SERVICE MANUAL SECTION

INSTRUMENTS (Data Link Driven Instrument Cluster)

Model: FE 300
Start Date: 03/01/2004

Model: IC Bus
Start Date: 03/01/2000
End Date: 03/01/2004

S08313

01/29/2007

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1. DESCRIPTION

1.1. GENERAL

All instruments are located on the instrument panel in a demountable instrument cluster (Figure 1) directly in front of the driver. Gauges and panel lights of the cluster are connected to the vehicle electrical system by three connectors mounted to the back side of the cluster.

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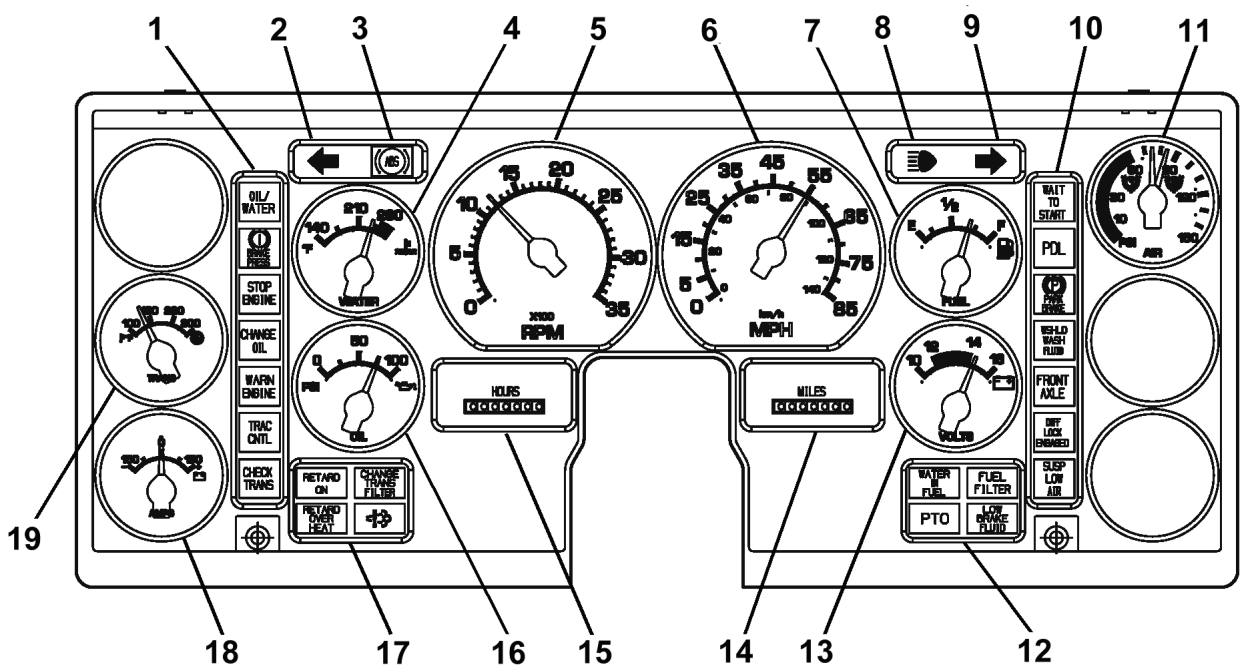

Figure 1 Instrument Cluster

Table 1

1. LEFT WARNING LIGHTS:	8. HIGH BEAM INDICATOR	12. RIGHT PACK WARNING LIGHTS:
A. OIL/WATER	9. RIGHT TURN INDICATOR	A. WATER-IN-FUEL
B. ((P)) BRAKE PRESS	10. RIGHT WARNING LIGHTS	B. FUEL FILTER
C. STOP ENGINE	A. WAIT-TO-START	C. PTO
D. CHANGE OIL	B. PDL	D. LOW BRAKE FLUID
E. WARN ENGINE	C. ((P)) PARK BRAKE	13. VOLTMETER GAUGE
F. TRAC CTRL	C. ((P)) LOW AIR	14. ODOMETER
G. CHECK TRANS	D. WSHLD WASH FLUID	15. HOURMETER
2. LEFT TURN INDICATOR	E. FRONT AXLE	16. ENGINE OIL PRESSURE GAUGE
3. (ABS) ANTI-LOCK BRAKE WARNING LIGHT	F. DIFF LOCK ENGAGED	17. LEFT PACK WARNING LIGHTS:
4. ENGINE WATER TEMPERATURE GAUGE	G. SUSP LOW AIR	A. RETARD ON
5. TACHOMETER GAUGE	11. DUAL AIR PRESSURE GAUGE (WITH AIR BRAKES ONLY)	B. CHANGE TRANS FILTER
6. SPEEDOMETER GAUGE		C. RETARD OVER HEAT
7. FUEL LEVEL GAUGE		D. ALTERNATOR
		18. AMMETER
		19. TRANSMISSION OIL TEMPERATURE GAUGE

The speedometer, odometer, tachometer, hour-meter, voltmeter, oil pressure gauge, and water temperature gauge are microprocessor driven. All other gauges are directly driven by either a sensor or mechanical connection. Gauges and meters are free floating at power off (key switch turned off) and may not return to a "zero" position when electrical power is removed.

1.2. SPEEDOMETER GAUGE

An electronic speedometer gauge (Figure 2) is located in the instrument cluster and it indicates miles and kilometers per hour. The electronic speedometer system consists of the dash mounted air core gauge, microprocessor, transmission mounted vehicle speed sensor (VSS), engine ECM2, data link and circuits that connect the units.

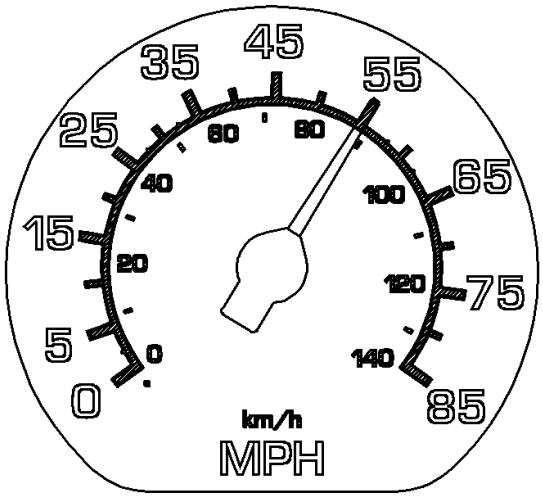

Figure 2 Speedometer Gauge

1.3. ODOMETER

The odometer (Figure 3) is a solenoid activated mechanical counter unit driven by the cluster microprocessor to log mileage traveled by the vehicle.

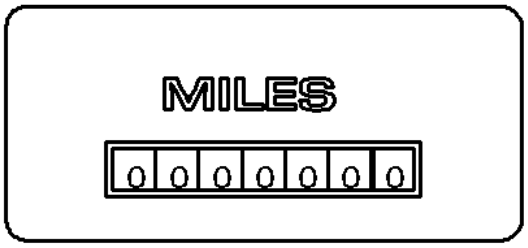

Figure 3 Odometer

1.4. TACHOMETER GAUGE

The electronic tachometer gauge (Figure 4) is located in the instrument cluster to record engine RPM (Revolutions Per Minute). The instrument enables drivers to keep engine speed within an efficient operating range. The electronic tachometer system consists of a dash mounted air core gauge and microprocessor, engine mounted camshaft position sensor, engine ECM2, data link and circuits that connect the units.

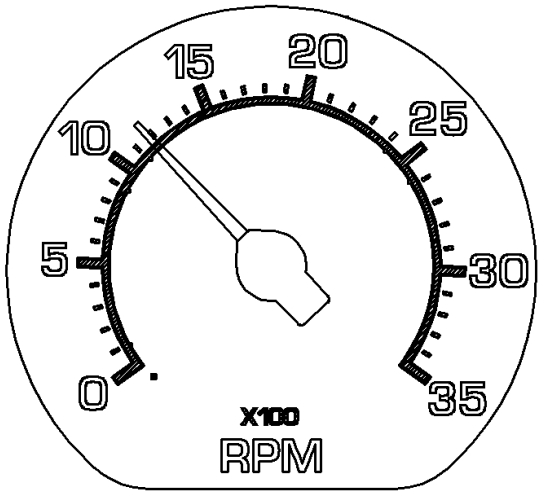

Figure 4 Tachometer Gauge

1.5. HOUR-METER

The hour-meter (Figure 5) is a solenoid activated mechanical counter type unit driven by the cluster microprocessor.

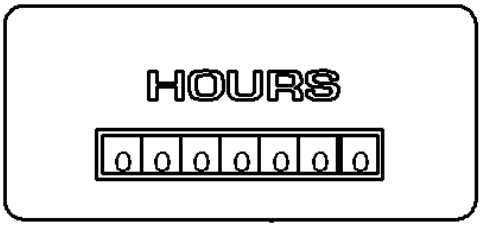

Figure 5 Hour-meter

1.6. VOLTMETER GAUGE

An electronic voltmeter gauge (Figure 6) is located in the instrument cluster. It is used to indicate the battery voltage available for the vehicle systems.

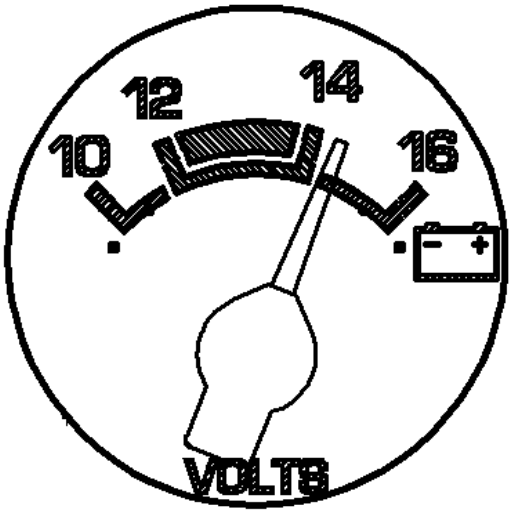

Figure 6 Voltmeter Gauge

1.7. ENGINE OIL PRESSURE GAUGE

An electronic engine oil pressure gauge (Figure 7) is located in the instrument cluster. It is used to indicate the engine oil pressure.

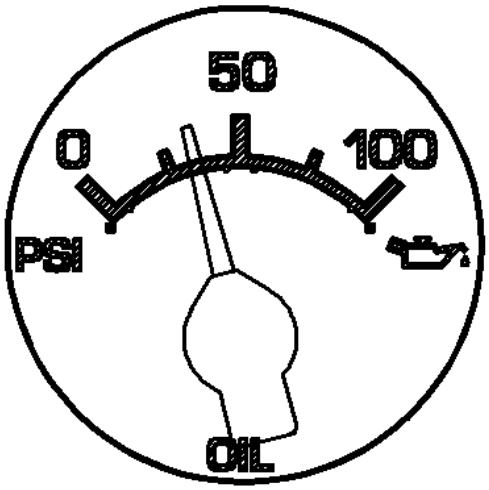

Figure 7 Engine Oil Pressure Gauge

1.8. DUAL AIR PRESSURE GAUGE

A dual readout pressure gauge (Figure 8) is located in the instrument cluster. It is used to indicate the air pressure in both the primary and secondary systems.

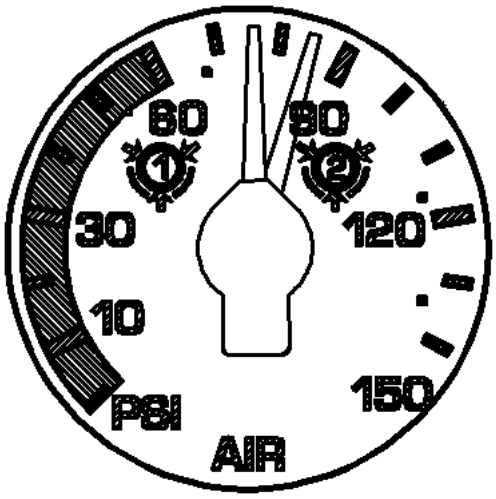

Figure 8 Dual Air Pressure Gauge

1.9. FUEL LEVEL GAUGE

An electric fuel level gauge (Figure 9) is located in the instrument cluster. It is used to indicate the amount of fuel contained in the vehicle's fuel tank(s).

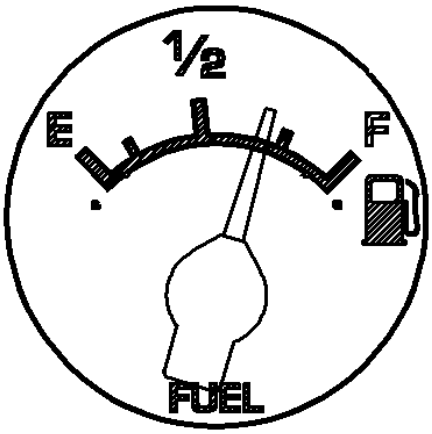

Figure 9 Fuel Level Gauge

1.10. ENGINE WATER TEMPERATURE GAUGE

An electronic engine water temperature gauge (Figure 10) is located in the instrument cluster. It is used to indicate the operating temperature of the engine.

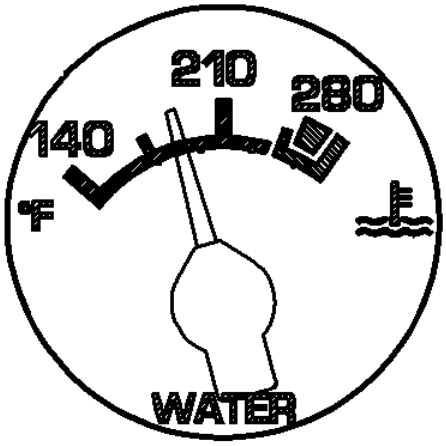

Figure 10 Engine Water Temperature Gauge

1.11. TRANSMISSION OIL TEMPERATURE GAUGE

An electronic transmission oil temperature gauge (Figure 11) is located in the instrument cluster. It is used to indicate the operating transmission oil temperature of the transmission.

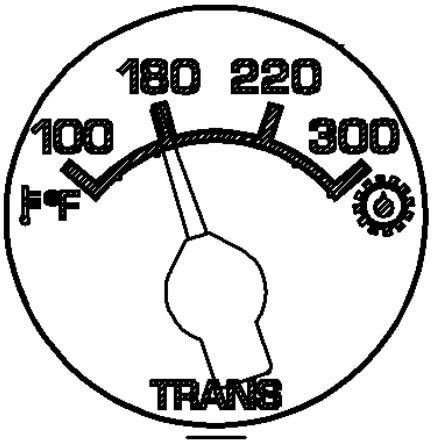

Figure 11 Transmission Oil Temperature Gauge

1.12. AMMETER GAUGE

The ammeter gauge (150 AMP) (Figure 12) is connected between the batteries ("B" terminal of cranking motor solenoid) and the alternator "B" terminal which has connected to it the vehicle loads (less the cranking motor). Thus when the alternator is charging the batteries, current flows through the ammeter and registers a positive reading. When the vehicle loads are greater than the output of the alternator, power flows from the batteries through the ammeter in the opposite direction, registering a negative reading.

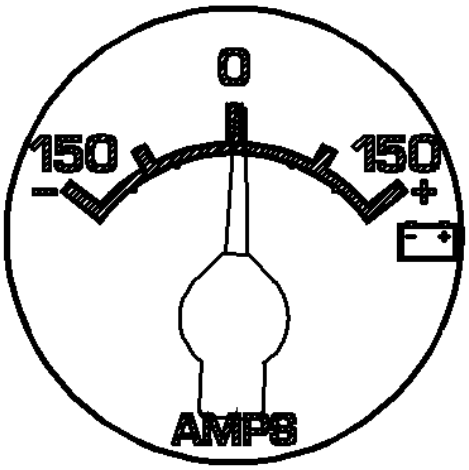

Figure 12 Ammeter Gauge

1.13. INDICATOR AND WARNING LIGHTS

OIL/WATER

The "OIL/WATER" warning light (Figure 1, Item 1.A) and red lens provide a warning, to driver of the vehicle, that the engine's oil pressure is running low, that its coolant temperature is running high, or the coolant level is low (with electronic engines). Thus the driver can take the necessary actions to protect the engine. This light is also used with International engines to signal that the engine is going to shut down in 30 seconds due to either idle shutdown counter or engine protection system.

((P)) BRAKE PRESS

The "BRAKE PRESS" warning light (Figure 1, Item 1.B) and red lens provide a warning, to the driver of the vehicle, that one of the following conditions is present: the air pressure has dropped below an acceptable level to keep the brakes fully released with an air brake system, or that there is an abnormal condition detected by the hydraulic brake monitor module.

STOP ENGINE

The "STOP ENGINE" warning light (Figure 1, Item 1.C) and red lens, used with International engines, provide a warning, to the driver of the vehicle, that the engine is going to shut down in 30 seconds due to either the idle shutdown timer or engine protection circuits.

CHANGE OIL

The "CHANGE OIL" warning light (Figure 1, Item 1.D) and yellow lens provide an indication, to the driver of the vehicle, that it is time to get the vehicle in for an oil change. This feature, available on vehicles with the International consolidated engine controller (CEC), keeps track of mileage and engine hours by using a programmed service interval counter to determine that it is time to change the engine oil and turn on the warning light.

WARN ENGINE

The "WARN ENGINE" warning light (Figure 1, Item 1.E) and yellow lens provide a warning, to the driver of the vehicle, that a sensor or system of the engine is not performing as it should. This condition could be affecting performance and or emissions, and indicates that the driver should get the vehicle into a shop for servicing.

This light is also used in conjunction with the (STI) Self Test Initialization switch and "STOP ENGINE" light to display active and inactive engine fault codes.

