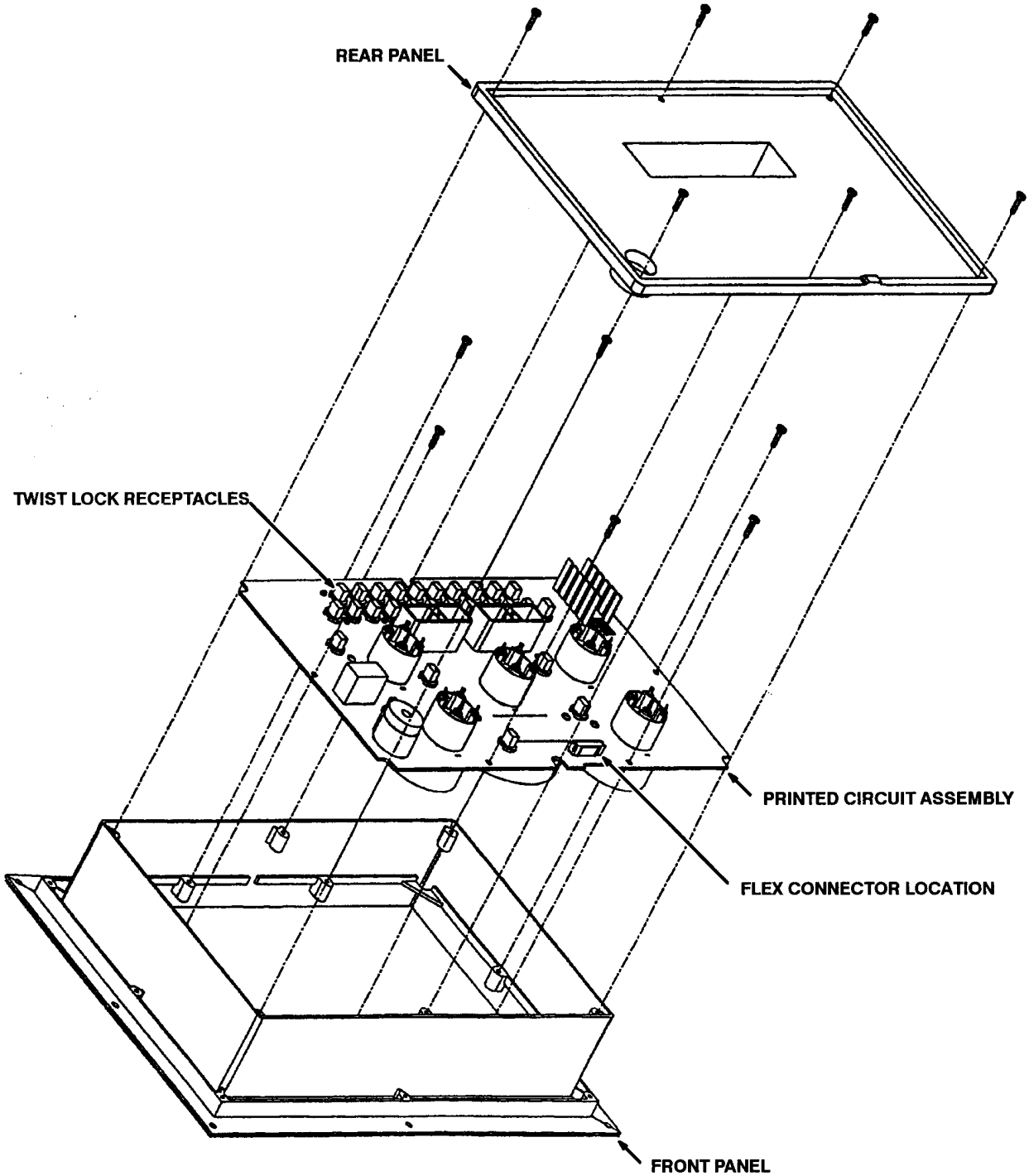

Figure 3 Front Panel, Rear Panel, Printed Circuit Assembly

Removal of the Printed Circuit Assembly

Refer to Figure 3.

1. Place the removed cluster face down on a clean horizontal surface. Remove the six mounting screws from the rear panel and set it aside.

2. Remove the six mounting screws from the printed circuit assembly.

3. Disconnect the flex circuit connector for the front overlay and gently pull the board away from the front panel housing.

Panel Lamp Replacement

The panel lamp bulbs are the push-in type and are mounted in a twist lock receptacle (Figure 3). The rear panel must be removed to gain access to the lamps.

2.3. SPEEDOMETER SENSOR

Refer to Figure 4.

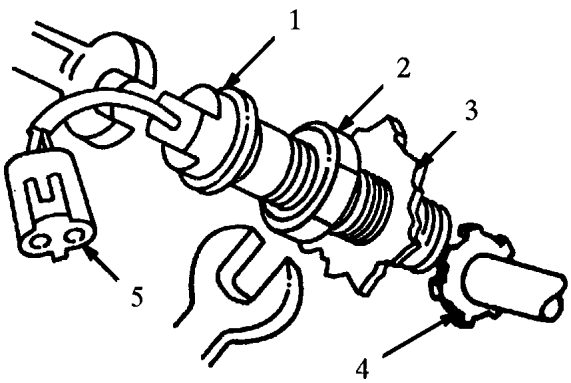

Figure 4 Speedometer Sensor

1. SENSOR BODY
2. LOCKNUT
3. HOUSING
4. TRANSMISSION SPEEDOMETER GEAR
5. SENSOR CONNECTOR

IMPORTANT – Turn the key switch to OFF before removing or installing the speedometer sensor.

Remove

1. Disconnect the sensor connector from the wiring harness connector.

2. Loosen the sensor locknut and remove the sensor from the back of the transmission housing.

IMPORTANT – Allison automatic transmissions use a non-adjustable speedometer sensor, but its electrical operation is similar to the standard International sensor.

Install

1. Install the new sensor by turning into the housing until it bottoms out against the speedometer gear. **Back off one (1) turn.**

2. Tighten the locknut using two wrenches to keep the sensor from turning while tightening the locknut. Tighten to 15 ft-lbs. (20 Nm).

3. Reconnect the sensor connector to the wiring harness connector.

4. Test drive the vehicle to test the speedometer.

3. PROGRAMMING

There are no adjustments or jumpers on the instrument cluster. All programming is performed on the ECM2.

4. CLUSTER FAILURE DIAGNOSTICS

CAUTION – Be sure to turn the key switch to OFF when the cluster or any cluster part is inserted or removed. Shorting across the meter pins could cause permanent damage to the cluster.

CAUTION – Static electricity can cause permanent damage to the cluster. Before working on the cluster, be sure to discharge all static from your body by touching metal that is grounded. Do not wear clothing that causes static buildup (such as nylon). Do not touch any pin connectors during removal and installation of gauges. Work on the cluster in a clean environment to avoid dust.

After a cluster failure or suspected malfunction, turn off electrical power to the cluster by switching off accessory voltage. Remove the cluster from the dash. Refer to INSTRUMENT CLUSTER, Remove.