TRAC CNTL

The "TRAC CNTL" warning light (Figure 1, Item 1.F) and green lens provide a warning, to the driver of the vehicle, that the optional traction control circuitry has been engaged, and that the anti-lock braking has been switched off.

CHECK TRANS

The "CHECK TRANS" warning light (Figure 1, Item 1.G) and yellow lens provide a warning, to the driver of the vehicle, that the transmission is overheating (with Allison nonelectronic transmissions), or that the transmission is overheating, or the ECU senses a problem with the Allison WTEC III electronic transmissions or with the Allison 2000 (LCT) transmissions.

LEFT TURN

The left turn arrow indicator light (Figure 1, Item 2) and green lens provide an indication, to the driver of the vehicle, that the turn signal switch is in the left turn position by blinking in unison with the turn signal lights.

(ABS) ANTI-LOCK BRAKE

The "ABS" indicator light (Figure 1, Item 3) and yellow lens provide an indication, to the driver of the vehicle, that the anti-lock brake system is activating and overriding the engine retarder. The light will also illuminate when a fault in the ABS system is detected by the ABS controller.

HIGH BEAM

The high beam indicator light (Figure 1, Item 8) and blue lens provide an indication, to the driver of the vehicle, that the headlights are on and switched to the bright position.

RIGHT TURN

The right turn arrow indicator light (Figure 1, Item 9) and green lens provide an indication, to the driver of the vehicle, that the turn signal switch is in the right turn position by blinking in unison with the turn signal lights.

WAIT-TO-START

The "WAIT-TO-START" warning light (Figure 1, Item 10.A) and yellow lens signals the driver to hold off on cranking over the engine until the glow plugs have heated up.

PDL

The power divider lock "PDL" warning light (Figure 1, Item 10.B) and yellow lens provide an indication, to the driver of the vehicle, that the power divider lock is engaged. Thus the driver can remember to unlock the power divider when acceptable road surfaces are reached.

((P)) PARK BRAKE

The "((P)) PARK BRAKE" warning light (Figure 1, Item 10.C) and red lens provide an indication, to the driver of the vehicle, that the parking brake is applied. This light is utilized with both air and hydraulic brake systems.

((P)) LOW AIR

The "((P))"ark brake "LOW AIR" warning light (Figure 1, Item 10.C) and red lens warns the driver that the air park brake system has either not yet pumped up to a pressure that will reliably release the park brake, or that the system is losing pressure and the park brake is going to apply. The light is used only with SE code orders.

WSHLD WASH FLUID

The "WSHLD WASH FLUID" warning light (Figure 1, Item 10.D) and yellow lens provide an indication, to the driver of the vehicle, that the windshield washer reservoir tank is low on windshield washer fluid.

FRONT AXLE

The "FRONT AXLE" warning light (Figure 1, Item 10.E) and yellow lens provide an indication, to the driver of the vehicle, that the transfer case has shifted to transfer power to the front drive shaft and axle, thus indicating that the vehicle is in four wheel drive.

DIFF LOCK ENGAGED

The "DIFF LOCK ENGAGED" warning light (Figure 1, Item 10.F) and yellow lens provide an indication, to the driver of the vehicle, that the differential lock is engaged. Thus the driver can remember to unlock the differential when acceptable road surfaces are reached.

SUSP LOW AIR

The "SUSP LOW AIR" warning light (Figure 1, Item 10.G) and red lens warn the driver that the air suspension system has not yet pumped up to a safe level for operation, or that a leak has developed in the system and that it is deflating.

WATER-IN-FUEL

The "WATER-IN-FUEL" warning light (Figure 1, Item 12.A) and yellow lens provide an indication, to the driver of the vehicle, that there is water up to the probe in the fuel filter. Thus the driver knows that the filter must be drained or changed to prevent water from getting into the engine.

FUEL FILTER

The "FUEL FILTER" warning light (Figure 1, Item 12.B) and yellow lens provide an indication, to the driver of the vehicle, that the fuel filter is becoming excessively plugged or restricted. Thus the filter should be changed to prevent hard starting, power limiting, or stalling.

PTO

A location for a bodybuilder to install a "Power Take Off (PTO)" warning light (Figure 1, Item 12.C) is supplied in the instrument cluster, and a red lens is also provided.

LOW BRAKE FLUID

A "LOW BRAKE FLUID" warning light (Figure 1, Item 12.D) and red lens is used to warn the driver of the vehicle that the brake master cylinder is low on fluid.

RETARD ON

The "RETARD ON" indicator light (Figure 1, Item 17.A) and green lens provide an indication, to the driver of the vehicle, that the transmission retarder has been enabled. Thus the driver will be reminded to turn off the retarder when road surfaces are slippery.

CHANGE TRANS FILTER

The "CHANGE TRANS FILTER" warning light (Figure 1, Item 17.B) and yellow lens provide a warning, to the driver of the vehicle, that the transmission fluid filter has become restricted.

RETARD OVER HEAT

The "RETARD OVER HEAT" warning light (Figure 1, Item 17.C) and red lens provide an indication, to the driver of the vehicle, that the transmission retarder has reached an unsafe operating temperature. At this point the driver should switch off the retarder and allow it to cool before turning it back on.

ALTERNATOR

An "ALTERNATOR" warning light (Figure 1, Item 17.D) and yellow lens provide an indication, to the driver of the vehicle, that the charging voltage to the battery is low.

2. OPERATION

2.1. SPEEDOMETER GAUGE

The sensor (Figure 13) is a magnetic pick up that senses the rotation of a 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 Fuller manual transmission, these are transmitted through connector (303), on circuits K47 and K47A, to connector (6021) on the ECM2. When Allison WTEC automatic transmission, these are transmitted from connector (7983), on circuits K139 and K148, to connector (7203) on the ECU, and these are transmitted from the control module connector (7204), on circuits K157, to connector (6021) on the ECM2. Or, Allison 2000 (LCT) automatic transmission, these are transmitted from connector (7600), on circuits K215 and K216, to connector (7304) on the TCM, and these are transmitted from the control module connector (7305), on circuits K126/K126W, 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 A98E(+) and A98F(-) to pins 7 and 9 of connector (11), into the instrument cluster. The instrument cluster's microprocessor drives the speedometer.

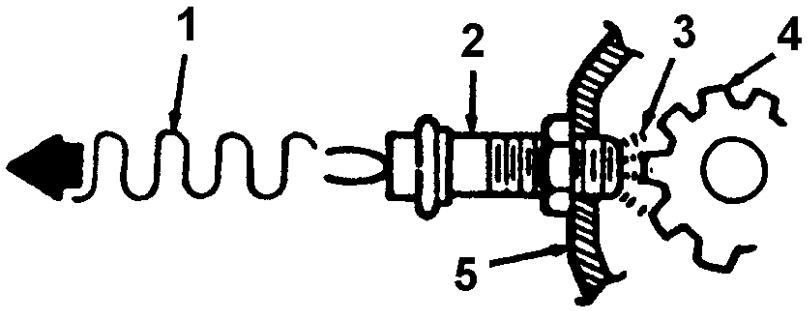

Figure 13 Speedometer Operation

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

A permanent magnet located in the sensor establishes a magnetic field at the tip of the sensor. The magnetic field is repeatedly interrupted by the teeth of the speedometer gear in the transmission, creating voltage impulses that are transmitted to the ECM2 which converts the analog signal to a digital data signal and feeds it to the speedometer.

2.2. ODOMETER

The electronic odometer system consists of a dash mounted, solenoid activated, mechanical counter and microprocessor. The microprocessor's internal counter advances the odometer 1/10 mile after counting the appropriate distance based on vehicle speed sensor information. In addition, the microprocessor's internal counter advances 1/20 mile every time the ignition is turned on to minimize odometer error by replacing the accumulated mileage that is less than 1/10 mile (lost when key switch is turned off) with an average value of 1/2 of 1/10 mile or 1/20 mile. This provides for a very accurate odometer.

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

2.3. TACHOMETER GAUGE

The camshaft position sensor is a magnetic pickup that senses the rotation of the engine's camshaft timing disk. The sensor's permanent magnet establishes a magnetic field at the tip of the sensor. This magnetic field is interrupted regularly by the windows in the camshaft timing disk. This interruption creates voltage impulses that are transmitted to the engine ECM2. The ECM2 converts the sensor signal to a digital data signal. This signal is transferred over the data link on circuits A98E(+) and A98F(-) to pins 7 and 9 of connector (11), into the instrument cluster. The instrument cluster's microprocessor drives the tachometer. Refer to the appropriate engine service manual for camshaft position sensor operation, adjustment and repair.

2.4. HOUR-METER

The electronic hour-meter system consists of a dash mounted, solenoid activated, mechanical counter and microprocessor. The microprocessor internal timer advances the hour-meter 1/10 hour for every 6 minutes that the engine is running (above 300 rpm). In addition, the microprocessor's internal timer advances its counter 3 minutes every time the ignition is turned on to minimize hour-meter error by replacing the accumulated time that is less than 1/10 hour (lost when key switch is turned off) with an average value of 1/2 of 1/10 hour or 3 minutes. This provides for a very accurate engine hour-meter.

2.5. VOLTMETER GAUGE

The battery voltage is measured by the engine ECM2, converted to a data signal, and transferred over the data link to the instrument cluster's microprocessor. This signal is transferred over the data link on circuits A98E(+) and A98F(-) to pins 7 and 9 of connector (11), into the instrument cluster. The instrument cluster's processor then drives the voltmeter display gauge.

2.6. ENGINE OIL PRESSURE GAUGE

The engine oil pressure is measured by an electrical sending unit, and fed to the engine ECM2. The ECM2 converts the electrical voltage into a data signal, and transfers it over the data link to the instrument cluster's microprocessor. This signal is transferred over the data link on circuits A98E(+) and A98F(-) to pins 7 and 9 of connector (11), into the instrument cluster. The instrument cluster's processor then drives the oil pressure display gauge.

2.7. DUAL AIR PRESSURE GAUGE

The dual read out pressure gauge is plumbed, with air lines, to both the primary and secondary air systems of the vehicle, thus displaying the pressure in PSI of both systems (a pointer for each system) at the same time.

2.8. FUEL LEVEL GAUGE

The battery voltage is to circuit A13/A13F, fuse F22, circuit A28/A28B, the green instrument cluster (11), pin 10 to the fuel gauge. The level of fuel in the vehicle fuel tank is sensed by the fuel sending unit (37). The sending unit feeds an electrical voltage through circuit K36, pin A of connector (37), circuit K36, pin D of connector (2) and circuit A36, pin 3 of connector (11) to the fuel gauge, which displays the fuel level. The fuel sender (37) pin B is grounded through circuits K36–G/K11–GJ to the (J10) engine ground. The fuel gauge is grounded through pin 2 of connector (11) circuits A28–G/A11–GB/A11–G to the (J1) platform ground.

2.9. ENGINE WATER TEMPERATURE GAUGE

The engine water temperature is measured by an electrical sending unit and is fed to the engine ECM2. The ECM2 converts the electrical voltage into a data signal, and transfers it over the data link to the instrument cluster's microprocessor. This signal is transferred over the data link on circuits A98E(+) and A98F(-) to pins 7 and 9 of connector (11), into the instrument cluster. The instrument cluster's processor then drives the water temperature display gauge.

2.10. TRANSMISSION OIL TEMPERATURE GAUGE

The battery voltage is to circuit A13/A13F, fuse F22, circuit A28/A28A, the yellow instrument cluster connector (10), pin 1 to the transmission oil temperature gauge. The transmission temperature is sensed by the transmission temperature sending unit (38). The sending unit feeds an electrical voltage through pin A of connector (38), circuit K31, pin F of connector (2) and circuit A31, pin 17 of the yellow instrument cluster connector (10) to the transmission oil temperature gauge, which displays the transmission oil temperature. The transmission temperature sending unit (38) pin B is grounded through circuits K31–G/K11–GJ to the (J10) engine ground. The transmission oil temperature gauge is grounded through pin 6 of connector (10) circuits A28–GA/A11–GB/A11–G to the (J1) platform ground.

2.11. AMMETER GAUGE (SHUNT)

The ammeter gauge current flows through the circuit K26, pin L of connector (15) and circuit A26, pin 16 of the yellow instrument cluster connector (10) to the ammeter gauge, which displays the positive or negative current flow. The ammeter gauge is grounded through pin 7 of connector (10) circuits A26A, pin M of connector (15), circuits K26A and K26A-FL to the "B" terminal of cranking motor solenoid.

2.12. INDICATOR AND WARNING LIGHTS

OIL/WATER: FE 300 With Air Brakes

The alarm receives power from fuse F24 over circuit A13B, and the oil/water warning light receives power from fuse F22, circuits A28 and A28A, and yellow instrument cluster connector (10), pin 5. The warning light illuminates when a ground path is applied to yellow instrument cluster connector (10), pin 10 by circuits A29A/35 and A97AF by the MSM1 (3111M), pin 1. The alarm will also sound at a slow rate when a ground path is applied by the MSM1 in response to low oil pressure, high water temperature, or low coolant level.

The battery voltage is through circuits A13/A13F, fuse F22, circuits A28/A28A, yellow instrument cluster connector (10), pin 5 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 K5AA(+) and K5AA(-) through pins A and C of connector (3084K), to the MSM1, circuits A5DMS(+) and A5DMS(-) to connector (3111) pins 5 and 6. A ground is sent from the MSM1 connector (3111M) through pin 1, circuit A97AF, to pin 1 of the audible alarm connector (211). This causes the indicator to illuminate.

OIL/WATER: FE 300 With Hydraulic Brakes

The alarm receives power from fuse F24 over circuit A13B, and the oil/water warning light receives power from fuse F22, circuits A28 and A28A, and yellow instrument cluster connector (10), pin 5. The warning light illuminates when a ground path is applied to yellow instrument cluster connector (10), pin 10 by circuits A29A/35 and A97AF by the MSM1 (3111M), pin 1. The alarm will also sound at a slow rate when a ground path is applied by the MSM1 in response to low oil pressure, high water temperature, or low coolant level.

The battery voltage is through circuits A13/A13F, fuse F22, circuits A28/A28A, yellow instrument cluster connector (10), pin 5 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 K5AA(+) and K5AA(-) through pins A and C of connector (3084K), to the MSM1, circuits A5DMS(+) and A5DMS(-) to connector (3111) pins 5 and 6. A ground is sent from the MSM1 connector (3111M) through pin 1, circuit A97AF, to pin 1 of the audible alarm connector (211). This causes the indicator to illuminate.

Oil/Water: IC

The engine ECM monitors the oil pressure, coolant temperature, and coolant level sensors, and when the oil pressure or coolant level drops below a programmed value or the water temperature climbs above a programmed value, the ECM will set its connector (379)/pin 54 to a low state (ground). This activates the warning alarm (20) at a slow rate by allowing current to flow from circuit 28D through the alarm (R1), through circuit 97AF, connector (2), circuit 97AF to the ECM (379).

The battery voltage is through fuse F24, circuits A28/28D at the alarm is fed to the oil/water warning light connector (26)/pin 5. When the ECM (379) sets pin 54 to a low state (applies a ground), the oil/water light will illuminate and the alarm (R1) will sound at a slow rate as current flows through it, connector (26)/pin 10, circuits 29/35 and 97AF, connector (2), circuits 97AF.

BRAKE PRESS: FE 300 With Hydraulic Brakes

When the hydraulic brake pressure system monitor module (86) detects a problem with the brake system, it applies a ground to circuit A90M, connector and blocking diode (25), and circuit A90NA to the alarm (211). Power will then flow from fuse F24 through circuit A13B and alarm connector (211), causing the alarm to sound at a fast rate. When a problem is detected, a ground is also applied by circuit A90M, connector (25), circuit A90N, and yellow instrument cluster connector (10), pin 3 to the brake warning light, causing it to illuminate. The brake warning light, the battery voltage is through circuits A13/A13F, fuse F22, circuits A28 and A28C, and yellow instrument cluster connector (10), pin 1.

BRAKE PRESS: FE 300 With Air Brakes

The brake press warning light, the battery voltage is through circuits A13/A13F, fuse F22, circuits A28 and A28A, and natural instrument cluster connector (10), pin 1. When the air pressure drops below 60 psi, the pressure switch will close, and power will flow through the warning light, natural instrument cluster connector (10), pin 3, circuits A40A and A40, connector (2), pin A4, circuit K40 and the low air pressure switch (717) to ground (1LA). This will cause the brake press warning light to illuminate, and the warning alarm (211) to sound at a fast rate. The warning alarm receives power from fuse F24 over circuit A13B.

Brake Pressure: IC With Hydraulic Brakes

When the hydraulic brake system monitor module (49) detects a problem with the brake system, it applies a ground to circuits 90S and 90T. The alarm (20) receives power from fuse F24 over circuit 28D, and when circuit 90S is switched to ground, the alarm will sound at a fast rate. The brake pressure warning light is supplied power from fuse F24, circuits 28 and 28A, and connector (26)/pin 1. When circuit 90T is switched to ground, power will flow through the brake pressure warning light (causing it to illuminate), connector (26)/pin 3, and circuit 90T to the brake monitor module (49).

Brake Pressure: IC With Air Brakes

The brake pressure warning light is fed power by fuse F24, circuits 28 and 28A, and connector (26)/pin 1. When the air pressure drops below 60 psi, the pressure switch will close, and power will flow through the warning light, connector (26)/pin 3, circuits 40, 40B, and 40A, connector (2), and circuit 40 through the low air pressure switch to ground. This will cause the brake pressure warning light to illuminate, and the warning alarm (20) to sound at a fast rate. The alarm receives power from fuse F24 over circuit 28D.

STOP ENGINE: FE 300 AND IC

SE item not covered at this time.

CHANGE OIL: FE 300

The engine ECM2 is programmed to track engine hours and vehicle miles, and when the programmed values are achieved, the ECM2 will turn on the “CHANGE OIL" indicator. The battery voltage is through circuits A13/A13F, fuse F22, circuits A28/A28K, yellow instrument cluster connector (10), pin 4 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 K5AA(+) and K5AA(-) through pins A and C of connector (3084K), to the MSM1 connector (3111) pins 5 and 6. A ground is sent from the MSM2 connector (3111) through pin 2, circuit A97AA, to pin 11 of the yellow instrument cluster connector (10). 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.

CHANGE OIL: IC

The engine ECM is programmed to track engine hours and vehicle miles, and when the programmed values are achieved, the ECM will apply a ground to connector (379)/pin 45, circuit 97AA, connector (2), and circuit 97AA to the change oil warning light connector (26)/pin 11. This will cause the change oil warning light, which is fed power from fuse F24 and circuits 28 and 28D through connector (26)/pin 4 to illuminate.

WARN ENGINE: FE 300

When the ECM2 detects a faulty sensor or circuit, it will set a fault code and turn on the “WARN ENGINE" indicator. The battery voltage is through circuits A13/A13F, fuse F22, circuits A28/A28K, green instrument cluster connector (10), pin 4 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 K5AA(+) and K5AA(-) through pins A and C of connector (3084K), to the MSM1 connector (3111) pins 5 and 6. A ground is sent from the MSM1 connector (3111) through pin 9, circuit A97T, to pin 12 of the yellow instrument cluster connector (10). This causes the indicator to illuminate.

WARN ENGINE: IC

When the ECM detects a faulty sensor or circuit, it will set a fault code and turn on the engine warn light by switching connector (379)/pin 55 to ground. This allows power to flow from fuse F24 through circuits 28 and 28D, connector (26)/pin 4, the engine warn light, connector (26)/pin 12, circuit 97T, connector (2), circuit 97T, and ECM connector (379/pin 55. This will cause the engine warn light to illuminate.

TRAC CTRL: FE 300 With Anti-lock Brake System (ABS) — Hydraulic Brakes

The battery voltage is through circuits A13/A13F, fuse F27, circuits A13J and A94T, to the “TRAC CTRL” warning light, connector (1500), pin A, connector (1500), pin B, circuit A94U, connector (2), pin F6, circuit N94U, to the full power HCV connector (9808), pin 13. When the traction control switch (1101) is placed (on)

position, the “TRAC CTRL” warning light to grounded through the full power HCV connector (9808), pin 8, circuit N94W, connector (2), pin A2, circuit A94W, the traction control switch (1101), circuits A94-GT and A11-G to the platform ground (1PG). The ABS module (ECU) (279) will enable the traction control mode and when the wheel sensors sense wheel slip, the module will apply 12 volts to the modulator valve for the brake to apply to the wheel that is slipping.

TRAC CTRL: FE 300 With WTEC or Allison 2000 ICT Anti-lock Brake System (ABS) — Air Brakes

The battery voltage is through circuits A13/A13C, fuse F27, circuits A13J and A94BT/A94DT, to the traction control switch (1101) and is placed (on) position, circuit N94FT, connector (2), pin A7, circuit N94FT, to the ABS module (ECU) connector (288), pin F2. Also, the battery voltage is to circuits A94BT/A94GT, to the “TRAC CTRL” warning light, connector (3127), pin B, connector (3127), pin A, circuit A94CT, connector (2), pin A5, circuit N94CT, to the ABS module (ECU) connector (288), pin C2. The “TRAC CTRL” warning light and the traction control switch are grounded through the coil of the ABS power relay (283), circuits A94–GB and A11-GB to the platform ground (4PG). The ABS module (ECU) (288) will enable the traction control mode and when the wheel sensors sense wheel slip, the module will apply 12 volts to the modulator valve for the brake to apply to the wheel that is slipping.

TRAC CTRL: IC

SE item not covered at this time.

CHECK TRANS: FE 300 With Allison WTEC III With Hydraulic Brakes

When the Allison ECU detects that the transmission is overheating or that there is a problem with the WTEC III system, it will apply a ground to circuit K115 at connector (7204), pin 31. The battery voltage is through circuits A13/A13F, fuse F22, circuits A28 and A28A, and yellow instrument cluster connector (10), pin 2, the “CHECK TRANS” warning light, connector (10), pin 1, circuit A125, connector (377), circuit A115, connector (644), circuit N125, connector (523), circuit K115, and ECU connector (7204), pin 31, to ground. This will cause the “CHECK TRANS” warning light to illuminate.

CHECK TRANS: FE 300 With Allison WTEC III GEN 4 With Hydraulic Brakes

When the Allison ECU detects that the transmission is overheating or that there is a problem with the WTEC III GEN 4 system, it will apply a ground to circuit K129 at connector (7150), pin 29. The battery voltage is through circuits A13/A13F, fuse F22, circuits A28 and A28A, and yellow instrument cluster connector (10), pin 2, the “CHECK TRANS” warning light, connector (10), pin 1, circuit A125, connector (377), circuit A115, connector (644), circuit N129, connector (523), circuit K129, and ECU connector (7150), pin 29, to ground. This will cause the “CHECK TRANS” warning light to illuminate.

CHECK TRANS: FE 300 With Allison WTEC III With Air Brakes

When the Allison ECU detects that the transmission is overheating or that there is a problem with the WTEC III system, it will apply a ground to circuit K115 at connector (7204), pin 31. The battery voltage is through circuits A13/A13F, fuse F22, circuits A28 and A28A, and yellow instrument cluster connector (10), pin 2, the “CHECK TRANS” warning light, connector (10), pin 1, circuit A125, connector (377), circuit A125, connector (644), circuit N125, connector (523), circuit K115, and ECU connector (7204), pin 31, to ground. This will cause the “CHECK TRANS” warning light to illuminate.

CHECK TRANS: FE 300 With Allison WTEC III GEN 4 With Air Brakes

When the Allison ECU detects that the transmission is overheating or that there is a problem with the WTEC III GEN 4 system, it will apply a ground to K129 at connector (7150), pin 29. The battery voltage is through circuits A13/A13F, fuse F22, circuits A28 and A28A, and yellow instrument cluster connector (10), pin 2, the “CHECK TRANS” warning light, connector (10), pin 1, circuit A125, connector (377), circuit A125, connector

(644), circuit N129, connector (523), circuit K129, and ECU connector (7150), pin 29, to ground. This will cause the “CHECK TRANS” warning light to illuminate.

CHECK TRANS: FE 300 With Allison 2000 (LCT)

When the Allison ECU detects that the transmission is overheating or that there is a problem with the 2000 (LCT) system, it will apply a ground to circuit K125 at connector (7305), pin 25. The battery voltage is through circuits A13/A13F, fuse F22, circuits A28 and A28A, and yellow instrument cluster connector (10), pin 2, the “CHECK TRANS” warning light, connector (10), pin 1, circuit A125, connector (377), circuit A125, connector (644), circuit N125, connector (9875), circuit K125, and ECU connector (7305), pin 25, to ground. This will cause the “CHECK TRANS” warning light to illuminate.

CHECK TRANS: FE 300 With Allison 1000/2000 GEN 4

When the Allison ECU detects that the transmission is overheating or that there is a problem with the 1000/2000 GEN 4 system, it will apply a ground to circuit K129 at connector (7150), pin 29. The battery voltage is through circuits A13/A13F, fuse F22, circuits A28 and A28A, and yellow instrument cluster connector (10), pin 2, the “CHECK TRANS” warning light, connector (10), pin 1, circuit A125, connector (377), circuit A125, connector (644), circuit N129, connector (9875), circuit K129, and ECU connector (7150), pin 29, to ground. This will cause the “CHECK TRANS” warning light to illuminate.

CHECK TRANS: IC With Allison MD

When the Allison ECU detects that the transmission is overheating or that there is a problem with the Allison MD system, it will apply a ground to circuit 115 at connector (634)/pin 31. This will allow power to flow through fuse F24, circuits 28 and 28A, connector (26)/pin 1, the Check Trans. warning light, connector (26)/pin 2, circuit 92A, connector (377), circuit 115, connector (418), circuit 115, and ECU connector (634)/pin 31 to ground. This will cause the Check Transmission warning light to illuminate.

LEFT TURN: FE 300 With International Turn Signal Switch (Stationary Column)

When the turn signal switch is placed in the left turn position, power flows through the turn signal switch and violet wire, connector (13)/pin D, circuits A56 and A56B to the left turn indicator connector (11)/pin 6. This will cause the left turn indicator, grounded through connector (11)/pin 2 and circuits A28-G and A11-G to (1PG) platform ground, to illuminate as the turn signal flasher blinks the turn signal lights.

LEFT TURN: FE 300 With Douglas Turn Signal Switch (Tilt Column)

When the turn signal switch is placed in the left turn position, power flows through the turn signal switch and yellow wire, connector (13)/pin E, circuits A56 and A56B to the left turn indicator connector (11)/pin 6. This will cause the left turn indicator, grounded through connector (11)/pin 2 and circuits A28-G and A11-G to (1PG) platform ground, to illuminate as the turn signal flasher blinks the turn signal lights.

LEFT TURN: IC With International Turn Signal Switch (Stationary Column and Tilt Column)

When the turn signal switch is placed in the left turn position, power flows through the turn signal switch and orange wire, connector (193) pin D, circuits 56, 56S, and 56C to the left turn indicator connector (27)/pin 6. This will cause the left turn indicator, grounded through connector (27)/pin 2 and circuits 28-GA and 11-G to cab ground, to illuminate as the turn signal flasher blinks the turn signal lights.

(ABS) ANTI-LOCK BRAKE: FE 300 With WTEC or Allison 2000 ICT Air Brakes

When the air anti-lock brake control module performs a bulb check or logs a fault code, it will set connector (288), pin E3, low (to ground). The battery voltage is through circuits A13/A13C, fuse F27, circuits A13J connector (168) and A13E/A13K, the coil of the warning light relay (284), circuit A94B, connector (297), circuit A94E, A94H, connector (451), and a gray wire to the ABS module (288),pin E3. This energizes the

warning light relay (284), and allows power to flow through fuse (F27), circuits A28, A94B, the anti-lock brake warning light (297), circuit A94E, the warning light relay (284). This will cause the warning light (297), which is grounded through circuit A94E, normally open contacts of the warning light relay (284), circuits A94-GA and A11-GB to platform ground (4PG), to illuminate.

(ABS) ANTI-LOCK BRAKE: FE300 With Hydraulic Brakes GEN 4

When the hydraulic anti-lock brake control module performs a bulb check or logs a fault code, it will set connector (279), pin 1, low (to ground). The battery voltage is through circuits A13/A13C, fuse F27, circuits A94D, the coil of the warning light relay (R1), circuit A94H, connector (2), circuit K94H, connector (261), circuit A94H, and a gray wire to the ABS module (279), pin 7. This energizes the warning light relay (R1), and allows power to flow through fuse (F22), circuits A28, A94B, the anti-lock brake warning light (422), circuit A94E, the warning light relay (R1), circuit A94H, connector (2), circuit K94A, to the hydraulic ABS module (279), pin 1. This will cause the warning light (422), which is grounded through circuit A94E, normally open contacts of the warning light relay (R1), circuits A94-GB and A11-G to platform ground (4PG), to illuminate.

(ABS) ANTI-LOCK BRAKE: IC Air Brakes

When the antilock brake control module performs a bulb check or logs a fault code, it will set connector (288)/pin E3 low (to ground). This will allow power to flow from fuse F24 through circuits 28, 94D, the coil of the warning light relay (R4), circuit 94H, connector (2), and a gray wire to the ABS module (288)/pin E3. This energizes the warning light relay (R4), and allows power to flow through fuse F24, circuits 94F, connector (422), and the antilock brake warning light. This will cause the warning light, which is grounded through circuit 94E, normally open contacts of the warning light relay (R4), circuits 94-GC and 11-G to cab ground, to illuminate.

(ABS) ANTI-LOCK BRAKE: IC Hyd Brakes

When the antilock brake control module performs a bulb check or logs a fault code, it will set connector (279)/pin 1 low (to ground). This will allow power to flow from fuse F24 through circuits 28, 94D, the coil of the warning light relay (R4), circuit 94H, connector (2), and a gray wire to the ABS module (279)/pin 1. This energizes the warning light relay (R4), and allows power to flow through fuse F24, circuits 94F, connector (422), and the antilock brake warning light. This will cause the warning light, which is grounded through circuit 94E, normally open contacts of the warning light relay (R4), circuits 94-GC and 11-G to cab ground, to illuminate.

HI BEAM: FE 300 With Douglas Turn Signal Switch (Tilt Column)

When the headlight switch (23) is moved to the on position and the dimmer switch (4) is placed in the high beam position, power will flow through circuit A51, dimmer switch connector (4), a green wire, the switch contacts, a brown wire, connector (4), circuits A52 and A52A, and the high beam indicator lamp and connector (11)/pin 4. Thus the lamp, grounded through connector (11)/pin 2 and circuits A28-G and A11-G to platform ground (1PG), will illuminate, indicating that the headlights are on and the dimmer switch is in the high beam position.

HI BEAM: FE 300 With International Turn Signal Switch (Stationary Column)

When the headlight switch (23) is moved to the on position and the dimmer switch (6) is placed in the high beam position, power will flow through circuit A51, circuit A51A, the normally closed contacts of lift-to-dim headlight relay (100), circuits A52C and A52A, and the high beam indicator lamp and connector (11)/pin 4. Thus the lamp, grounded through connector (11)/pin 2 and circuits A28-G and A11-G to platform ground (1PG), will illuminate, indicating that the headlights are on and the dimmer switch is in the high beam position.

HI BEAM: IC With International Turn Signal Switch (Stationary Column)

When the headlight switch (23) is moved to the on position and the dimmer switch (6) is placed in the high beam position, power will flow through circuit 51, circuit 51A, the normally closed contacts of lift-to-dim headlight relay (100), circuits 52C and 52A, and the high beam indicator lamp and connector (27)/pin 4. Thus

the lamp, grounded through connector ((27)/pin 2 and circuits 28-G and 11-G to platform ground (1PG), will illuminate, indicating that the headlights are on and the dimmer switch is in the high beam position.

RIGHT TURN: FE 300 With International Turn Signal Switch (Stationary Column)

When the turn signal switch is placed in the right turn position, power flows through the turn signal switch and orange/red wire, connector (13)/pin F, circuits A57 and A57B to the right turn indicator connector (11)/pin 12. This will cause the right turn indicator, grounded through connector (11)/pin 2 and circuits A28-G and A11-G to (1PG) platform ground, to illuminate as the turn signal flasher blinks the turn signal lights.

RIGHT TURN: FE 300 With Douglas Turn Signal Switch (Tilt Column)

When the turn signal switch is placed in the right turn position, power flows through the turn signal switch and light blue wire, connector (13)/pin F, circuits A57 and A57B to the right turn indicator connector (11)/pin 12. This will cause the right turn indicator, grounded through connector (11)/pin 2 and circuits A28-G and A11-G to (1PG) platform ground, to illuminate as the turn signal flasher blinks the turn signal lights.

RIGHT TURN: IC With International Turn Signal Switch (Stationary Column and Tilt Column)

When the turn signal switch is placed in the right turn position, power flows through the turn signal switch and blue wire, connector (193)/pin F, circuits 57, 57S, and 57C to the right turn indicator connector (27)/pin 12. This will cause the right turn indicator, grounded through connector (27)/pin 2 and circuits 28-GA and 11-G to cab ground, to illuminate as the turn signal flasher blinks the turn signal lights.

WAIT-TO-START: FE 300

When the key switch is initially moved to the ignition position, the engine controller ECM2 (6020) will activate the glow plugs and the “WAIT-TO-START" indicator. The battery voltage is through circuits A13/A13F, fuse F22, circuits A28/A28C, natural instrument cluster connector (12), pin 8 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 K5AA(+) and K5AA(-) through pins A and C of connector (3084K), to the MSM1 connector (3111) pins 5 and 6. A ground is sent from the MSM1 connector (3111) through pin 10, circuit A97AE, to pin 5 of the natural instrument cluster connector (12). This causes the indicator to illuminate.

WAIT-TO-START: IC With International T 444E Engine

When the key switch is initially moved to the ignition position on vehicles equipped with T 444E engines, the engine controller (379) will activate the glow plugs and apply a ground to pin 53. This will illuminate the wait to start warning light, which is fed battery power through connector (28)/pin 8, as a ground is applied to the light by connector (28) pin 5, circuit 18-G, connector (2), circuit 18-G, and ECM and connector (379) pin 53.

PDL: FE 300 AND IC

SE item not covered at this time.

((P)) PARK BRAKE: FE 300 With Hydraulic Brakes

Power is fed by the battery voltage is through circuits A13/A13F, fuse F22 to circuits A28 and A28C and the “((P)) PARK BRAKE” warning light and connector (12)/pin 8. When the parking brake is applied, power will flow through the warning light and connector (12)/pin 17, circuits A44A and K44A, the park brake switch (218), and circuits K44-G and K11-GD to start motor ground. This will cause the park brake warning light to illuminate, indicating that the parking brake is applied. The lamp will also illuminate when the key switch (20) is moved to the start position, and a ground is applied through circuit A44, a brake diode (82), and circuit A90X, performing a bulb check.