4.1. CLUSTER HARNESS CONNECTORS

The instrument cluster is connected to the vehicle by two vehicle harness connectors on the back of the cluster. The natural connector is on the left (driver's side) and the green connector is on the right. Each harness connector has seventeen (17) pins numbered right to left. The bottom row contains pins 1 through 9 and the top row, pins 10 through 17. There is a space between pins 13 and 14 (Figure 5).

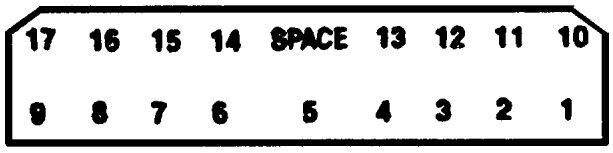

Figure 5 Harness Connector

Left Side Harness Connector (28) Pin Outs (Natural Color)

Table 2 Left Side Harness Connector (28) Pin Outs (Natural Color)

1. Not used	10. Not Used
2. Dimmer (+)	11. Water-in-Fuel Indicator (+)
3. Fuel Filter Vacuum Indicator (-)	12. Low Voltage Indicator (+)
4. Spare	13. Suspension Low Air Indicator (-)
5. Wait-to-Start Indicator	14. Oil/Water Light and Alarm (-)
6. Check Transmission	15. Engine Warning Indicator (-)
7. Change Oil Indicator (-)	16. Low Voltage Indicator

Table 2 Left Side Harness Connector (28) Pin Outs (Natural Color) (cont.)

8. Not Used	17. Park Brake Indicator (-)
9. Brake Light and Alarm (-)	

Right Side Harness Connector (27) Pin Outs (Green Color)

Table 3 Right Side Harness Connector (27) Pin Outs (Green Color)

1. Illumination Output	10. Ignition Power
2. Ground	11. Low Brake Fluid
3. Fuel Level Sender	12. Right Turn indicator (+)
4. High Beam Indicator (+)	13. Spare
5. Range Inhibited	14. Air Filter
6. Left Turn Indicator (+)	15. Spare
7. + J1708 (data link)	16. ABS Warning
8. Not Used	17. Coolant Level
9. - J1708 (data link)	

4.2. CLUSTER CONNECTORS

Looking at the rear of the cluster the two connectors will be the reverse of the plug in harness connectors. The left connector is green and the right is natural. The connector pins are numbered from left to right (Figure 6). The bottom row has pins 1 through 9. The top row has pins 10 through 17 with a space between pins 13 and 14.

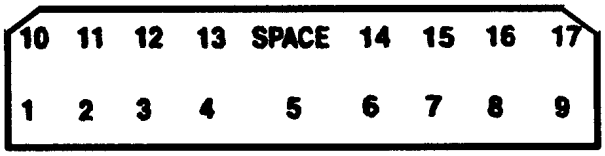

Figure 6 Connector Pins

4.3. HARNESS CONTINUITY AND VOLTAGE TESTS

1. Turn the key switch to OFF.

2. Unplug the wiring harness connector servicing the gauge in question from the cluster. Refer to CLUSTER HARNESS CONNECTORS and GROUP 08 - ELECTRICAL, Circuit Diagrams.

3. Using an ohmmeter, check the resistance of the sensor circuit affecting the gauge in question. The resistance should read less than one (1) ohm.

4. Using an ohmmeter, check the resistance of the harness ground circuit. The resistance should read less than one (1) ohm.

5. Turn the key switch to accessories position and using a voltmeter, check the harness power circuit. It should read just under battery voltage.

6. If all three harness circuits check OK, install a new cluster.

7. If the voltage measurement or either of the two electrical resistances is incorrect, a faulty sensor, connector, wiring harness or other failure is indicated and further testing is required.

4.4. FUEL LEVEL SENSOR/GAUGE

If the electric fuel gauge shows a reading which is suspected of being incorrect, insure all electrical connections are clean, tight, unbroken and are not shorted. If this fails to remedy the problem, the fuel level sensor must be checked. The fuel level sensor is a float/resistive potentiometer type with the following output characteristics at different fuel levels.

IMPORTANT – Before checking the fuel gauge, be sure the vehicle has been parked on a level surface long enough for the fuel level to stabilize. In cold weather insure the vehicle interior is warmed up.

Table 4 Fuel Tank Level to Sensor Output

Fuel Tank Levels	Sensor Output (Ohms)
Full	88±3
3/4	66±3
1/2	44±2
1/4	22±2
Empty	1±1

When the sensor wire is shorted to ground, the gauge should read “E”mpty. When the sensor wire is disconnected, the gauge should read “F"ull.

Locate the fuel level sensor circuit pin in the cluster harness, connector (27) pin 3, and measure the resistance to ground. If the resistance reading and the fuel level agree with the above table but the gauge does not match, replace the instrument cluster or the cluster printed circuit board (the fuel gauge is not replaceable or repairable). If the readings and the fuel level do not match, disconnect the harness at the fuel sensor and measure the resistance at the sensor. If correct readings are obtained, repair the harness. If readings are out of specification, replace the fuel sensor.

4.5. INSTRUMENT CLUSTER SELF TEST DIAGNOSTICS

If the speedometer, odometer, voltmeter, oil pressure, or water temperature gauge indicates a failure, the circuits serving the instrument in question must be checked for clean, tight, unbroken and non-shorted connections.

IMPORTANT – Be sure all relays in the vehicle are the suppressed type.

IMPORTANT – Make sure the accessory voltage to the cluster is within a range of 11 to 16 volts.

The cluster will test itself each time the vehicle is powered up. The instrument cluster has self testing capabilities which include:

- park brake light
- water-in-fuel light
- fuel filter light

- water temp. gauge
- engine oil pressure gauge
- voltage gauge
- speedometer
- J1708 (data link) connections

The self testing diagnostics provide a strong indication of what is wrong with the unit. This reduces the need to remove the cluster from the vehicle and cuts down on troubleshooting time.

Pass Indications

The cluster will test itself each time the vehicle is powered up. If all tests pass, the unit will drive the voltmeter, oil pressure gauge, and water temperature gauge needles through a full sweep. The speedometer needle will be driven through a 45 degree sweep. And the parking brake, water-in-fuel, and the fuel filter lights will come on for approximately 6 seconds. These tests indicate that the gauges and lights are in working order. If the odometer display does not display an error code and the speedometer does not point down, then the data link is present from the ECM. Other indicator lights will light when the vehicle is powered up. These lights are tested by the devices which drive the particular indicators.

Fail Indications

If the cluster self test does not initiate or if any of the individual gauges fail, the corrective actions on the following chart should be taken.

4.6. SPEEDOMETER, ODOMETER/HOURMETER, VOLTAGE, OIL PRESSURE, AND WATER TEMPERATURE GAUGES FAILURE CHART

Table 5 Speedometer, Odometer/Hourmeter, Voltage, Oil Pressure, And Water Temperature Gauges Failure Chart

Failure Mode	First Action	Second Action
1. Speedometer, voltmeter, oil pressure gauge or water temperature gauge needles do not move on power up.	Verify that ignition voltage and ground are provided to the instrument cluster. Refer to CLUSTER HARNESS CONNECTORS and GROUP 08 - ELECTRICAL, Circuit Diagrams.	Replace the instrument cluster.
2. Speedometer needle points straight down and the odometer displays an error message.	J1708 Data Link failure. Insure the vehicle Data Link is not shorted. Refer to CLUSTER HARNESS CONNECTORS and GROUP 08 - ELECTRICAL, Circuit Diagrams.	Verify the data link output from the ECM2 is correct by using an electronic service tool. If the data is missing, troubleshoot the ECM2. Replace the cluster if the data is present.