((P)) PARK BRAKE: FE 300 With Air Brakes

Power is fed by the battery voltage is through circuits A13/A13F, fuse F22 to circuits A28 and A28C and the “((P)) PARK BRAKE” warning light and connector (12)/pin 8. When the parking brake is applied, power will flow through the warning light and connector (12)/pin 17, circuits A44 to the park brake switch (218), and circuits A44GA to platform ground. This will cause the park brake warning light to illuminate, indicating that the parking brake is applied. The lamp will also illuminate when the key switch (20) is moved to the start position, and a ground is applied through circuit A44GB, a brake diode (64), and circuit A44, performing a bulb check.

((P)) PARK BRAKE: IC With Hydraulic Brakes

Power is applied by fuse 24 to circuits 28 and 28C and the park brake warning light and connector (28)/pin 8. When the parking brake is applied, power will flow through the warning light and connector (28)/pin 17, circuits 44 and 44A, connector (214), a black wire, connector (218), the park brake switch, connector (218), a white wire, connector (214), and circuit 44-G to ground. This will cause the park brake warning light to illuminate, indicating that the park brake is applied. With US and Canadian DRL, additional circuitry is connected between connector (214). The lamp will also illuminate when the key switch is moved to the start position, and a ground is applied through circuit 44A or 44B, performing a bulb check.

((P)) LOW AIR: FE 300

SE item not covered at this time.

((P)) LOW AIR: IC

The "((P))"ark brake "LOW AIR" warning light is fed power by fuse F24, circuits 28 and 28C, and connector (28)/pin 8. When the air pressure drops below 60 psi, the pressure switch will close, and power will flow through the warning light, connector (28)/pin 9, circuits 40D, connector (1151), and circuit 40D through the low air pressure switch to ground. This will cause the "((P))"ark brake "LOW AIR" warning light to illuminate, and the warning alarm (3098) to sound at a fast rate. The alarm receives power from fuse F20 over circuit 40.

WINDSHIELD WASHER FLUID: FE 300 AND IC

SE item not covered at this time.

FRONT AXLE: FE 300 AND IC

SE item not covered at this time.

DIFF. LOCK ENGAGED: FE 300 AND IC

SE item not covered at this time.

SUSP LOW AIR: FE 300 AND IC With Hydraulic Brakes

SE item not covered at this time.

WATER-IN-FUEL: FE 300

The I6 engine ECM2 will turn on the “WATER-IN-FUEL” warning light. The battery voltage is through circuits A13/A13A, fuse F20, circuits A97AC/A97AB, to the MSM1 connector (3111) pin 7 and to the WIF connector (3116), pin G, circuit A19K, to the WIF connector (3116), pin C, circuit A19–G, to the “WATER-IN-FUEL” warning light (9), pin B. The “WATER-IN-FUEL” 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 K5AA(+) and K5AA(-) through pins A and C of connector (3084K), to the MSM1 connector (3111) pins 5 and 6. A ground is sent from the MSM2 connector (3111) through pin 3, circuit A19–GD, to the WIF connector (3116), pin H, circuit

A19F, to the WIF connector (3116), pin B, to the “WATER-IN-FUEL” warning light (9), pin A, thus causing the “WATER-IN-FUEL” warning light to illuminate.

WATER-IN-FUEL: IC

With the key switch in the ignition or start position, the water-in-fuel module receives power at connector (470)/pin A from fuse F22, circuit 13A, connector (3), and circuits 13A and 19A. When the key switch is moved to the start position, a ground is applied to circuit 19A, connector (1150), circuit 19C, connector (2), circuit 19C, going to the water-in-fuel module (470)/pin C. This initiates a bulb check by causing the module to apply power to connector (470)/pin B, circuit 19B, connector (2), circuit 19B, connector (1150), circuit 19B, and the water-in-fuel warning light and connector (433). This causes the warning light, grounded through connector (433) and circuit 19-G to cab ground, to illuminate. When water is detected in the fuel filter by the water probe, a ground path is completed to the water-in-fuel module (470)/pin D by circuit 19E, connector (401), circuit 19C, thus causing the water-in-fuel warning light to illuminate.

FUEL FILTER: FE 300

When the fuel filter becomes restricted, the contacts of the fuel filter vacuum switch will close and the ECM2 will turn on the “FUEL FILTER" indicator. The battery voltage is through circuits A28/A19J, fuse F22, circuits A19J, to the “FUEL FILTER" warning light (69), pin A, in the instrument cluster. The “FUEL FILTER" 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 K5AA(+) and K5AA(-) through pins A and C of connector (3084K), to the MSM1 connector (3111) pins 5 and 6. A ground is sent from the MSM2 connector (3111) through pin 1, circuit A19K, to the “FUEL FILTER" warning light (69), pin B, in the instrument cluster. This causes the indicator to illuminate.

FUEL FILTER: IC

With the key switch in the on or start position, power is applied to fuse F24, circuits 28/19F, connector (1150), and circuit 19F to the fuel filter warning light (434). When the fuel filter becomes restricted, the contacts of the fuel filter vacuum switch will close and the fuel filter warning light will illuminate as a ground path is applied through circuit 19D, connector (1150), circuit 19D, connector (2), circuit 19D, connector (401), and circuit 19B to the switch and chassis ground.

PTO: FE 300 AND IC

Refer to information provided by body builder.

LOW BRAKE FLUID: FE 300 With Hydraulic Brakes

With the key switch in the on or start position, battery voltage is through circuits A13/A13F, fuse F22, circuits A28 and A90R to the “LOW BRAKE FLUID” warning light (89–A). With the key switch held in the start position, the low brake fluid warning light will illuminate (bulb check is performed) as a ground is applied through circuits A90V and A90W, brake diode assy (82), and circuit A44-G (also A31-GD with pall transmission filter) to the key switch ground.

LOW BRAKE FLUID: IC With Hydraulic Brakes

With the key switch in the on or start position, power is applied to fuse F19, and circuits 13E and 90U to the low brake fluid warning light. With the key switch held in the start position, the low brake fluid warning light will illuminate (bulb check is performed) as a ground is applied through circuits 90U and 90E, blocking diode (47), and circuit 90-G/11-G to the cab ground.

RETARD ON: FE 300 With Allison WTEC III XMSN GEN 4

When the key switch is in the ignition or start position, power from fuse F1C–1 flows through circuit V146A, connector (7101), pin U, circuit K146A, to the ECU “S” connector (7204), pin 4, and the spliced circuit

V146A/V146D, to the retard on warning light relay connector (7807), pin 1. When the retard on on/off switch (919) is moved to the on position, the switch (919), pin 1, circuit A163A, connector (644), pin F, circuit N163A, connector (523), pin L, circuit K163A, spliced circuit K163, to the ECU “S” connector (7204), pin 27, and through the switch (919), pin 2, circuit A143H, connector (644), pin H, circuit N143H, spliced circuit N143A, connector (523), pin J, circuit K143A, to the ECU “S” connector (7204), pin 32, and the retarder enable function is completed. The retarder warning light relay circuit V146B to its coil and circuit V146D to its contacts, will become de-energized when the ECU removes its ground to circuit K125 at connector (7202), pin 18, through spliced circuit K125A, connector (7101), pin Q, circuit V125A, relay (7807), pin 5. This will allow power to flow through the contacts of the de-energized warning light relay (7807), circuit V92H, connector (7100), pin L, circuit K92H, connector (523), pin V, circuit N92H, connector (1601), pin A and circuit A92H to the “RETARD ON” warning light (926), pin A. This will cause the warning light (926), pin B, which is grounded through circuits A92-GA/A186, connector (377), pin A, circuits A186/A11-G to the platform ground (1PG), to illuminate.

RETARD ON: IC With Allison MD and International Engines

When the key switch is in the ignition or start position, power from fuse F24 flows through circuit 97K, connector (3), circuits 97K and 24B, connector (372), circuit 24B, connector (789), circuit 24B, and the retarder enable relay coil (790). When the retarder on/off switch (917) is moved to the on position, a ground is applied to ECM connector (379)/pin 15 by circuit 24, connector (3), circuit 24, connector (377), circuit 24, connector (377), circuit 24V, switch (917), circuits 92-G, 92-GY, 94-GC, connector (377), and circuits 94-GC and 11-G to cab ground. This causes the ECM (379) to switch pin 47 low (to apply a ground), and power to flow through the enable relay coil and circuit 24A, connector (789), circuit 24A, connector (372), circuit 24A, and the ECM at connector (379)/pin 47. This will activate the retarder enable relay, and complete a ground circuit from connector (632)/pin 31, circuits 161 and 161D, the relay’s normally open contacts, and circuit 163 to ECU connector (634)/pin 27. The retarder warning light relay (791), which receives power from fuse F24 through the same circuits as the retarder enable relay (790) [listed above] and circuit 146H to its coil and also circuit 146F to its contacts, will become de-energized when the ECU removes its ground to circuit 125 at connector (632)/pin 18. This will allow power to flow through the contacts of the de-energized warning light relay (791), circuit 92H, connector (499), and circuit 92H to the retarder on warning light. This will cause the warning light, which is grounded through circuits 92-GZ, 92-GY, and 94-GC, connector (337), and circuits 94-GC and 11-G to cab ground, to illuminate.

CHANGE TRANS FILTER: FE 300 With Allison WTEC III XMSN GEN 4

For vehicles equipped with the automatic transmission filter warning light, power is supplied to fuse F10, circuit A31D, and the filter warning light (94). When the key switch (20) is held in the start position, power will flow through the filter warning light (94), circuit A31-GA, connector (344), a blue wire, and the pigtail of the filter pressure differential switch. This power will flow through the normally closed contacts of the pressure switch and its connector, a green wire, connector (344), circuit A31-GB, blocking diode (64), circuits A31-GC and A31-GD, and the key switch ground, thus causing the warning light to illuminate for a bulb check. When the transmission filter becomes restricted, the pressure differential switch’s normally open contacts will close and power will flow through the warning light to the switch as above, but the power will flow through the normally open contacts of the switch and its connector, a brown wire, connector (344) and circuit A11-GE to platform ground, thus illuminating the change trans filter warning light.

CHANGE TRANS FILTER: IC With Allison “AT”

For vehicles equipped with the automatic transmission filter warning light, power is supplied to fuse F24, circuits 28/19F, connector (1150), 31B and the filter warning light (837). When the key switch (63) is held in the start position, power will flow through the filter warning light (837), circuit 31-GA, connector (760A), a blue wire, and the pigtail of the filter pressure differential switch. This power will flow through the normally closed contacts of the pressure switch and its connector, a green wire, connector (760B), circuit 31-GA, blocking diode (47), circuits 31D, and the key switch ground, thus causing the warning light to illuminate for a bulb check. When the transmission filter becomes restricted, the pressure differential switch’s normally open contacts will

close and power will flow through the warning light to the switch as above, but the power will flow through the normally open contacts of the switch and its connector, a brown wire, connector (760B) and circuit 31-G to cab ground, thus illuminating the change trans filter warning light.

RETARD OVER HEAT: FE 300 With Allison WTEC III XMSN

The battery voltage is through circuits A13/A13F, fuse F22, circuits A28 and A13J, connector (377), pin F, circuit A13J, to the “RETARD OVER HEAT” warning light, connector (925), pin B, connector (925), pin A, circuit A105B, connector (1601), pin B, circuit N105B, connector (523), pin U, circuit K105B/K105, to the ECU connector (7202), pin 19. When the transmission ECU detects that the transmission retarder is overheating, it will apply a ground (switch to low state) to illuminate the “RETARD OVER HEAT” warning light.

RETARD OVER HEAT: FE 300 With Allison WTEC III XMSN GEN 4

The battery voltage is through circuits A13/A13F, fuse F22, circuits A28 and A13J, connector (377), pin F, circuit A13J, to the “RETARD OVER HEAT” warning light, connector (925), pin B, connector (925), pin A, circuit A164B, connector (1601), pin B, circuit N164B, connector (523), pin U, circuit K164B/K164, to the TCM connector (7150), pin 64. When the transmission TCM detects that the transmission retarder is overheating, it will apply a ground (switch to low state) to illuminate the “RETARD OVER HEAT” warning light.

RETARD OVER HEAT: IC With Allison MD

When the transmission ECU detects that the transmission retarder is overheating, it will apply a ground (switch to low state) to (632)/pin 19 and circuit 105, connector (499), circuit 105 and the retarder overheat warning light. Thus the light that receives power from the key switch (63), circuit 13E, connector (377), circuit 13E, will illuminate.

ALTERNATOR: FE 300

When the voltage output of the alternator is low, a ground will be provided on terminal (G) of the alternator, and through the I6 circuit filters. This ground will be present on circuit A26 to pin 16, of the yellow instrument cluster connector (10) and will cause the “ALTERNATOR” warning light, to illuminate. The battery voltage is through circuit A26A, the yellow instrument cluster (10), pin 7 to the alternator warning light.

ALTERNATOR: IC

SE item not covered at this time.

3. REMOVE AND INSTALL

3.1. INSTRUMENT CLUSTER

The cluster is a reliable, quick-disconnect package for the most commonly used instruments. Should the need arise, the cluster body can be quickly detached from the instrument panel for quick access to any of its components. Either the complete cluster assembly or any of its components can be replaced.

Always place the ignition in the OFF position (not ACC) prior to working on the cluster, due to potential shorting between the ground and ignition pins, which will damage the circuit board and gauges.

CAUTION – Static electricity can cause permanent damage to the cluster. Before working on the cluster, be sure you have removed all static electricity from your body by touching metal that is grounded. Do not wear clothing that causes static build up (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 bezel during removal by placing a soft cloth on the forward side of the steering column.
2. Remove the two cluster mounting screws (Item 1, Figure 14) located on the lower front face of the cluster.

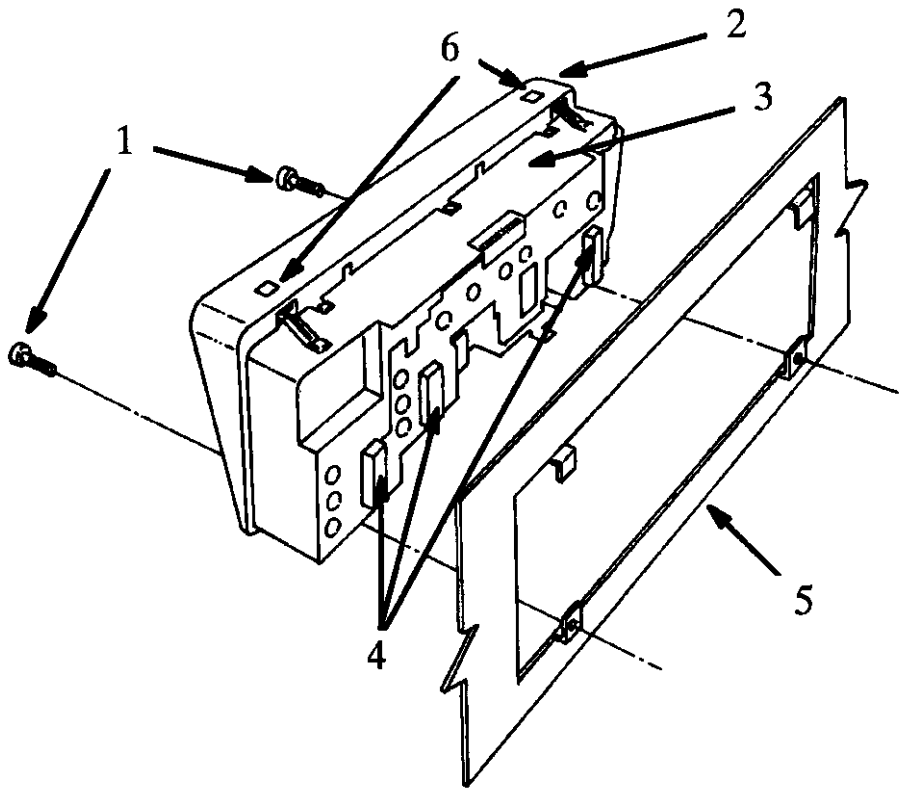

Figure 14 Instrument Cluster Assembly

1. CLUSTER MOUNTING SCREWS
2. INSTRUMENT CLUSTER BEZEL
3. CLUSTER
4. WIRING HARNESS CONNECTOR
5. DASH PANEL
6. RETAINING TABS

3. Depress the two gray retaining tabs (Item 6, Figure 14) located on the top corners of the bezel.

4. Holding the tabs depressed, pull the cluster forward and gently release it from the dash panel. If the cluster does not come loose easily, put more pressure on the tabs and continue to pull gently. Do not attempt to pry the cluster from the dash panel as damage will result.

5. Disconnect the three wiring harness connectors from the back of the cluster assembly (Figure 15).

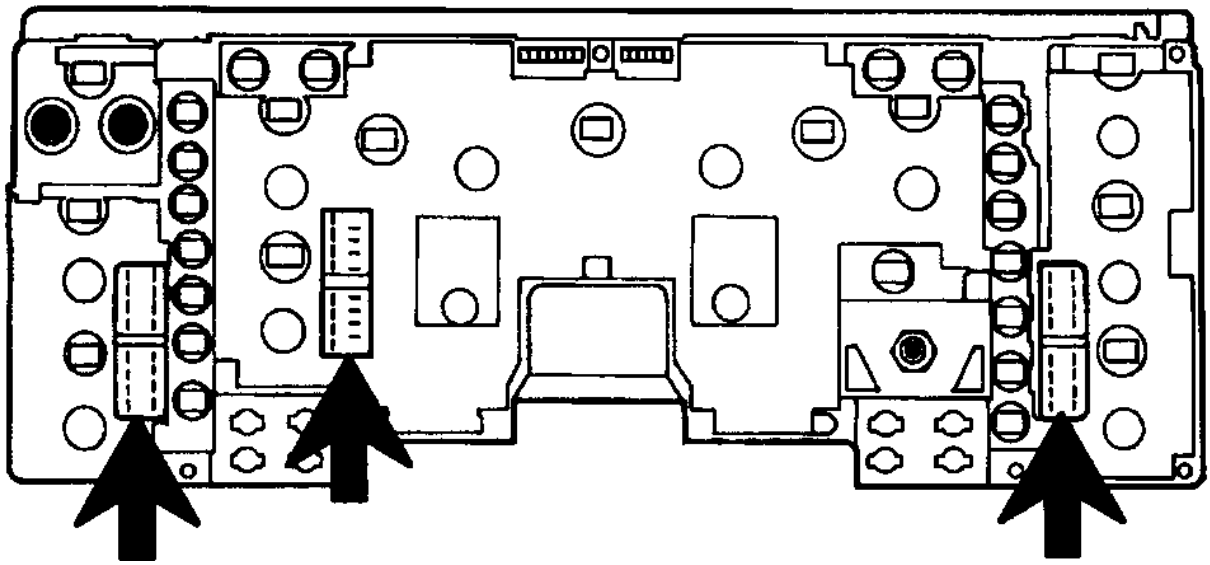

Figure 15 Disconnect Wiring Harness Connectors

WARNING – Whenever any component is serviced or removed from the air system, be sure to set the parking brake and/or block the vehicle to prevent it from moving while the service is being performed. Also drain air from the system to prevent dirt or debris from being propelled into one's eyes.

6. After bleeding the air system, disconnect the air lines from the fittings on the back of the air gauge. A double needle air pressure gauge is used with vehicles with air brakes (Figure 16).

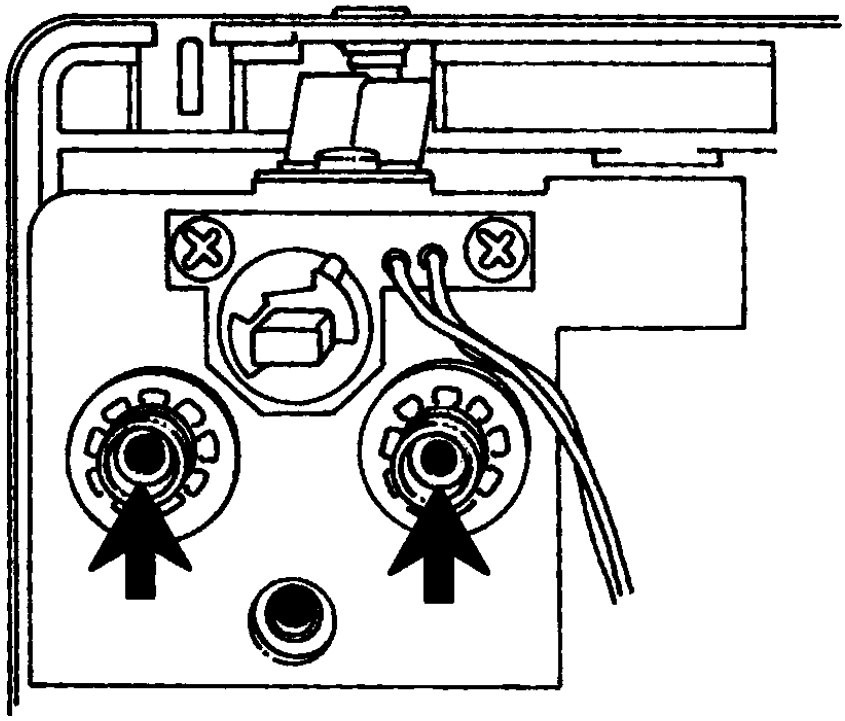

Figure 16 Disconnect Air Lines From Fittings on Back of Air Gauge

NOTE – Note the color of the air lines being removed from the gauge. The green line is for the primary system and the orange line is for the secondary system.

7. The instrument cluster assembly is now free to be removed from the instrument panel.

Install

1. Connect the air lines to the air pressure gauge. The green line is for the primary system and the orange for the secondary system.

   NOTE – Do not exceed 36 in-lbs. (4.0 Nm) of torque when tightening air lines.

2. Connect the three wiring harness connectors to the back of the cluster. These connectors are color-coded for proper orientation.

3. Align the cluster in the instrument panel frame and push the cluster gently until the retaining tabs snap into place.

4. Install the two cluster mounting screws on the lower front face of the cluster.

3.2. INSTRUMENT CLUSTER COMPONENTS

Remove

1. With the cluster released from the dash panel (refer to INSTRUMENT CLUSTER, Remove), remove the three (3) bezel screws that fasten the bezel to the cluster housing (Figure 17). Place the instrument cluster face up on a clean, horizontal surface to prevent loss of unused gauge covers, gauges, etc.

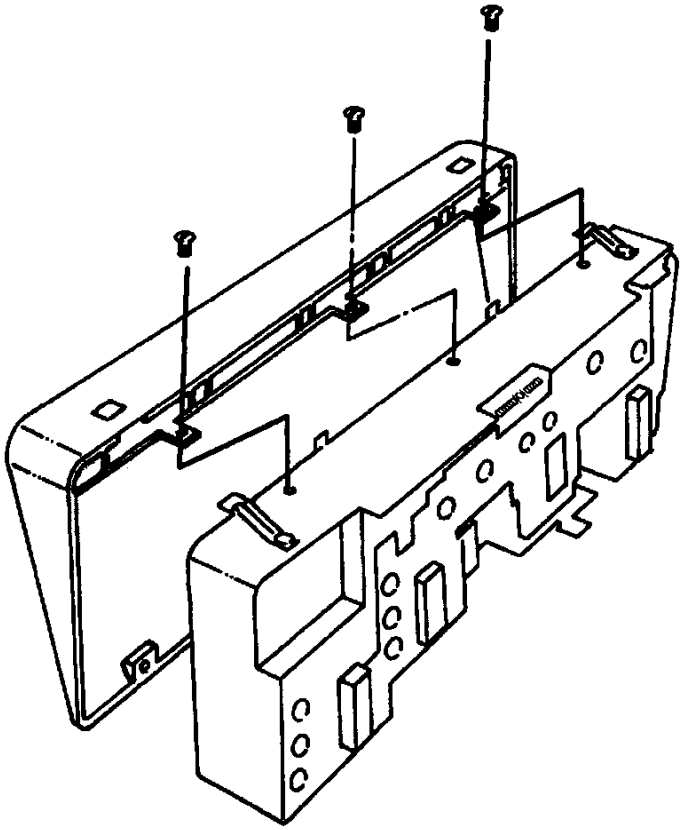

Figure 17 Remove Bezel Screws Fastening Bezel to Cluster Housing

2. Remove the bezel lens assembly from the housing and put it in a safe place to prevent scratching. Take care not to damage the gauge pointers with the bezel.

> **CAUTION – Individual gauge dials are not protected by a lens. When removing or installing gauges, handle them by the edge of the dial face only. Do not touch the gauge pointer.**

3. All gauges, with the exception of the air pressure, hourmeter and odometer, are plug-in gauges. To remove, locate the hole in the back of the cluster behind the gauge and using a small, blunt tool such as a small screwdriver handle, push the gauge out of the housing. Once the gauge has cleared the housing, it may be removed from the front.

> **CAUTION – After a gauge is removed from the cluster, it is important that the exposed terminals attached to the circuit board are not touched or shorted across. Static electricity or shorting between power and ground terminals can damage the cluster.**

4. To remove the hourmeter and/or odometer, disconnect the wiring plugs from the circuit board at the back of the cluster. At the front of the cluster, remove the adhesive-backed mask covering the gauge, then retract the two fingers that hold the gauges in the cluster and lift the gauge out of the cluster.

CAUTION – When removing or installing the hourmeter or odometer, do not touch the metal portion of the leads that fasten to the circuit board. A static discharge could damage the cluster.

5. The mechanical type air gauge is front serviceable after the air line fittings and the retaining nuts have been removed from the rear of the gauge.

6. The panel lamp bulbs are the push-in type and are mounted in a twist lock receptacle. They are serviceable from the rear of the instrument cluster by twisting to remove (Figure 18).

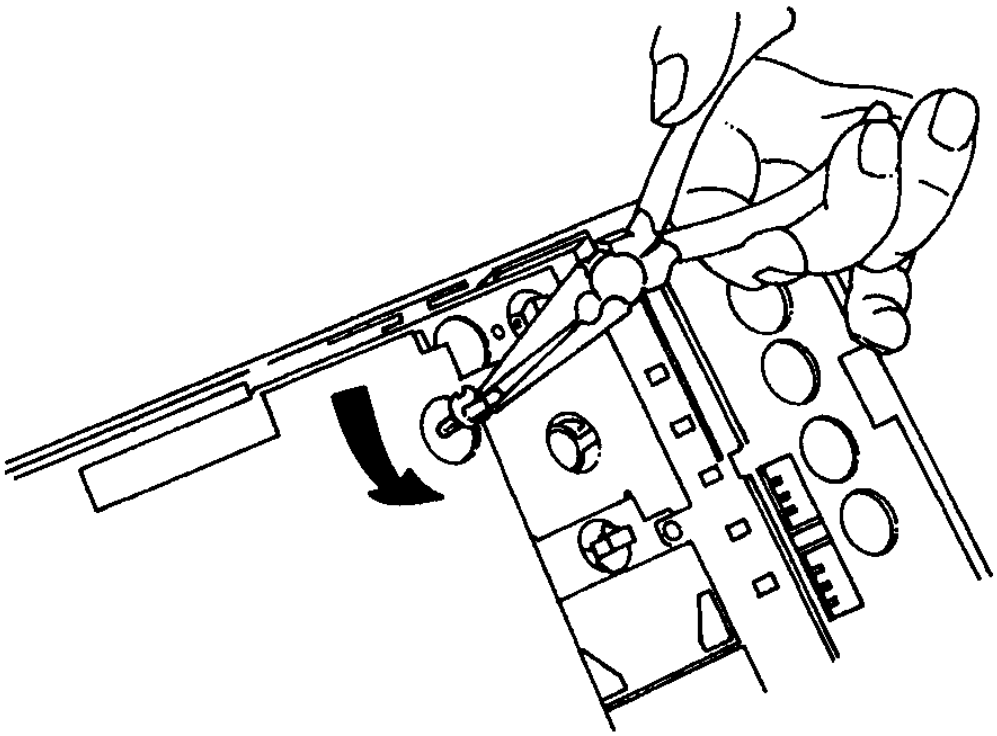

Figure 18 Twist Panel Lamp Bulbs to Remove

The gauge back lights are #936 bulbs and the turn signals, high beam and warning lights are #37.

3.3. PRINTED CIRCUIT BOARDS

Replacement

Since printed circuit boards are fastened to and integral with the instrument cluster body, the boards and cluster are available for replacement as a complete assembly only. Where replacement is required, obtain a new gaugeless instrument cluster assembly and transfer all gauges, warning light masks and light bulbs from old cluster body to the new.

3.4. SPEEDOMETER SENSOR

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 (Figure 19).

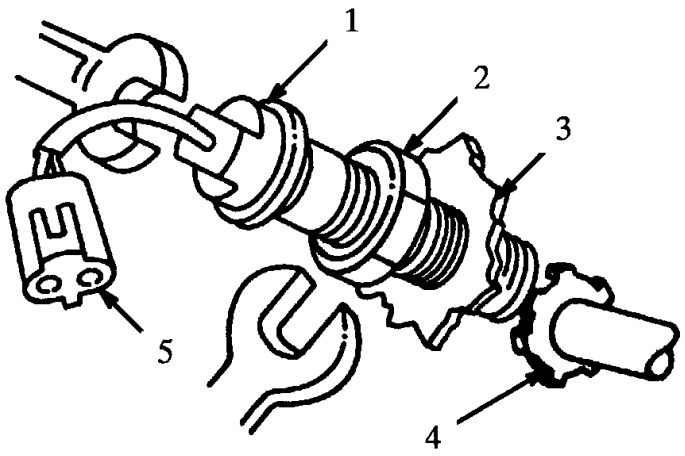

Figure 19 Disconnect Sensor Connector From Wiring Harness Connector

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

4. INSTRUMENT CLUSTER JUMPER USAGE

The speedometer jumper pins are used to set up the cluster for MPH or KPH as the primary speedometer readout, and to select axle ratios. They are located at the top edge of the cluster and can be accessed by pulling the cluster out of the instrument panel (Item 3, Figure 20). All other speedometer and tachometer parameters are programmed electronically through the data link into the engine ECM2.

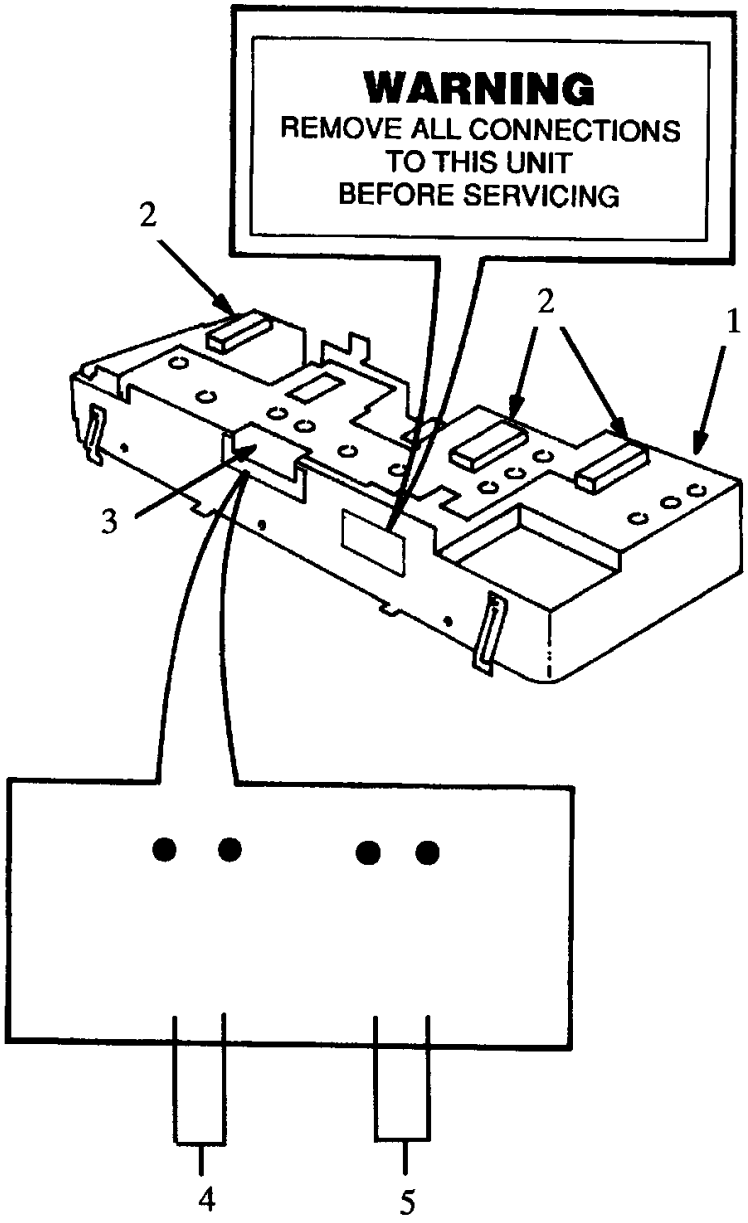

Figure 20 Jumper Pin Location

1. CLUSTER
2. WIRING HARNESS CONNECTORS
3. RECEPTACLE PINS FOR JUMPERS
4. ENGLISH-METRIC CONVERSION SPEEDOMETER AND ODOMETER JUMPER PINS (MPH/KPH)
5. ONE AXLE RATIO SETTING JUMPER PINS

There may be two jumpers visible. The left jumper is for setting the odometer from English to metric readings (Item 4, Figure 20). For miles per hour (MPH), the jumper is not installed. For a kilometers per hour (KPH) speedometer, the jumper is installed.

The right jumper (Item 5, Figure 20) is for calibration of the two available two-speed axle ratios. These are 1.36:1 (jumper not installed) and 1.39:1 (jumper installed). If the vehicle does not have a two-speed axle, the jumper setting is inactive and a jumper is not needed.

IMPORTANT – For the speedometer and tachometer to function properly when tire sizes and/or rear axle ratios are changed, the engine ECM2 must be reprogrammed so that it will send the correct data to the instrument cluster.

5. CLUSTER FAILURE DIAGNOSIS

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 you have removed all static electricity from your body by touching metal that is grounded. Do not wear clothing that causes static build up (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.

5.1. CLUSTER HARNESS CONNECTORS

Connecting the instrument panel to the vehicle are three vehicle harness connectors fastened to the back of cluster. The left or driver's side connector is yellow, the center is green, and the right or passenger's side connector is natural in color.

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 21).