Table 5 Speedometer, Odometer/Hourmeter, Voltage, Oil Pressure, And Water Temperature Gauges Failure Chart (cont.)

Failure Mode	First Action	Second Action
3. Speedometer goes through a good power up sweep, but the speedometer does not work when driving.	Check speedometer sensor wiring continuity and sensor output signal levels. Refer to GROUP 08 - ELECTRICAL, Circuit Diagrams.	Verify the signal from the ECM2 by using an electronic service tool. If the data is missing, troubleshoot the ECM2. Replace the cluster if the data is present.
4. Any of the gauges other than the speedometer or the fuel gauge fail to perform correctly during the self test.	Check the appropriate sensor wiring to the ECM2. Refer to GROUP 08 - ELECTRICAL, Circuit Diagrams.	Verify the signal from the ECM2 by using an electronic service tool. If the data is missing, troubleshoot the ECM2. Replace the cluster if the data is present.

4.7. THERMISTOR RESISTANCE CHECK

To check thermistor type temperature sensors, the approximate temperature of the component being checked must be known to determine the amount of resistance that will be read at the cluster harness connector.

Table 6 Thermistor Resistance Check

Component Temperature		Thermistor Resistance
Fahrenheit	Centigrade	(Ohms)
32	0	8,335
50	10	4,945
68	20	3,010
86	30	1,871
104	40	1,185
140	60	505
158	70	341
194	90	169.8
212	100	125.6
230	110	95.2
248	120	73.5
266	130	57.5

The thermistor type sensor is used in the following electrical gauge applications:

- Engine Coolant Temperature
- Transmission Temperature (Option)

4.8. TRANSMISSION TEMPERATURE GAUGE (USED ONLY WITH AUTOMATIC TRANSMISSIONS) (OPTION)

The transmission temperature gauge is not part of the instrument cluster and is mounted separately. If the reading is suspected of being incorrect the circuits serving the instrument should be checked for clean, tight, unbroken and non-shorted connections.

NOTE – The transmission temperature gauge may not indicate a reading due to a low/short run time condition.

If this gauge is suspected of being faulty, short out connector (345) at the sensor. The gauge should read full scale.

5. TROUBLESHOOTING

Refer to Electrical System Troubleshooting Guide in GROUP 08 of the CTS-5000 Master Service Manual.

Before beginning these test procedures, do the following:

A. Make sure the vehicle batteries are at 75% state of charge (SOC) or higher. This represents an open circuit voltage (OCV) of 12.4 volts. Batteries with an OCV of 12 volts or less are either completely discharged or have a dead cell.

B. Check any light or indicator lamp filaments that are suspected of being open (burned out). This is done to avoid unnecessary extensive circuit checks.

C. Inspect all connectors for loose or damaged pins, wires, etc. Refer to TEST EQUIPMENT AND CONNECTOR REPAIR section in GROUP 08 - ELECTRICAL in CTS-5000 Master Service Manual.

D. When the technician determines that a fuse is blown, while checking its condition, he is directed to locate the cause of the overload condition and to repair it. While no further instruction on this procedure is listed in the diagnostic tables, the common procedure is as follows: isolate sections of the circuit by disconnecting connectors, and measure the resistance to ground to find the circuit that is shorted to ground. Then locate the damaged spot in the wire or connector and repair.

E. Diagnostics for circuits that are malfunctioning by sticking in the on position are generally not covered in detail. It is assumed that the technician knows to check for a malfunctioning switch, relay, or solenoid.

CAUTION – Do not probe the ECM2 connectors with metal leads as it could damage the connector. Always use a Hickok 60 pin breakout box (ZTSE4346) to test ECM related circuits.

5.1. TRANSMISSION TEMPERATURE GAUGE (SENSOR MUST BE WARM) (OPTION)

Table 7 Transmission Temperature Gauge (Sensor Must Be Warm) (Option)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	On	Disconnect connector (345) from transmission sender. Connect a jumper between pins A and B.		Gauge should read full scale.	Gauge circuits test good. Replace faulty sensor.	Go to next step.
2.	On	Measure voltage between pin I of the gauge and ground.	Pin I of gauge to ground.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 13H from fuse F11, then repair. Reconnect connectors.
3.	Off	Measure resistance from pin G of the gauge to ground.	Pin G of gauge to ground.	<1 ohm.	Go to next step.	Locate open in circuit 11GD between pin G of the gauge and ground, then repair.
4.	Off	Measure resistance between pin A on connector (345) of the wire harness, circuit 31, and pin S of the gauge.	Conn. (345)/ pin A, cir. 31 to pin S.	<1 ohm.	Go to next step.	Locate open in circuit 31, between connector (345)/pin A and pin S of the gauge, then repair.
5.	Off	Remove jumper from connector (340). Remove wire from pin S of the gauge. Measure resistance between wire and ground.	Wire from pin S to ground.	>100K ohms.	Go to next step.	Locate short in circuit 31, between connector (345)/pin A and pin S of the gauge, then repair.
6.	Off/ On	Reconnect sensor and gauge. Move key switch to ignition position. Does the temperature gauge work properly?		Temperature gauge works properly.		Temperature gauge is faulty. Replace the gauge.

5.2. FUEL LEVEL GAUGE

Table 8 Fuel Level Gauge

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off	Disconnect connector (196) from fuel sender. Measure resistance from pin B, circuit 36-G of harness connector to ground.	Conn. (196), cir. 36-G to gnd.	<1 ohm.	Go to next step.	Locate open in circuit 36-G between connector (196) and cylinder head ground stud, then repair.
2.	Off	Measure resistance to ground at both terminals on fuel sender.	Terminals to ground.	>100K ohms.	Go to next step. (Do not reconnect fuel sender yet.)	Replace fuel sender.
3.	Off	Remove instrument cluster and remove conn. (27). Jumper across conn. (196) of wire harness. Measure resistance between pin 3 of conn. (27) to ground.	Conn. (27)/ pin 3, cir. 36 to gnd.	<1 ohm.	Remove jumper. Go to next step.	Locate open in circuit between conn. (27) and conn. (196).
4.	Off	Measure resistance between pin 3 of connector (27), circuit 36 of wire harness and ground.	Conn. (27)/ pin 3, cir. 36 to gnd.	>100K ohms.	Reconnect fuel sender and conn. (196). Go to next step.	Locate short to ground in circuit 36, then repair.
5.	On	Move key switch to ignition position and measure voltage from pin 10 of connector (27), circuit 28 to ground.	Conn. (27)/ pin 10, cir. 28 to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair. Reconnect connectors.
6.	Off/ On	Reconnect sensor and cluster. Move key switch to ignition position. Does fuel gauge work properly?		Fuel gauge works properly.		Fuel gauge is faulty. Replace instrument cluster.