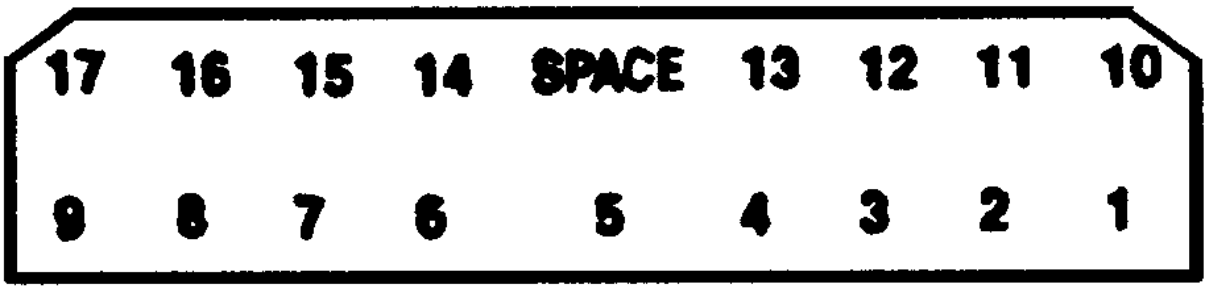

Figure 21 Harness Connector Pins

Left Side Harness Connector Pinouts (Yellow) (10)

BOTTOM ROW

1. Ignition Voltage (+) Cir A28A
2. Check Trans (-) Cir A92
3. Brake Pressure (-) Cir A40A Air Brakes or A90N With Hydraulic Brakes)
4. Stop Engine/Change Oil and Engine Warning (+) Cir A28K
5. Oil/Water (+) Cir A28D
6. Gauge Ground (-) Cir A28-GA
7. Ammeter (-) Cir A26A
8. Gauge Backlighting (+) Cir A62B
9. (No Connection)

TOP ROW

10. Oil/Water (-) Cir A29/A35
11. Stop Engine/Change Oil (-) Cir A97AA
12. Engine Warning (-) Cir A97T
13. (No Connection)
14. ABS Warning Cir A94BD
15. Gauge Backlighting (-) Cir A62-GA
16. Ammeter (+) Cir A26
17. Transmission Oil Temperature Cir A31A

Center Harness Connector Pinouts (Green) (11)

BOTTOM ROW

1. Gauge Backlighting (+) Cir A62C
2. Electronic Ground (-) Cir A28-G
3. Fuel Sensor Cir A36
4. High Beam (+) Cir A52A
5. (No Connection)
6. Left Turn (+) Cir A56B

7. J1587/J1708 Data Link (+) Cir A98E(+)
8. (No Connection)
9. J1587/J1708 Data Link (-) Cir A98F(-)

TOP ROW

10. Ignition Voltage (+) Cir A28B
11. Gauge Backlighting (-) Cir A62-GB
12. Right Turn (+) Cir A57B
13. (No Connection)
14. (No Connection)
15. (No Connection)
16. (No Connection)
17. (No Connection)

Right Side Harness Connector Pinouts (Natural) (12)

BOTTOM ROW

1. Gauge Backlighting (+) Cir A62D
2. (No Connection)
3. Gauge Ground (-) Cir A28-GB
4. (No Connection)
5. Wait To Start (-) Cir A97AE
6. (No Connection)
7. (No Connection)
8. Ignition Voltage (+) Cir A28C
9. (No Connection)

TOP ROW

10. Gauge Backlighting (-) Cir A62-GC
11. (No Connection)
12. (No Connection)
13. Windshield Washer Fluid (+) Cir A28H

14. (No Connection)

15. (No Connection)

16. (No Connection)

17. Parking Brake (-) Cir A44A With Hydraulic or Air Brakes

5.2. CLUSTER CONNECTORS

Looking at the rear of the cluster (Figure 20), the three connectors (Figure 22) will be the reverse of the plug-in harness connectors (Figure 21). The right connector is yellow, the center is green and the left is natural.

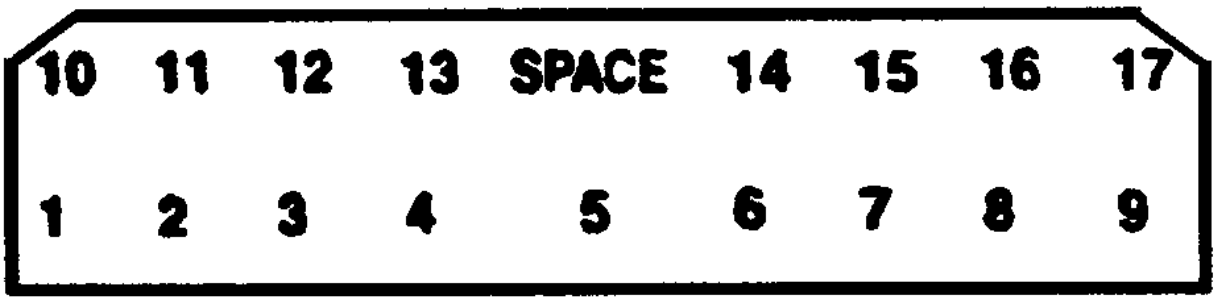

Figure 22 Cluster Connectors

The connector pins are numbered from left to right. The bottom row has pins 1 through 9. The top row has pins 10 through 17. There is a space between pins 13 and 14 in the top row.

5.3. AIR GAUGE FAILURE

If either air gauge pressure reading is outside a ± 5 psi range of the shop gauge reading, replace the cluster air gauge.

5.4. FUEL LEVEL SENSOR

If the electric fuel gauge shows a reading and it is suspected of being in error and the steps defined in FUEL GAUGE, OPTIONAL ELECTRICALLY OPERATED TEMPERATURE GAUGE, OR AMMETER FAILURE, do not locate the problem, the fuel level sensor must be checked. The fuel level sensor used 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 long enough on a level surface for the fuel to settle out, and in cold weather be sure the cab interior is warmed up.

Table 2 Fuel Tank Level to Sensor Output Ohms

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

Table 2 Fuel Tank Level to Sensor Output Ohms (cont.)

Fuel Tank Levels	Sensor Output Ohms
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 (11)/pin 3] and measure resistance to ground. If the resistance reading and the fuel level agrees with the above listing and the gauge does not match, replace the fuel gauge.

If readings and fuel level do not match, disconnect harness at sensor and measure resistance at the sensor. If correct readings are obtained, repair harness. If readings are out of specification, replace fuel level sensor.

5.5. FUEL GAUGE, OPTIONAL ELECTRICALLY OPERATED TEMPERATURE GAUGE, OR AMMETER FAILURE

If any of the five possible electrical temperature gauges or the fuel gauge is suspected of displaying incorrectly, the vehicle circuits that affect the suspected gauge must be checked for clean, tight, unbroken and non-shorted connections. If the wiring and connector are OK, the thermistor type temperature sensor's electrical resistance must be checked with a quality ohmmeter at the cluster harness connector. Refer to CLUSTER HARNESS CONNECTORS for the pin locations.

NOTE – The following tests are for the three pin electric gauges and circuitry only. These tests do not apply to the four pin data link driven electronic gauges and circuitry.

Instrument Gauge Tester Operation

The Instrument Gauge Tester (Special Tool Catalog #ZE-2781) (Figure 23) permits testing of electric gauges without removing them from the vehicle. This tester will provide up to 2050 ohms required for making low scale readings on temperature gauges.

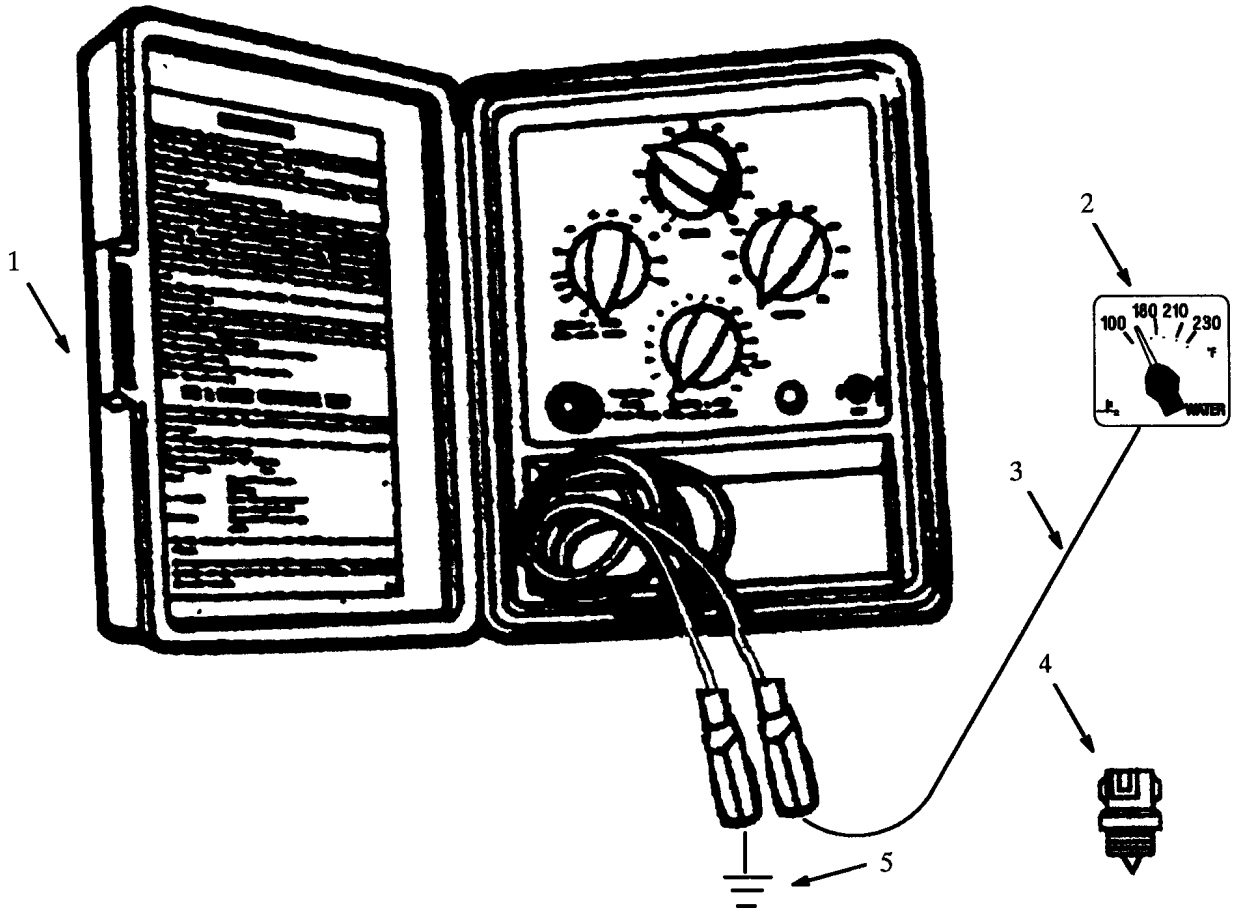

Figure 23 Instrument Gauge Tester

1. INSTRUMENT GAUGE TESTER
2. ELECTRIC GAUGE
3. WIRE TO GAUGE
4. SENDER
5. GROUND

To test an electric gauge:

1. With key off, disconnect the sensor wire at the sensor.
2. Connect one lead of the Instrument Gauge Tester to the sensor wire.
3. Connect the other tester lead to a good vehicle ground.
4. Set the resistance to the values shown in Gauge Tester Resistance Settings.
5. Turn key switch to ON.
6. Note gauge needle positions.

If gauge responds correctly to the tests:

- Gauge is OK.
- Sender unit may be faulty, or
- Sender unit ground may be faulty.

NOTE – Sealant or dirt on the sender unit or engine threads may prevent good electrical ground. Check for this condition before replacing sender unit.

If gauge does not respond to the tester:

- Check continuity of gauge wiring circuits for opens or shorts.
- Check connectors for clean, tight fits.
- Check gauge cluster ground circuit. Make sure circuit is grounded.
- If wiring is OK, replace gauge.

Gauge Tester Resistance Settings

Table 3 Gauge Tester Resistance Settings (Ohms) — For Use With ZE-2781 Gauge Tester)

Type of Gauge	Gauge Reading (Within Two Needle Widths ±)		
	Low Scale	Half Scale	Full Scale
Fuel Level	1	44	88
Oil Temperature: Engine	1365	63	28
Oil Temperature: Transmission	1365	63	28
Oil Temperature: Rear Axle	1365	63	28

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 4 Component Temperature to Thermistor Resistance

Component Temperature		Thermistor Resistance (Ohms)
Fahrenheit	Centigrade	
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

Table 4 Component Temperature to Thermistor Resistance (cont.)

Component Temperature		Thermistor Resistance (Ohms)
Fahrenheit	Centigrade	
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
- Engine Oil Temperature
- Transmission Oil Temperature
- Forward Rear Axle Temperature
- Rear Rear Axle Temperature.

NOTE – The two axle gauges and the transmission oil temperature gauge may not indicate a gauge reading due to a low/short run time condition. If there is no gauge reading and any of these gauges is suspected of having a faulty reading, short out the appropriate leads at the sensor. When the sensor leads are shorted together, the gauge should read full scale.

Restricted Needle Movement

If the sensor electrical resistance checks OK, the gauge should be checked for restricted needle movement. Very gently move the needle between the minimum and maximum dial positions. If the needle moves freely, the gauge must be checked for an open or shorted winding. Make sure the key is in the "OFF" position.

Open or Shorted Gauge Winding Check

CAUTION – Static electricity can cause permanent damage to the cluster. Before working on the cluster, be sure you have removed all static electricity from your body by touching metal that is grounded. Do not wear clothing that causes static build up (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 it has been determined that an individual gauge is defective by using the substitution of a known good gauge method, the gauge can be further quick tested as follows:

Remove the gauge and use an ohmmeter to check for an open or shorted winding between the two terminals that connect to that winding. Refer to Cluster Pinouts Table.

- Below 20 ohms - SHORT - Replace Gauge
- Above 1000 ohms - OPEN - Replace Gauge
- Between 20 and 1000 ohms - OK - Refer to Harness Continuity and Voltage Tests.

Cluster Pinouts 16.73in8.0in72

Refer to Figure 24 and Figure 25.

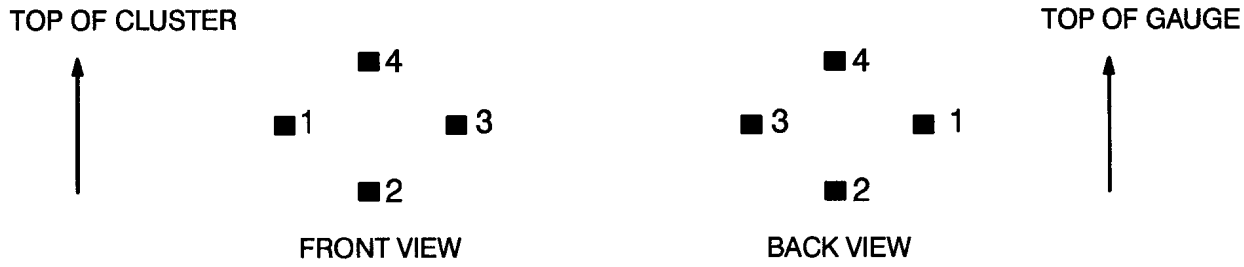

Figure 24 Cluster Pinouts

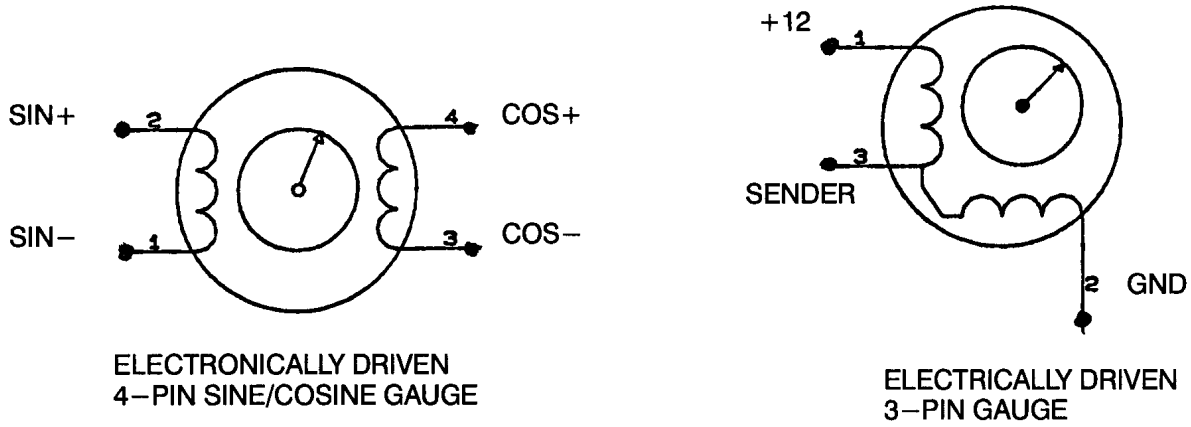

Figure 25 Gauge Position

Table 5 Cluster Pinouts Table

Gauge	Position			
	1	2	3	4
Speedometer	SIN-	SIN+	COS-	COS+
Tachometer	SIN-	SIN+	COS-	COS+
Voltmeter	SIN-	SIN+	COS-	COS+
Oil Pressure	SIN-	SIN+	COS-	COS+
Water Temp. Gauge	SIN-	SIN+	COS-	COS+
Temp. Gauges (N/Water Temp.)	+12V	Ground	Sender	Not used
Fuel Level	+12V	Ground	Sender	Not used
Pyrometer	Reference voltage*	Ground	Sender	Not used
Ammeter	Positive	Not used	Negative	Not used
* Stewart Warner (round amplifier) 3.5 to 3.9 volts; Isspro (square amplifier) 7.7 to 8.7 volts				

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 harness ground circuit and sensor circuit affecting the gauge in question. The resistance should read less than one (1) ohm.

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

5. If all three harness circuits check OK, install a new cluster that does not yet contain plug-in gauges.

6. 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.

5.6. VOLTMETER DISPLAY FAILURE

If the voltmeter display is indicating a problem, the circuits that serve it must be checked for clean, tight, unbroken and non-shorted connections. If the circuits check OK, measure the appropriate voltage at the appropriate cluster harness connector (refer to CLUSTER HARNESS CONNECTORS and GROUP 08 - ELECTRICAL, Circuit Diagrams). Turn the key switch to ACC and read across the accessory voltage and ground with a good test voltmeter. Replace the voltmeter display gauge if it does not read near the test accessory voltage.

5.7. EXHAUST TEMPERATURE DISPLAY FAILURE

Exhaust Temperature Display Gauge

1. If the exhaust temperature display gauge indicates a problem, check the circuits serving the pyrometer for clean, tight, unbroken and non-shorted connections (refer to CLUSTER HARNESS CONNECTORS and GROUP 08 - ELECTRICAL, Circuit Diagrams).

2. If the circuits are OK, measure the appropriate voltages through the cluster harness connector that services the pyrometer. The pyrometer is supplied with two driving voltages. ALL VOLTAGES ARE MEASURED WITH RESPECT TO THE ELECTRONIC GROUND PIN:

   a. Pyrometer power voltage for Isspro is 8.2 ± 0.5 volts, for Stewart Warner 3.7 ± 0.2 volts (Connector 10-Yellow, Terminal 16).

   b. Sensor voltage that varies according to the exhaust gas temperature and will range from .15 to 6.1 (vdc) (Connector 10-Yellow, Terminal 7).

   c. Ground is at Connector 10-Yellow, Terminal 6.

Pyrometer Sensor Voltage

Table 6 Pyrometer Sensor Voltage

Temperature		Voltage (DC)
Fahrenheit	Centigrade	
300	149	0.15

Table 6 Pyrometer Sensor Voltage (cont.)

Temperature		Voltage (DC)
Fahrenheit	Centigrade	
600	315	1.60
900	482	3.10
1200	649	4.60
1500	816	6.10

1. If voltages **are not** within limits, a faulty sensor, connector or wiring harness is indicated and further testing is required.

2. If the voltages are within limits, the pyrometer gauge should be checked for a sticky needle (refer to Restricted Needle Movement).

   a. The needle sticks, replace the pyrometer gauge.

   b. The needle moves freely, check internal voltage.

Internal Voltage Check

1. Turn key switch to OFF, remove the pyrometer gauge from cluster and make sure the cluster harness connectors are properly installed on the cluster (refer to CLUSTER HARNESS CONNECTORS).

2. Turn the key switch to ACC and measure the voltage across the gauge's cluster socket pins. Refer to GROUP 08 - ELECTRICAL, Circuit Diagrams. Pyrometer reference voltage is at Terminal 1, Sensor voltage at Terminal 3 and Ground at Terminal 2.

   a. If the proper voltages **are not** present, replace cluster with a new gaugeless cluster and re-install gauges.

   b. If the voltages are correct, turn the key switch to OFF and re-install the pyrometer gauge. Turn the key switch to ACC and if the gauge **does not** operate, replace the gauge.

5.8. SPEEDOMETER, ODOMETER, TACHOMETER, HOUR-METER, VOLTMETER, OIL PRESSURE GAUGE, AND WATER TEMPERATURE GAUGE FAILURE ISOLATION

If the speedometer, odometer, tachometer, hour-meter, 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 instrument cluster has self testing capabilities that will identify various failures in the electronic portions of the unit. The self testing diagnostics provide a strong indication of exactly what is wrong with the unit, without removing the cluster from the vehicle or spending a large amount of time troubleshooting.

Pass Indications

The cluster will test itself each time the vehicle is powered up. If all tests pass, the unit will drive the speedometer, tachometer, voltmeter, oil pressure gauge, and water temperature gauge needles through one

complete sweep. This indicates that all input circuits are good and tells the driver that all output circuits driving the gauges are good.

Fail Indications

The cluster will provide failure indications in two ways:

1. Does not provide a proper gauge sweep on power up.

2. The speedometer, tachometer, voltmeter, oil pressure gauge, and water temperature gauge needles "wave" on power up.

If the unit senses a circuit problem at power up, the speedometer, tachometer, voltmeter, oil pressure gauge, and water temperature gauge needles will simultaneously wave from 0 and one of the numbers on the speedometer and tachometer dial faces three times. Corrective action is defined in the following failure chart.

Electronic Service Tool (EST) Diagnostics

Operation and accuracy of the speedometer, tachometer, fuel, oil pressure, water temperature and voltmeter can be verified with an EST, without removing the cluster. The EZ-Tech, with the instrument cluster software, can be used to exercise the speedometer/tachometer, through the J1708 data link . Refer to the instrument cluster software manual for instructions.

5.9. SPEEDOMETER, ODOMETER, TACHOMETER, HOUR-METER, VOLTMETER, OIL PRESSURE GAUGE, AND WATER TEMPERATURE GAUGE FAILURE CHART

Table 7 Speedometer, Odometer, Tachometer, Hour-meter, Voltmeter, Oil Pressure Gauge, and Water Temperature Gauge Failure Chart

FAILURE MODE	FIRST ACTION	SECOND ACTION
1. Speedometer, tachometer, voltmeter, oil pressure gauge, and water temperature gauge needles do not move on power up.	Verify that ignition voltage and ground are provided to cluster. Refer to CLUSTER HARNESS CONNECTORS and GROUP 08 - ELECTRICAL, Circuit Diagrams.	Replace cluster.
2. Speedometer, tachometer, voltmeter, oil pressure or water temperature gauge needle moves erratically on power up sweep.	Swap the speedometer and tachometer in the cluster, or water temperature gauge for another temperature gauge, etc. in the cluster. If the defect follows the meter, replace the meter.	If the defect stays at the same meter location, replace the cluster.
3. Speedometer and tachometer sweep in unison and the tachometer needle points to three (3) times.	J1587/J1708 Data Link failure. Insure that the vehicle Data Link is not shorted or wired incorrectly. With the ignition on, voltage from Positive data link circuit to ground should be approximately 4 volts. Voltage from Negative data link circuit to ground should be approximately 1 volt. Refer to CLUSTER HARNESS CONNECTORS and GROUP 08 - ELECTRICAL, Circuit Diagrams.	Verify data from the ECM2 by using an electronic service tool (EST), such as the EZ-Tech™ or Pro-Link® 9000, with the applicable engine software. If data is present replace cluster.

Table 7 Speedometer, Odometer, Tachometer, Hour-meter, Voltmeter, Oil Pressure Gauge, and Water Temperature Gauge Failure Chart (cont.)

FAILURE MODE	FIRST ACTION	SECOND ACTION
4. Speedometer and tachometer sweep in unison and the tachometer needle points to three (3) times.	Cluster electronics failed. Replace cluster.	
5. Speedometer and tachometer sweep in unison and the tachometer needle points to three (3) times.	Odometer drive circuit failed, odometer is disconnected, or odometer coil is open. Insure odometer connector is properly seated to the printed wiring board connector.	Disconnect odometer connector, swap with hour-meter or connect to hour-meter connector, start engine, and note if odometer advances once every 6 minutes. If odometer advances, replace cluster. If odometer does not advance, replace odometer.
6. Speedometer and tachometer go through a good power up sweep, but **speedometer does not work** when driving.	Check speedometer sensor wiring continuity and sensor output signal levels. Refer to CLUSTER HARNESS CONNECTORS and GROUP 08 - ELECTRICAL, Circuit Diagrams.	Verify signal to ECM2 by using an electronic service tool (EST), such as the EZ-Tech™ or Pro-Link® 9000.
7. Speedometer and tachometer go through a good power up sweep, but **tachometer does not work** when driving.	Verify signal to ECM2 by using an electronic service tool.	
8. Speedometer and tachometer go through a good power up sweep, but **odometer does not work** when driving.	Remove odometer and swap with hour-meter or connect to hour-meter connector, start engine, and note if odometer advances every 6 minutes. If odometer advances, replace the cluster.	If odometer does not advance, replace odometer.
9. Speedometer and tachometer go through a good power up sweep, but hour-meter does not work when driving.	Swap hour-meter with odometer, drive truck and note if the hour-meter (placed in odometer location) advances every tenth of a mile. If the hour-meter operates, replace the cluster.	If the hour-meter does not advance, replace the hour-meter.

6. TROUBLESHOOTING (INDICATOR AND WARNING LIGHT DIAGNOSTICS)

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 the 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.

6.1. OIL/WATER

FE 300 With Air Brakes

Table 8 FE 300 With Air Brakes

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 data-link?	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 MSM1 connector (3111). 2. Connect pin 1 to ground.	(3111), 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 warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.

Table 8 FE 300 With Air Brakes (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
5.	Off	1. Instrument cluster removed. 2. Measure resistance from disconnected conn. (10), pin 10, circuit A97AF, A29A/35 to MSM1 disconnected conn. (3111) pin 1.	(10), pin 10, cir. A97AF, A29A/35 to (3111) pin 1.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A97AF, A29A/35 or cluster, then repair.
6.	Off/ On	1. Instrument cluster removed. 2. Move key switch to ignition. 3. Measure voltage from conn. (10), pin 5, circuit A28A/A28 to ground.	(10), pin 5, cir. A28A/A28 to gnd.	12±1.5 volts.	Install cluster. Go to next step.	Locate cause of no or low voltage in circuit A28A/A28 from fuse F22, then repair.
7.	Off/ On	1. Leave J1939 sniffer connected		Is the engine (0x00) on the data-link?	Go to step 8.	Go to step 11.
8.	Off/ On	1. Turn the key to OFF. 2. Disconnect MSM1 connector (3111). 3. Measure resistance across data-link pins 5 & 6, in wiring harness	(3111), pins 5 and 6.	Is the resistance approx. 60 ohms?	Go to step 9.	Fix data-link wiring, cir A5DMS(-) and A5DMS(+), retest
9.	Off/ On	1. Turn the key to Ignition. 2. Measure the voltage at the MSM1's harness ignition pin 7 to ground.	(3111), pin 7, cir A13MS to gnd.	Is the voltage 12-16 volts?	Go to step 7.	Fix wiring cir A13MS or fuse F31, retest.

Table 8 FE 300 With Air Brakes (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
10.	Off/ On	1. Measure the resistance between the MSM1's harness ground pin 8 and ground	(3111), pin 8, cir A11–GM/ A11–G to gnd.	Is the resistance less than 10 ohms?	Replace MSM and retest	Fix ground wiring cir A11–GM/ A11–G 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 data-link?	Check the engine's power connections and data link wiring.	Verify sniffer is working properly

FE 300 With Hydraulic Brakes

Table 9 FE 300 With Hydraulic Brakes

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 data-link?	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 MSM1 connector (3111). 2. Connect pin 1 to ground.	(3111), pin 1 to gnd.	Does the "Oil/Water" lamp turn on and alarm sounds?	Replace MSM and retest	Go to next step.

Table 9 FE 300 With Hydraulic Brakes (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
4.	Off	1. Remove instrument cluster. 2. Remove OIL/WATER indicator bulb. 3. Test bulb for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
5.	Off	1. Instrument cluster removed. 2. Measure resistance from disconnected conn. (10), pin 10, circuit A97AF, A29/35 to MSM1 disconnected conn. (3111) pin 1.	(10), pin 10, cir. A97AF, A29/35 to (3111) pin 1.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A97AF, A29/35 or cluster, then repair.
6.	Off/ On	1. Instrument cluster removed. 2. Move key switch to ignition. 3. Measure voltage from conn. (10), pin 5, circuit A28D/A28 to ground.	(10), pin 5, cir. A28D/A28 to gnd.	12±1.5 volts.	Install cluster. Go to next step.	Locate cause of no or low voltage in circuit A28D/A28 from fuse F22, then repair.
7.	Off/ On	1. Leave J1939 sniffer connected		Is the engine (0x00) on the data-link?	Go to step 8.	Go to step 11.
8.	Off/ On	1. Turn the key to OFF. 2. Disconnect MSM1 connector (3111). 3. Measure resistance across data-link pins 5 & 6, in wiring harness	(3111), pins 5 and 6.	Is the resistance approx. 60 ohms?	Go to step 9.	Fix data-link wiring, cir A5DMS(-) and A5DMS(+), retest

Table 9 FE 300 With Hydraulic Brakes (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 MSM1's harness ignition pin 7 to ground.	(3111), pin 7, cir A13MS to gnd.	Is the voltage 12-16 volts?	Go to step 7.	Fix wiring cir A13MS or fuse F31, retest.
10.	Off/ On	1. Measure the resistance between the MSM1's harness ground pin 8 and ground	(3111), pin 8, cir A11–GM/A11–G to gnd.	Is the resistance less than 10 ohms?	Replace MSM and retest	Fix ground wiring cir A11–GM/A11–G 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 data-link?	Check the engine's power connections and data link wiring.	Verify sniffer is working properly

IC

Table 10 IC

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ECM connector (379) and use a test jumper to connect pin 54/circuit 97AF to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (379), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace defective ECM.	Go to next step.
2.	Off	Loosen cluster and remove oil/water warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists. Clear fault codes from ECM.

Table 10 IC (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
3.	Off	Disconnect connector (26), and with jumper still attached at connector (379), measure resistance from connector (26) circuit 29/35 to ground.	(26), 29/35 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 29/35, 97AF, connector (2), circuit 97AF, then repair. Reconnect connector and clear fault codes.
4.	On	Move key switch to ignition position and measure voltage from connector (26) circuit 28D to ground.	(26), 28D to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28D from fuse F24, then repair. Reconnect connectors and clear fault codes.
5.	On	With jumper still installed at connector (379), reconnect connector (26). Does warning light illuminate?			Warning light circuits test good. Reconnect connector.	Replace defective cluster assembly. Reconnect connector and clear fault codes.

6.2. BRAKE PRESSURE

FE 300 With Hydraulic Brakes

Table 11 FE 300 With Hydraulic Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect hydraulic brake booster monitor module connector (86) and use a test jumper to connect pin C/circuit A90M to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (86), and turn key on. If warning light does not illuminate during bulb check, replace brake monitor module.	Go to next step.
2.	Off	Loosen cluster and remove BRAKE PRESS light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.

Table 11 FE 300 With Hydraulic Brakes (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
3.	Off	Disconnect connector (25), and with jumper still attached at connector (86), measure resistance from connector (25) circuit A90N to ground.	(25), A90N to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A90N or A90M, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (25) circuit A28C to ground.	(25), A28C to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28 or A28C from fuse F22, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (86), reconnect connector (25). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (86).	Replace defective cluster assembly. Reconnect connector.

FE 300 With Air Brakes

Table 12 FE 300 With Air Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect air pressure switch connector (1LA) and use a test jumper to connect circuit K40 to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Reconnect conn. (1LA), and drain air from brake system. If warning light does not illuminate when press. <60 psi, replace pressure switch.	Go to next step.
2.	Off	Loosen cluster and remove BRAKE PRESS light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.

Table 12 FE 300 With Air Brakes (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
3.	Off	Disconnect connector (2), and with jumper still attached at connector (1LA), measure resistance from connector (2) circuit A40A to ground.	(2), A40A to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuits A40A, A40, connector (2), circuit N40, connector (9850) or circuit K40, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (2) circuit A28D to ground.	(2), A28D to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28 or A28D from fuse F22, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (1LA), reconnect connector (2). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (1LA).	Replace defective cluster assembly. Reconnect connector.

IC With Hydraulic Brakes

Table 13 IC With Hydraulic Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect hydraulic brake booster monitor module (49) and use a test jumper to connect pin C/circuit 90T to ground. Move key switch to ignition position. Does warning light illuminate?			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	Loosen cluster and remove brake pressure light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.

Table 13 IC With Hydraulic Brakes (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
3.	Off	Disconnect connector (26), and with jumper still attached at connector (49), measure resistance from connector (26) circuit 90T to ground.	(26), 90T to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 90T, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (26) circuit 28A to ground.	(26), 28A to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28A from fuse F24, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (49), reconnect connector (26). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (49).	Replace defective cluster assembly. Reconnect connector.

IC With Air Brakes

Table 14 IC With Air Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Remove warning buzzer at relay socket (20), move key switch to ignition position, and at relay socket and circuit 40A, connect a jumper to ground. Does warning light illuminate?			Warning light circuits test good. Re-install warning buzzer. To test sensor circuits, go to Step 6.	Go to next step.
2.	Off	Loosen cluster and remove brake pressure warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and re-install warning buzzer.
3.	Off	Disconnect connector (26), and with jumper still attached at socket (20), measure resistance from connector (26) circuit 40A to ground.	(26), 40A to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 40A, then repair.

Table 14 IC With Air Brakes (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 from connector (26) circuit 28D to ground.	(26), 28D to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28 or 28D from fuse F24, then repair.
5.	On	With jumper still installed at socket (20), reconnect connector (26). Does warning light illuminate?			Warning light circuits test good. Re-install warning buzzer. To test sensor circuits, go to next step.	Replace defective cluster assembly. Re-install warning buzzer.
6.	On	Disconnect low air press. sensor connector and install a jumper wire from circuit 40 to ground. Does warning light illuminate?			Go to next step.	Locate open or poor connection in circuit 40B or 40A, connector (2), or circuit 40, then repair. Go to next step.
7.	On	Remove jumper and reconnect air pressure sensor connector. Drain air pressure from brake system until <60 psi. Does warning light illuminate?			Circuits check good. Turn key switch off.	Replace defective air pressure sensor.

6.3. STOP ENGINE

FE 300 and IC SE item not covered at this time.

6.4. CHANGE OIL

FE 300 With International Engines

Table 15 FE 300 With International Engines

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 data-link?	Go to step 2.	Go to step 4.