5.3. LEFT TURN INDICATOR

Table 9 Left Turn Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off	Move turn signal switch to left turn position. Does left turn signal light illuminate?		Signal light (not cluster indicator) illuminates.	Go to next step.	Refer to Electrical Troubleshooting Manual (ETM) for troubleshooting of turn signal lights and switch.
2.	Off	Remove instrument cluster and remove left turn signal indicator light bulb. Test bulb for continuity.	Across indicator light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb or replace cluster, reconnect connector. If problem persists, repeat all tests.
3.	Off	Disconnect conn. (27), and measure voltage from pin 6 of wire harness connector, circuit 56C to ground.	Conn. (27)/ pin 6, cir. 56C to gnd.	Alternating from 0 to 12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 56C, then repair. Reconnect connectors.
4.	Off	At conn. (27), measure voltage from wire harness connector pin 6, circuit 56C to pin 2, circuit 28-GB.	Conn. (27)/ pin 6, cir. 56C to 28-GB.	Alternating from 0 to 12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit 56, 56C or 28-GB, then repair.
5.	Off	Reconnect connector (27). Does turn signal indicator blink with turn signal lights?			Left turn indicator and circuits test good.	Replace defective cluster assembly.

5.4. RIGHT TURN INDICATOR

Table 10 Right Turn Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off	Move turn signal switch to right turn position. Does right turn signal light illuminate?		Signal light flashes.	Go to next step.	Refer to Electrical Troubleshooting Manual (ETM) for troubleshooting of turn signal lights and switch.
2.	Off	Remove instrument cluster and remove right turn signal indicator light bulb. Test bulb for continuity.	Across indicator light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb or replace cluster, reconnect connector. If problem persists, repeat all tests.
3.	Off	Disconnect conn. (27), and measure voltage from pin 12, circuit 57C to ground.	Conn. (27)/ pin 12, cir. 57C to gnd.	Alternating from 0 to 12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 57C, then repair. Reconnect connectors.
4.	Off	At conn. (27), measure voltage from pin 12, circuit 57C to pin 2, circuit 28-GB with turn signal switch in right turn position.	Conn. (27)/ pin 12, cir. 57C to pin 2, 28-GB.	Alternating from 0 to 12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit 57, 57C or 28-GB, then repair.
5.	Off	Reconnect connector (27). Does turn signal indicator blink with turn signal lights?		Signal indicator flashes.	Right turn indicator and circuits test good.	Replace defective cluster assembly.

5.5. WATER–IN–FUEL INDICATOR

Table 11 Water–in–Fuel Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	On	Disconnect conn. (6708) from fuel filter. Connect a jumper from pin 2 to ground. Does warning light illuminate?		Warning light illuminates.	Warning light circuits test good. Replace water probe.	Go to next step.
2.	On	Remove instrument cluster and remove water- in- fuel indicator light bulb. Test bulb for continuity.	Across indicator light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb or replace cluster, repeat tests if problem persists.
3.	On	Disconnect conn. (28). At pin 11 of wire harness conn. (28), measure resistance from circuit 19L to gnd.	Conn. (28), cir. 19L to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 19L, then repair.
4.	Off	Disconnect conn. (470). At wire harness, measure resistance between pin D to gnd.	Conn. (470), pin D to gnd.	<1 ohm.	Go to next step.	Locate open in circuit 19C, then repair.
5.	On	Reconnect conn. (28), and use a jumper wire to connect pin A of conn. (470) circuit 19K to pin B, circuit 19L. Does warning light illuminate?		Warning light illuminates.	Go to next step.	Locate cause of low or no voltage in circuit 19K or open in circuit 19L, then repair. The instrument cluster may need replaced.
6.	On	Remove jumper and reconnect conn. (470). Leave connector (6708) jumper at circuit 19C connected. Does warning light illuminate?		Warning light illuminates.	Warning light circuits test good. Remove jumper and reconnect all connectors.	Replace defective water- in- fuel module.

5.6. WAIT–TO–START INDICATOR

CAUTION – Do not probe the ECM2 connectors with metal leads as it could damage the connector. Always use a Hickok 60 pin breakout box (ZTSE-4445) to test ECM2 related circuits.

Table 12 Wait–to–Start Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	1. Turn key to RUN 2. Connect J1939 sniffer		Are both the engine (0x00) and the MSM (aka ESC) on the Datalink?	Go to step 2.	Go to step 4.
2.	Off/ On	1. Disconnect J1939 sniffer. 2. Connect Master Diagnostics 3. Monitor the "Wait to start" output.		Does the "Wait to Start" output change?	Go to step 3.	ECM2 is not updating "Wait to Start" output. See engine troubleshooting guide.
3.	Off/ On	1. Disconnect MSM connector (3040). 2. Connect pin 10 to ground.	(3040), pin 10 to gnd.	Does the "Wait to Start" lamp turn on?	Replace MSM and retest	Go to next step.
4.	Off	1. Remove instrument cluster. 2. Remove wait- to-start indicator bulb. 3. Test bulb for continuity.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and repeat test.
5.	Off	1. Instrument cluster removed. 2. Measure resistance from disconnected conn. (28), pin 5, circuit 18-G to MSM disconnected conn. (3040) pin 10.	(28), pin 5, cir. 18-G to (3040) pin 10.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 18-G or cluster, then repair.

Table 12 Wait–to–Start Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
6.	Off/ On	1. Instrument cluster removed. 2. Move key switch to ignition. 3. Measure voltage from conn. (27), pin 10, circuit 28 to ground.	(27), pin 10, cir. 28 to gnd.	12±1.5 volts.	Install cluster. Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair.
7.	Off/ On	1. Leave J1939 sniffer connected		Is the engine (0x00) on the Datalink?	Go to step 8.	Go to step 11.
8.	Off/ On	1. Turn the key to OFF. 2. Disconnect MSM connector (3040). 3. Measure resistance across datalink pins 5 & 6, in wiring harness	(3040), pins 5 and 6.	Is the resistance approx. 60 ohms?	Go to step 9.	Fix datalink wiring, cir 5AM(-) and 5AL(+), retest
9.	Off/ On	1. Turn the key to Ignition. 2. Measure the voltage at the MSM's harness ignition pin 7 to ground.	(3040), pin 7, cir 13MS.	Is the voltage 12-16 volts?	Go to step 7.	Fix wiring cir 13MS or fuse F20, retest.
10.	Off/ On	1. Measure the resistance between the MSM's harness ground pin 8 and ground	(3040), pin 8, cir 11–GM to gnd.	Is the resistance less than 10 ohms?	Replace MSM and retest	Fix ground wiring cir 11–GM and cab ground, retest.
11.	Off/ On	1. Leave J1939 sniffer connected NOTE: This assumes the "Wait to Start" output can be monitored using MD.		Is the MSM (aka ESC) on the Datalink?	Check the engine's power connections and data link wiring.	Verify sniffer is working properly

5.7. ABS INDICATOR

Table 13 ABS Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	Disconnect ABS warning light relay conn. (4F), and connect a jumper wire on circuit 94E (going to warning light) to ground. Move key switch to ignition position. Does warning light illuminate?		Warning light illuminates.	Go to Step 6.	Go to next step.
2.	On	Remove instrument cluster and remove indicator bulb. Test bulb for continuity.	Across bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and if problem persists, replace cluster, repeat all tests.
3.	Off	With jumper still in place, disconnect conn. (27). Measure resistance between pin 16 , circuit 94E and ground.	Conn. (27)/ pin 16, cir. 94E to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 94E, then repair.
4.	Off/ On	Disconnect wire harness conn. (27). Move key switch to ignition position and measure voltage from pin 10, circuit 28 to ground.	Conn. (27)/ pin 10, cir. 28 to gnd.	12±1.5 volts.	Reconnect conn. (27). Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair. Reconnect connectors.
5.	On	With jumper still installed, reconnect conn. (27). Does warning light illuminate?		Warning light illuminates.	Go to next step.	Replace defective cluster assembly. Reconnect connector and clear fault codes.

Table 13 ABS Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
6.	Off	With ABS warning light relay conn. (4F) closed, measure resistance across ABS warning light relay.	Across switch.	<1 ohm.	Go to next step.	Replace defective ABS warning light relay. Reconnect relay conn. (4F).
7.	Off	At ABS warning light relay, measure resistance from ground wire to ground.	Near switch, ground wire to gnd.	<1 ohm.	Warning light circuits test good. Reconnect circuits. Reconnect (4F).	Locate open or poor connection in ground circuit, then repair.

5.8. HIGH BEAM INDICATOR

Table 14 High Beam Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off	Turn headlight switch to on, and change dimmer switch from low to high beam position. Check if headlights change from low to high beams.		Headlight high beams work. Cluster indicator doesn't.	Go to next step.	Headlights or high beams don't work or switch, and cluster indicator is also inoperative. Go to Step 5.
2.	Off	Remove instrument cluster and remove high beam indicator light bulb. Test bulb for continuity.	Across indicator light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb or replace cluster, repeat test if problem persists.
3.	Off	Disconnect conn. (27), move headlight switch to on, and dimmer switch to high beam position. Measure voltage from pin 4 of wire harness conn. (27), circuit 52A to gnd.	Conn. (27)/ pin 4 to gnd.	12±1.5 volts.	Go to next step.	Go to Step 5.

Table 14 High Beam Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
4.	Off	While alternating from high to low beam, measure voltage at wiring harness conn. (27), from pin 4, circuit 52A to pin 2, circuit 28-GB.	Conn. (27)/ pin 4 to pin 2.	Alternating from 0 to 12±1.5 volts.	High beam circuits check good.	If indicator lamp fails to illuminate, locate open or poor connection in circuit 28-GB or 11-GA, then repair. If light fails to turn off, check relay or switch. Go to next step.
5.	Off	Remove dimmer relay (4J). Move headlight switch to on, and dimmer switch to high beam position. Measure voltage from pin 3, circuit 51 to ground.	Socket (4J), pin 3, cir. 51 to gnd.	12±1.5 volts.	Go to next step.	Locate cause of low or no voltage in circuit 50, headlight switch or circuit 51, then repair.
6.	Off	With switches still set, at relay socket (4J), measure voltage from pin 1, circuit 51C to ground.	Socket (4J), pin 1, cir. 51C to gnd.	12±1.5 volts.	Go to next step.	Locate cause of low or no voltage in circuit 58, headlight switch or circuit 51C, then repair.
7.	Off	While switching from low to high beams, with headlights on, measure voltage at relay socket (4J), from pin 1, circuit 51C to pin 2, circuit 51D.	Socket (4J), pin 51C to 51D.	Switch from 0 to 12±1.5 volts.	Replace relay (4J).	Locate open or poor connection in circuit 51D, dimmer switch or conn. (192), circuit 51-G or 11-G to cab ground, then repair.
8.	Off	Re-install relay. With headlight switch in on position and dimmer switch in high beam position, at conn. (27), measure voltage from pin 4, circuit 52A to ground.	Conn. (27)/ pin 4 to gnd.	12±1.5 volts.	Circuits to cluster check good. Reconnect cluster. If warning light fails to illuminate, replace defective cluster.	Locate open or poor connection in circuit 52C or 52A, then repair. If the circuit checks good, replace dimmer relay.

5.9. COOLANT LEVEL INDICATOR

Table 15 Coolant Level Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	Disconnect coolant level tank MAG switch conn. (400), and connect a jumper wire on circuit 34B (going to warning light) to ground. Move key switch to ignition position. Does warning light illuminate?		Warning light illuminates.	Go to Step 6.	Go to next step.
2.	On	Remove instrument cluster and remove indicator bulb. Test bulb for continuity.	Across bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and if problem persists, replace cluster, repeat all tests.
3.	Off	With jumper still in place, disconnect conn. (27). Measure resistance between pin 17 , circuit 34B and ground.	Conn. (27)/ pin 17, cir. 34B to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 34B or ECM2 (6020) pin 4, then repair.
4.	Off/ On	Disconnect wire harness conn. (27). Move key switch to ignition position and measure voltage from pin 10, circuit 28 to ground.	Conn. (27)/ pin 10, cir. 28 to gnd.	12±1.5 volts.	Reconnect conn. (27). Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair. Reconnect connectors.
5.	On	With jumper still installed, reconnect conn. (27). Does warning light illuminate?		Warning light illuminates.	Go to next step.	Replace defective cluster assembly. Reconnect connector and clear fault codes.

Table 15 Coolant Level Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
6.	Off	With coolant level MAG sw. closed, measure resistance across coolant level switch.	Across switch.	<1 ohm.	Go to next step.	Replace defective coolant level switch. Reconnect (400).
7.	Off	At coolant level switch, measure resistance from ground wire to ground.	Near switch, ground wire to gnd.	<1 ohm.	Warning light circuits test good. Reconnect circuits. Reconnect (400).	Locate open or poor connection in ground circuit, then repair.

5.10. CHANGE OIL INDICATOR

CAUTION – Do not probe the ECM2 connectors with metal leads as it could damage the connector. Always use a Hickok 60 pin breakout box (ZTSE-4445) to test ECM related circuits.

Table 16 Change Oil Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	1. Turn key to RUN 2. Connect J1939 sniffer		Are both the engine (0x00) and the MSM (aka ESC) on the Datalink?	Go to step 2.	Go to step 4.
2.	Off/ On	1. Disconnect J1939 sniffer. 2. Connect Master Diagnostics 3. Monitor the "Change Oil" output.		Does the "Change Oil" output change?	Go to step 3.	ECM2 is not updating "Change Oil" output. See engine troubleshooting guide.
3.	Off/ On	1. Disconnect MSM connector (3041). 2. Connect pin 2 to ground.	(3041), pin 2 to gnd.	Does the "Change Oil" lamp turn on?	Replace MSM and retest	Go to next step.

Table 16 Change Oil Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
4.	Off	1. Remove instrument cluster. 2. Remove Change Oil indicator bulb. 3. Test bulb for continuity.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and repeat test.
5.	Off	1. Instrument cluster removed. 2. Measure resistance from disconnected conn. (28), pin 7, circuit 97AA to MSM disconnected conn. (3041) pin 2.	(28), pin 7, cir. 97AA to (3041) pin 2.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 97AA or cluster, then repair.
6.	Off/ On	1. Instrument cluster removed. 2. Move key switch to ignition. 3. Measure voltage from conn. (27), pin 10, circuit 28 to ground.	(27), pin 10, cir. 28 to gnd.	12±1.5 volts.	Install cluster. Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair.
7.	Off/ On	1. Leave J1939 sniffer connected		Is the engine (0x00) on the Datalink?	Go to step 8.	Go to step 11.
8.	Off/ On	1. Turn the key to OFF. 2. Disconnect MSM connector (3040). 3. Measure resistance across datalink pins 5 & 6, in wiring harness	(3040), pins 5 and 6.	Is the resistance approx. 60 ohms?	Go to step 9.	Fix datalink wiring, cir 5AM(-) and 5AL(+), retest

Table 16 Change Oil Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
9.	Off/ On	1. Turn the key to Ignition. 2. Measure the voltage at the MSM's harness ignition pin 7 to ground.	(3040), pin 7, cir 13MS.	Is the voltage 12-16 volts?	Go to step 7.	Fix wiring cir 13MS or fuse F20, retest.
10.	Off/ On	1. Measure the resistance between the MSM's harness ground pin 8 and ground	(3040), pin 8, cir 11–GM to gnd.	Is the resistance less than 10 ohms?	Replace MSM and retest	Fix ground wiring cir 11–GM and cab ground, retest.
11.	Off/ On	1. Leave J1939 sniffer connected NOTE: This assumes the "Change Oil" output can be monitored using MD.		Is the MSM (aka ESC) on the Datalink?	Check the engine's power connections and data link wiring.	Verify sniffer is working properly

5.11. AIR FILTER INDICATOR

Table 17 Air Filter Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	Disconnect filter minder switch conn. (3110), and connect a jumper wire on circuit 95 (going to warning light) to ground. Move key switch to ignition position. Does warning light illuminate?		Warning light illuminates.	Go to Step 6.	Go to next step.
2.	On	Remove instrument cluster and remove indicator bulb. Test bulb for continuity.	Across bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and if problem persists, replace cluster, repeat all tests.

Table 17 Air Filter Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
3.	Off	With jumper still in place, disconnect conn. (27). Measure resistance between pin 14 , circuit 95 and ground.	Conn. (27)/ pin 14, cir. 95 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 95, then repair.
4.	Off/ On	Disconnect wire harness conn. (27). Move key switch to ignition position and measure voltage from pin 10, circuit 28 to ground.	Conn. (27)/ pin 10, cir. 28 to gnd.	12±1.5 volts.	Reconnect conn. (27). Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair. Reconnect connectors.
5.	On	With jumper still installed, reconnect conn. (27). Does warning light illuminate?		Warning light illuminates.	Go to next step.	Replace defective cluster assembly. Reconnect connector and clear fault codes.
6.	Off	With filter minder sw. closed, measure resistance across filter minder switch.	Across switch.	<1 ohm.	Go to next step.	Replace defective filter minder switch. Reconnect (3110).
7.	Off	At filter minder switch, measure resistance from ground wire to ground.	Near switch, ground wire to gnd.	<1 ohm.	Warning light circuits test good. Reconnect circuits. Reconnect (3110).	Locate open or poor connection in ground circuit, then repair.

5.12. RANGE INHIBIT INDICATOR

Table 18 Range Inhibit Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	Disconnect Allison TCM conn. (3031), and connect a jumper wire on circuit 123 (going to warning light) to ground. Move key switch to ignition position. Does warning light illuminate?		Warning light illuminates.	Go to Step 6.	Go to next step.
2.	On	Remove instrument cluster and remove indicator bulb. Test bulb for continuity.	Across bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and if problem persists, replace cluster, repeat all tests.
3.	Off	With jumper still in place, disconnect conn. (27). Measure resistance between pin 5, circuit 123 and ground.	Conn. (27)/ pin 5, cir. 123 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 123, then repair.
4.	Off/ On	Disconnect wire harness conn. (27). Move key switch to ignition position and measure voltage from pin 10, circuit 28 to ground.	Conn. (27)/ pin 10, cir. 28 to gnd.	12±1.5 volts.	Reconnect conn. (27). Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair. Reconnect connectors.
5.	On	With jumper still installed, reconnect conn. (27). Does warning light illuminate?		Warning light illuminates.	Go to next step.	Replace defective cluster assembly. Reconnect connector and clear fault codes.

Table 18 Range Inhibit Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
6.	Off	With Range Inhibit sw. closed, measure resistance across Range Inhibit switch.	Across switch.	<1 ohm.	Go to next step.	Replace defective Range Inhibit switch. Reconnect (3031).
7.	Off	At Range Inhibit switch, measure resistance from ground wire to ground.	Near switch, ground wire to gnd.	<1 ohm.	Warning light circuits test good. Reconnect circuits. Reconnect (3031).	Locate open or poor connection in ground circuit, then repair.

5.13. LOW BATTERY INDICATOR

Table 19 Low Battery Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	On	Disconnect circuit 1C from lug 1 of alternator. Connect a jumper between wire from lug 1 and ground. Does warning light illuminate?		Warning light illuminates.	Warning light circuits test good. Troubleshoot alternator.	Go to next step.
2.	Off	Remove cluster and remove low voltage indicator light bulb. Test bulb for continuity.	Across indicator light bulb.	<100 ohms.	Go to next step.	Replace defective bulb or replace cluster, repeat tests if problem persists.
3.	Off	Disconnect conn. (28). With jumper still in place, measure resistance from pin 16 of wire harness conn. (28), circuit 1C to ground.	Conn. (28)/ pin 16, cir. 1C to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 1C, then repair.

Table 19 Low Battery Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
4.	On	Move key switch to ignition position and measure voltage at pin 10 of wiring harness conn. (27), circuit 28.	Conn. (27), pin 10, cir. 28.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28, conn. (27), fuse F3, then repair.
5.	On	With jumper still installed at circuit 1C, reconnect connector (28). Does indicator light?		Warning light illuminates.	Warning light circuits test good. Reconnect circuit 1C to alternator lug 1.	Replace defective cluster assembly and reconnect all connectors.

5.14. PARK BRAKE INDICATOR

Table 20 Park Brake Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	Disconnect park brake switch conn. (1PB), and connect a jumper wire on circuit 44A (going to warning light) to ground. Move key switch to ignition position. Does warning light illuminate?		Warning light illuminates.	Go to Step 6.	Go to next step.
2.	On	Remove instrument cluster and remove indicator bulb. Test bulb for continuity.	Across bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and if problem persists, replace cluster, repeat all tests.
3.	Off	With jumper still in place, disconnect conn. (28). Measure resistance between pin 17 , circuit 44 and ground.	Conn. (28)/ pin 17, cir. 44 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 44 or 44A, then repair.

Table 20 Park Brake Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
4.	Off/ On	Disconnect wire harness conn. (27). Move key switch to ignition position and measure voltage from pin 10, circuit 28 to ground.	Conn. (27)/ pin 10, cir. 28 to gnd.	12±1.5 volts.	Reconnect conn. (27). Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair. Reconnect connectors.
5.	On	With jumper still installed, reconnect conn. (28). Does warning light illuminate?		Warning light illuminates.	Go to next step.	Replace defective cluster assembly. Reconnect connector and clear fault codes.
6.	Off	With parking brake applied, measure resistance across park brake switch.	Across switch.	<1 ohm.	Go to next step.	Replace defective park brake switch. Reconnect (1PB).
7.	Off	At park brake switch, measure resistance from ground wire to ground.	Near switch, ground wire to gnd.	<1 ohm.	Warning light circuits test good. Reconnect circuits. Reconnect (1PB).	Locate open or poor connection in ground circuit, then repair.

5.15. BRAKE PRESSURE INDICATOR

Table 21 Brake Pressure Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	Disconnect hydraulic brake booster monitor module conn. (49). Use a test jumper to connect pin C, circuit 90T of wire harness connector to ground. Move key switch to ignition position. Does alarm sound and warning light illuminate?		Warning light illuminates and alarm sounds.	Warning light circuits test good. Turn key off, reconnect conn. (49), and turn key on. If warning light does not illuminate during bulb check, replace brake monitor module.	Go to next step.
2.	Off	Remove instrument cluster and remove brake pressure light bulb. Test bulb for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb or replace cluster, reconnect connector. If problem persists, repeat all tests.
3.	Off	Disconnect conn. (28). With jumper still attached at conn. (49), measure resistance from pin 9 of conn. (28), circuit 90T to ground.	Conn. (28)/ pin 9, cir. 90T to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 90T, then repair. Reconnect connectors.
4.	Off/ On	Disconnect wire harness connector (27). Move key switch to ignition position and measure voltage from pin 10, circuit 28 to ground.	Conn. (27)/ pin 10, cir. 28 to gnd.	12±1.5 volts.	Reconnect conn. (27). Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair. Reconnect connectors.
5.	On	With jumper still installed at conn. (49), reconnect conn. (28). Does warning light illuminate and an alarm sound?		Warning light illuminates and alarm sounds.	Warning light circuits test good. Reconnect conn. (49).	Replace defective cluster assembly. Reconnect connector.

5.16. OIL/WATER INDICATOR

CAUTION – Do not probe the ECM2 connectors with metal leads as it could damage the connector. Always use a Hickok 60 pin breakout box (ZTSE-4445) to test ECM related circuits.

Table 22 Oil/Water Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	1. Turn key to RUN 2. Connect J1939 sniffer		Are both the engine (0x00) and the MSM (aka ESC) on the Datalink?	Go to step 2.	Go to step 4.
2.	Off/ On	1. Disconnect J1939 sniffer. 2. Connect Master Diagnostics 3. Monitor the "Oil/Water" output.		Does the "Oil/Water" output change?	Go to step 3.	ECM2 is not updating "Oil/Water" output. See engine troubleshooting guide.
3.	Off/ On	1. Disconnect MSM connector (3040). 2. Connect pin 1 to ground.	(3040), pin 1 to gnd.	Does the "Oil/Water" lamp turn on and alarm sounds?	Replace MSM and retest	Go to next step.
4.	Off	1. Remove instrument cluster. 2. Remove Oil/Water indicator bulb. 3. Test bulb for continuity.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and repeat test.
5.	Off	1. Instrument cluster removed. 2. Measure resistance from disconnected conn. (28), pin 14, circuit 97AF to MSM disconnected conn. (3040) pin 1.	(28), pin 14, cir. 97AF to (3040) pin 1.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 97AF or cluster, then repair.

Table 22 Oil/Water Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
6.	Off/ On	1. Instrument cluster removed. 2. Move key switch to ignition. 3. Measure voltage from conn. (27), pin 10, circuit 28 to ground.	(27), pin 10, cir. 28 to gnd.	12±1.5 volts.	Install cluster. Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair.
7.	Off/ On	1. Leave J1939 sniffer connected		Is the engine (0x00) on the Datalink?	Go to step 8.	Go to step 11.
8.	Off/ On	1. Turn the key to OFF. 2. Disconnect MSM connector (3040). 3. Measure resistance across datalink pins 5 & 6, in wiring harness	(3040), pins 5 and 6.	Is the resistance approx. 60 ohms?	Go to step 9.	Fix datalink wiring, cir 5AM(-) and 5AL(+), retest
9.	Off/ On	1. Turn the key to Ignition. 2. Measure the voltage at the MSM's harness ignition pin 7 to ground.	(3040), pin 7, cir 13MS.	Is the voltage 12-16 volts?	Go to step 7.	Fix wiring cir 13MS or fuse F20, retest.
10.	Off/ On	1. Measure the resistance between the MSM's harness ground pin 8 and ground	(3040), pin 8, cir 11–GM to gnd.	Is the resistance less than 10 ohms?	Replace MSM and retest	Fix ground wiring cir 11–GM and cab ground, retest.
11.	Off/ On	1. Leave J1939 sniffer connected NOTE: This assumes the "Oil/Water" output can be monitored using MD.		Is the MSM (aka ESC) on the Datalink?	Check the engine's power connections and data link wiring.	Verify sniffer is working properly

5.17. WARN ENGINE INDICATOR

CAUTION – Do not probe the ECM2 connectors with metal leads as it could damage the connector. Always use a Hickok 60 pin breakout box (ZTSE-4445) to test ECM related circuits.

Table 23 Warn Engine Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	1. Turn key to RUN 2. Connect J1939 sniffer		Are both the engine (0x00) and the MSM (aka ESC) on the Datalink?	Go to step 2.	Go to step 4.
2.	Off/ On	1. Disconnect J1939 sniffer. 2. Connect Master Diagnostics 3. Monitor the "Warn Engine" output.		Does the "Warn Engine" output change?	Go to step 3.	ECM2 is not updating "Warn Engine" output. See engine troubleshooting guide.
3.	Off/ On	1. Disconnect MSM connector (3040). 2. Connect pin 9 to ground.	(3040), pin 9 to gnd.	Does the "Warn Engine" lamp turn on?	Replace MSM and retest	Go to next step.
4.	Off	1. Remove instrument cluster. 2. Remove Warn Engine indicator bulb. 3. Test bulb for continuity.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and repeat test.
5.	Off	1. Instrument cluster removed. 2. Measure resistance from disconnected conn. (28), pin 15, circuit 97T to MSM disconnected conn. (3040) pin 9.	(28), pin 15, cir. 97T to (3040) pin 9.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 97T or cluster, then repair.

Table 23 Warn Engine Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
6.	Off/ On	1. Instrument cluster removed. 2. Move key switch to ignition. 3. Measure voltage from conn. (27), pin 10, circuit 28 to ground.	(27), pin 10, cir. 28 to gnd.	12±1.5 volts.	Install cluster. Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair.
7.	Off/ On	1. Leave J1939 sniffer connected		Is the engine (0x00) on the Datalink?	Go to step 8.	Go to step 11.
8.	Off/ On	1. Turn the key to OFF. 2. Disconnect MSM connector (3040). 3. Measure resistance across datalink pins 5 & 6, in wiring harness	(3040), pins 5 and 6.	Is the resistance approx. 60 ohms?	Go to step 9.	Fix datalink wiring, cir 5AM(-) and 5AL(+), retest
9.	Off/ On	1. Turn the key to Ignition. 2. Measure the voltage at the MSM's harness ignition pin 7 to ground.	(3040), pin 7, cir 13MS.	Is the voltage 12-16 volts?	Go to step 7.	Fix wiring cir 13MS or fuse F20, retest.
10.	Off/ On	1. Measure the resistance between the MSM's harness ground pin 8 and ground	(3040), pin 8, cir 11–GM to gnd.	Is the resistance less than 10 ohms?	Replace MSM and retest	Fix ground wiring cir 11–GM and cab ground, retest.
11.	Off/ On	1. Leave J1939 sniffer connected NOTE: This assumes the "Warn Engine" output can be monitored using MD.		Is the MSM (aka ESC) on the Datalink?	Check the engine's power connections and data link wiring.	Verify sniffer is working properly

5.18. SUSPENSION LOW AIR INDICATOR

Table 24 Suspension Low Air Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	Disconnect low air pressure conn. switch (475). Use a test jumper to connect pin C, circuit 40 (on wire harness not going to air tank) to ground. Move key switch to ignition position. Does warning light illuminate?		Warning light illuminates.	Go to Step 5.	Go to next step.
2.	Off	Remove instrument cluster and remove indicator bulb. Test bulb for continuity.	Across bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and if problem persists, replace cluster, repeat test.
3.	Off/ On	Disconnect wire harness conn. (27). Move key switch to ignition position and measure voltage from pin 10, circuit 28 to ground.	Conn. (27)/ pin 10, cir. 28 to gnd.	12±1.5 volts.	Reconnect conn. (27). Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair. Reconnect connectors.
4.	Off	Measure resistance between pin C of conn. (475) and pin 13 of conn. (28).	Pin C of conn. (475) and pin 13 of conn. (28).	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 40 and 40A, then repair.
5.	Off	Drain air from suspension system and measure the resistance across pins A and C of conn. (475) on air tank.	Across switch.	<1 ohm.	Go to next step.	Replace defective air pressure switch.

Table 24 Suspension Low Air Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
6.	Off	At pin A of air pressure switch conn. (475), circuit 61-G, measure resistance to ground.	Pin A of conn. (475), cir. 61-G to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 61-G, then repair.
7.	On	With jumper still installed, reconnect connector (28). Does warning light illuminate?		Warning light illuminates.	Warning light circuits test good. Reconnect circuits.	Replace defective cluster assembly.

5.19. SUSPENSION LOW AIR ALARM

Table 25 Suspension Low Air Alarm

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	Disconnect low air pressure conn. switch (475). Use a test jumper to connect pin C, circuit 40 (on wire harness not going to air tank) to ground. Move key switch to ignition position. Does alarm sound?		Alarm sounds.	Go to next step.	Go to Step 4.
2.	Off	Drain air from suspension system and measure resistance across pins A and C of conn. (475) on air tank.	Across switch.	<1 ohm.	Go to next step.	Replace defective air pressure switch.
3.	Off	At pin A of air pressure switch conn. (475), circuit 61-G, measure resistance to ground.	Pin A of conn. (475), cir. 61-G to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 61-G, then repair.

Table 25 Suspension Low Air Alarm (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
4.	On	Measure voltage at pin 2 of conn. (474) on wiring harness.	Pin 2 of conn. (474).	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 61A from fuse F15, then repair. Reconnect connectors.
5.	Off	Measure resistance between pin A of conn. (475) and ground.	Conn. (475), pin A to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 61-G, then repair.
6.	Off	Measure resistance between pin C of conn. (475) and pin 5 of conn. (474).	Conn. (475), pin C to conn. (474), pin 5.	<1 ohm.	Replace defective low air alarm. Reconnect conn. (474) and (475).	Locate open or poor connection in circuit 40, then repair.

5.20. CHECK TRANS INDICATOR

Table 26 Check Trans Indicator

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	Disconnect Allison TCM conn. (3031), and connect a jumper wire on circuit 125 (going to warning light) to ground. Move key switch to ignition position. Does warning light illuminate?		Warning light illuminates.	Go to Step 6.	Go to next step.
2.	On	Remove instrument cluster and remove indicator bulb. Test bulb for continuity.	Across bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and if problem persists, replace cluster, repeat all tests.
3.	Off	With jumper still in place, disconnect conn. (28). Measure resistance between pin 7, circuit 125 and ground.	Conn. (28)/ pin 7, cir. 125 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 125, then repair.

Table 26 Check Trans Indicator (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
4.	Off/ On	Disconnect wire harness conn. (27). Move key switch to ignition position and measure voltage from pin 10, circuit 28 to ground.	Conn. (27)/ pin 10, cir. 28 to gnd.	12±1.5 volts.	Reconnect conn. (27). Go to next step.	Locate cause of no or low voltage in circuit 28 from fuse F13, then repair. Reconnect connectors.
5.	On	With jumper still installed, reconnect conn. (27). Does warning light illuminate?		Warning light illuminates.	Go to next step.	Replace defective cluster assembly. Reconnect connector and clear fault codes.
6.	Off	With Check Trans sw. closed, measure resistance across Check Trans switch.	Across switch.	<1 ohm.	Go to next step.	Replace defective Check Trans switch. Reconnect (3031).
7.	Off	At Check Trans switch, measure resistance from ground wire to ground.	Near switch, ground wire to gnd.	<1 ohm.	Warning light circuits test good. Reconnect circuits. Reconnect (3031).	Locate open or poor connection in ground circuit, then repair.

5.21. FUEL FILTER INDICATOR (OPTION)

Table 27 Fuel Filter Indicator (Option)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
1.	Off/ On	Disconnect conn. (401) from fuel filter vacuum switch. Connect pin B, circuit 19E to ground with a jumper wire. Move key switch to ignition position. Does warning light illuminate?		Warning light illuminates.	Warning light circuits test good. Reconnect conn. (401). If warning lights fails to illuminate when filter becomes restricted, replace vacuum switch.	Go to next step.
2.	On	Remove cluster and remove fuel filter indicator bulb. Test bulb for continuity.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb or replace cluster, repeat test if problem persists.
3.	Off/ On	Disconnect wire harness conn. (27). Move key switch to ignition position and measure voltage from pin 10, circuit 28 to ground.	Conn. (27)/ pin 10, cir. 28 to gnd.	12±1.5 volts.	Reconnect conn. (27). Go to next step.	Locate cause of no or low voltage in circuit 28, connector (27), then repair.
4.	Off	With jumper still in place, measure resistance from pin 3 of conn. (28), circuit 19B to ground.	Conn. (28), pin 3, cir. 19B to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 19B, conn. (28), conn. (2) or circuit 19E, then repair.
5.	Off/ On	Re-install cluster and bulb. Move key switch to ignition position. Does warning light illuminate?		Warning light illuminates.	Warning light circuits test good. Reconnect conn. (401).	Replace defective cluster assembly.