Table 15 FE 300 With International Engines (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
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 MSM2 connector (3111). 2. Connect pin 2 to ground.	(3111), pin 2 to gnd.	Does the "Change Oil" lamp turn on?	Replace MSM and retest	Go to next step.
4.	Off	1. Remove instrument cluster. 2. Remove CHANGE OIL indicator bulb. 3. Test bulb for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
5.	Off	1. Instrument cluster removed. 2. Measure resistance from disconnected conn. (10), pin 11, circuit A97AA to MSM2 disconnected conn. (3111) pin 2.	(10), pin 11, cir. A97AA to (3111) pin 2.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A97AA or cluster, then repair.
6.	Off/ On	1. Instrument cluster removed. 2. Move key switch to ignition. 3. Measure voltage from conn. (10), pin 4, circuit A28K to ground.	(10), pin 4, cir. A28K to gnd.	12±1.5 volts.	Install cluster. Go to next step.	Locate cause of no or low voltage in circuit A28, A28K from fuse F22, then repair.
7.	Off/ On	1. Leave J1939 sniffer connected		Is the engine (0x00) on the data-link?	Go to step 8.	Go to step 11.

Table 15 FE 300 With International Engines (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
8.	Off/ On	1. Turn the key to OFF. 2. Disconnect MSM1 connector (3111). 3. Measure resistance across data-link pins 5 & 6, in wiring harness	(3111), pins 5 and 6.	Is the resistance approx. 60 ohms?	Go to step 9.	Fix data-link wiring, cir A5DMS(-) and A5DMS(+), retest
9.	Off/ On	1. Turn the key to Ignition. 2. Measure the voltage at the MSM1 conn. (3111) harness ignition pin 7 to ground.	(3111), pin 7, cir A13MS.	Is the voltage 12-16 volts?	Go to step 7.	Fix wiring cir A13MS or fuse F31, retest.
10.	Off/ On	1. Measure the resistance between the MSM1 conn. (3111) harness ground pin 8 and ground	(3111), pin 8, cir A11–GM, A11–G to gnd.	Is the resistance less than 10 ohms?	Replace MSM and retest	Fix ground wiring cir A11–GM, A11–G and platform 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 data-link?	Check the engine's power connections and data link wiring.	Verify sniffer is working properly

IC With International Engines

Table 16 IC With International Engines

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ECM connector (379) and use a test jumper to connect pin 45/circuit 97AA to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (379), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECM.	Go to next step.
2.	Off	Loosen cluster and remove change oil warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (26), and with jumper still attached at connector (379), measure resistance from connector (26) circuit 97AA to ground.	(26), 97AA to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 97AA, connector (2), or circuit 97AA, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (26) circuit 28D to ground.	(26), 28D to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28 or 28D from fuse F24, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (379), reconnect connector (26). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (379).	Replace defective cluster assembly. Reconnect connector.

6.5. WARN ENGINE

FE 300 With International Engines

Table 17 FE 300 With International Engines

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 data-link?	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 MSM1 connector (3111). 2. Connect pin 9 to ground.	(3111), 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 warning light bulb..	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
5.	Off	1. Instrument cluster removed. 2. Measure resistance from disconnected conn. (10), pin 12, circuit A97T to MSM1 disconnected conn. (3111) pin 9.	(10), pin 12, cir. A97T to (3111) pin 9.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A97T or cluster, then repair.

Table 17 FE 300 With International Engines (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. (11), pin 4, circuit A28K to ground.	(11), pin 4, cir. A28K to gnd.	12±1.5 volts.	Install cluster. Go to next step.	Locate cause of no or low voltage in circuit A28, A28K or fuse F22, then repair.
7.	Off/ On	1. Leave J1939 sniffer connected		Is the engine (0x00) on the data-link?	Go to step 8.	Go to step 11.
8.	Off/ On	1. Turn the key to OFF. 2. Disconnect MSM1 connector (3111). 3. Measure resistance across data-link pins 5 & 6, in wiring harness	(3111), pins 5 and 6.	Is the resistance approx. 60 ohms?	Go to step 9.	Fix data-link wiring, cir A5DMS(-) and A5DMS(+), retest
9.	Off/ On	1. Turn the key to Ignition. 2. Measure the voltage at the MSM1 conn. (3111) harness ignition pin 7 to ground.	(3111), pin 7, cir A13MS.	Is the voltage 12-16 volts?	Go to step 7.	Fix wiring cir A13MS or fuse F31, retest.
10.	Off/ On	1. Measure the resistance between the MSM1 conn. (3111) harness ground pin 8 and ground	(3111), pin 8, cir A11–GM, A11–G to gnd.	Is the resistance less than 10 ohms?	Replace MSM and retest	Fix ground wiring cir A11–GM, A11–G and platform 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 data-link?	Check the engine's power connections and data link wiring.	Verify sniffer is working properly

IC With International Engines

Table 18 IC With International Engines

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ECM connector (379) and use a test jumper to connect pin 55/circuit 97T to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (379), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECM.	Go to next step.
2.	Off	Loosen cluster and remove engine warn warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (26), and with jumper still attached at connector (379), measure resistance from connector (26) circuit 97T to ground.	(26), 97T to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 97T, connector (2), circuit 97T, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (26) circuit 28D to ground.	(26), 28D to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28 or 28D from fuse F24, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (379), reconnect connector (26). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (379).	Replace defective cluster assembly. Reconnect connector.

6.6. TRAC CTRL

FE 300 With Anti-lock Brake System (ABS) — Hydraulic Brakes

Table 19 FE 300 With Anti-lock Brake System (ABS) — Hydraulic Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect traction control switch conn. (1101), and connect a jumper wire from circuit A94W to ground. Move key switch to ignition position. Does warning light illuminate?			Go to Step 6.	Go to next step.
2.	Off	Loosen cluster and remove TRAC CTRL warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	With jumper still in place, disconnect connector (1500) and at pin B, circuit A94U, measure resistance to ground.	(1500), A94U, to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A94U, conn. (2), pin F6 or N94U, then repair.
4.	On	With jumper still in place, move key switch to ignition position, and at connector (1500) and at pin A, circuit A94T, measure voltage from pin A, circuit A94U, to pin B, circuit A94T.	(1500), A94U to A94T.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28 or A94T from fuse F22, then repair.
5.	On	With jumper still installed, reconnect connector (1500). Does warning light illuminate?			Go to next step.	Replace defective cluster assembly. Reconnect connector and clear fault codes.
6.	Off	With traction control switch conn. (1101) applied, measure resistance across traction control switch conn. (1101).	Across switch (1101).	<1 ohm.	Go to next step.	Replace defective traction control switch.
7.	Off	At traction control switch conn. (1101), measure resistance from circuit A94-GT to ground.	(1101), A94-GT to gnd.	<1 ohm.	Warning light circuits test good. Reconnect circuits.	Locate open or poor connection in circuits A94W, conn. (2), pin A2, N94W, A94-GT or A11-G to platform ground, then repair.

FE 300 With WTEC or Allison 2000 ICT Anti-lock Brake System (ABS) — Air Brakes

Table 20 FE 300 With WTEC or Allison 2000 ICT Anti-lock Brake System (ABS) — Air Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off	Disconnect ABS ECU connector (288) and use a test jumper to connect pin C2 to +12 volts. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (288), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove TRAC CTRL warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	On	Disconnect connector (3127), and with jumper still attached at connector (288), measure voltage from connector (3127), pin A, circuit A94CT to ground.	(3127), A94CT to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in, N94CT connector (2), or circuit A94CT then repair. Reconnect connectors.
4.	Off	At connector (3127), measure voltage from connector (3127), pin B, circuit A94GT to ground.	(3127), A94GT to gnd.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuits A11-GB, A94–GB, coil of relay (283), circuits A94BT, A94GT or A13M, from fuse F27, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (288), reconnect connector (3127). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (288).	Replace defective cluster assembly. Reconnect connector.
6.	Off	With traction control switch connector (1101) applied, measure resistance across traction control switch connector (1101).	Across switch (1101).	<1 ohm.	Locate open or poor connection in circuits N94DT, conn. (2), pin A7, or N94FT, then repair.	Replace defective traction control switch.

6.7. TRAC CTRL

SE item not covered at this time.

6.8. CHECK TRANS

FE 300 With Allison WTEC III Transmission With Hydraulic Brakes

Table 21 FE 300 With Allison WTEC III Transmission With Hydraulic Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect Allison ECU connector (7204) and use a test jumper to connect pin 31, circuit K115 to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (7204), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove CHECK TRANS warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (10), and with jumper still attached at connector (7204), measure resistance from connector (10), pin 2, circuit A125 to ground.	(10), A125 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in connector (7204), pin 31, circuit K115, connector (523), circuit N125, connector (644), circuit A115, connector (377), circuit A125 or connector (10), pin 2, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (10), pin1, circuit A28A to ground.	(10), A28A to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28 or A28A from fuse F22, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (7204), reconnect connector (10). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (7204).	Replace defective cluster assembly. Reconnect connector.

FE 300 With Allison WTEC III GEN 4 Transmission With Hydraulic Brakes

Table 22 FE 300 With Allison WTEC III GEN 4 Transmission With Hydraulic Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect Allison ECU connector (7150) and use a test jumper to connect pin 29, circuit K129 to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (7150), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove CHECK TRANS warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (10), and with jumper still attached at connector (7150), measure resistance from connector (10), pin 2, circuit A125 to ground.	(10), A125 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in connector (7150), pin 29, circuit K129, connector (523), circuit N125, connector (644), circuit A115, connector (377), circuit A125 or connector (10), pin 2, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (10), pin 1, circuit A28A to ground.	(10), A28A to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28 or A28A from fuse F22, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (7150), reconnect connector (10). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (7150).	Replace defective cluster assembly. Reconnect connector.

FE 300 With Allison WTEC III Transmission With Air Brakes

Table 23 FE 300 With Allison WTEC III Transmission With Air Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect Allison ECU connector (7204) and use a test jumper to connect pin 31, circuit K115 to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (7204), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove CHECK TRANS warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (10), and with jumper still attached at connector (7204), measure resistance from connector (10), pin 2, circuit A125 to ground.	(10), A125 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in connector (7204), pin 31, circuit K#115, connector (523), circuit N125, connector (644), circuit A125, connector (377), circuit A125 or connector (10), pin 2, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (10), pin 1, circuit A28A to ground.	(10), A28A to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28 or A28A from fuse F22, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (7204), reconnect connector (10). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (7204).	Replace defective cluster assembly. Reconnect connector.

FE 300 With Allison WTEC III GEN 4 Transmission With Air Brakes

Table 24 FE 300 With Allison WTEC III GEN 4 Transmission With Air Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect Allison ECU connector (7150) and use a test jumper to connect pin 29, circuit K129 to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (7150), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove CHECK TRANS warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (10), and with jumper still attached at connector (7150), measure resistance from connector (10), pin 2, circuit A125 to ground.	(10), A125 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in connector (7150), pin 29, circuit K129, connector (523), circuit N129, connector (644), circuit A125, connector (377), circuit A125 or connector (10), pin 2, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (10), pin 1, circuit A28A to ground.	(10), A28A to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28 or A28A from fuse F22, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (7150), reconnect connector (10). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (7150).	Replace defective cluster assembly. Reconnect connector.

FE 300 With Allison 2000 (LCT) Transmission

Table 25 FE 300 With Allison 2000 (LCT) Transmission

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect Allison ECU connector (7305) and use a test jumper to connect pin 25, circuit K125 to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (7305), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove CHECK TRANS warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (10), and with jumper still attached at connector (7305), measure resistance from connector (10), pin 2, circuit A125 to ground.	(10), A125 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in connector (7305), pin 25, circuit K125, connector (9875), circuit N125, connector (644), circuit A125, connector (377), circuit A125 or connector (10), pin 2, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (10), pin 1, circuit A28A to ground.	(10), A28A to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28 or A28A from fuse F22, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (7305), reconnect connector (10). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (7305).	Replace defective cluster assembly. Reconnect connector.

FE 300 With Allison 1000/2000 GEN 4 Transmission

Table 26 FE 300 With Allison 1000/2000 GEN 4 Transmission

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect Allison ECU connector (7150) and use a test jumper to connect pin 29, circuit K129 to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (7150), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove CHECK TRANS warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (10), and with jumper still attached at connector (7150), measure resistance from connector (10), pin 2, circuit A125 to ground.	(12), A125 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in connector (7150), pin 29, circuit K129, connector (9875), circuit N129, connector (644), circuit A125, connector (377), circuit A125 or connector (10), pin 2, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (10), pin 1, circuit A28A to ground.	(10), A28A to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28 or A28A from fuse F22, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (7150), reconnect connector (10). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (7150).	Replace defective cluster assembly. Reconnect connector.

IC With Allison MD Transmission

Table 27 IC With Allison MD Transmission

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect Allison ECU connector (634) and use a test jumper to connect pin 31/circuit 115 to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (634), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove Check Trans warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (26), and with jumper still attached at connector (634), measure resistance from connector (26) circuit 115/pin 2 to ground.	(26), 115 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 92, connector (377), circuit 115, connector (418), or circuit 115, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (26) circuit 28A to ground.	(26), 28A to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28 or 28A from fuse F24, then repair. Reconnect connectors.
5.	On	With jumper still installed at connector (634), reconnect connector (26). Does warning light illuminate?			Warning light circuits test good. Reconnect connector (634).	Replace defective cluster assembly. Reconnect connector.

6.9. LEFT TURN INDICATOR

FE 300 With International Turn Signal Switch (Stationary Column)

Table 28 FE 300 With International Turn Signal Switch (Stationary Column)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off	Move turn signal switch (62) to left turn position. Does left turn signal light illuminate?			Go to next step.	Refer to Electrical Troubleshooting Manual (ETM) for troubleshooting of turn signal lights and switch.
2.	Off	Loosen cluster and remove LEFT TURN signal indicator light bulb. Test for continuity.	Across indicator light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (11), and measure voltage from circuit A56B to ground.	(11), A56B to gnd.	Pulsating 12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A56B, then repair. Reconnect connectors.
4.	Off	At connector (11), measure voltage from circuit A56B to circuit A28-G with turn signal in left turn position.	(11), A56B to A28-G.	Pulsating 12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit A28-G or A11-G to platform ground, then repair.
5.	Off	Reconnect connector (11). Does turn signal indicator blink with turn signal lights?			Left turn indicator and circuits test good.	Replace defective cluster assembly.

FE 300 With Douglas Turn Signal Switch (Tilt Column)

Table 29 FE 300 With Douglas Turn Signal Switch (Tilt Column)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off	Move turn signal switch (95) to left turn position. Does left turn signal light illuminate?			Go to next step.	Refer to Electrical Troubleshooting Manual (ETM) for troubleshooting of turn signal lights and switch.
2.	Off	Loosen cluster and remove LEFT TURN signal indicator light bulb. Test for continuity.	Across indicator light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (11), and measure voltage from circuit A56B to ground.	(11), A56B to gnd.	Pulsating 12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A56B, then repair. Reconnect connectors.

Table 29 FE 300 With Douglas Turn Signal Switch (Tilt Column) (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
4.	Off	At connector (11), measure voltage from circuit A56B to circuit A28-G with turn signal in left turn position.	(11), A56B to A28-G.	Pulsating 12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit A28-G or A11-G to platform ground, then repair.
5.	Off	Reconnect connector (11). Does turn signal indicator blink with turn signal lights?			Left turn indicator and circuits test good.	Replace defective cluster assembly.

IC With International Turn Signal Switch (Stationary Column and Tilt Column)

Table 30 IC With International Turn Signal Switch (Stationary Column and Tilt Column)

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?			Go to next step.	Refer to Electrical Troubleshooting Manual (ETM) for troubleshooting of turn signal lights and switch.
2.	Off	Loosen cluster and remove left turn signal indicator light bulb. Test for continuity.	Across indicator light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (27), and measure voltage from circuit 56C to ground.	(27), 56C to gnd.	Pulsating 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 connector (27), measure voltage from circuit 56C to circuit 28-GA with turn signal in left turn position.	(27), 56C to 28-GA.	Pulsating 12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit 28-GA, or 11-G to cab ground, 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.

6.10. (ABS) ANTI-LOCK BRAKE WARNING LIGHT

FE 300 With WTEC or Allison 2000 ICT Air Brakes

Table 31 FE 300 With WTEC or Allison 2000 ICT Air Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ABS ECU connector (288) and use a test jumper to connect pin E3 to ground. Move key switch to ignition position. Does ABS warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (288), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove (ABS) anti-lock brake warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off/ On	Disconnect connector (297), move key switch to ignition position, and measure voltage from circuit A94B to ground.	(297), A94B to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuits A13K, A13E or A94B from fuse (F27), then repair.
4.	On	Remove warning light relay (284), and at relay socket, measure voltage from circuit A94E to ground.	(284), A94E to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A94E, then repair.
5.	On	At relay socket (284), measure voltage from circuit A94E to A94-GA.	(284), A94E to A94-GA.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuits A94-GA, A94-GB or A11-GB, then repair.
6.	On	With jumper still connected at ECU, at relay socket (284), measure voltage from circuit A94E to A94H.	(284), A94E to A94H.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuits A94H, conn. (451) or gray wire, then repair.
7.	Off	Bench test warning light relay (284) by measuring resistance from pin 30 to 87A.	Relay, pin 30 to 87A.	<1 ohm.	Go to next step.	Replace defective warning light relay.

Table 31 FE 300 With WTEC or Allison 2000 ICT Air Brakes (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
8.	Off	Bench test warning light relay (284) by applying +12V to pin 86, gnd. to pin 85, and measuring resistance from pin 30 to 87.	Energized relay, pin 30 to 87.	<1 ohm.	Go to next step.	Replace defective warning light relay.
9.	Off/ On	Re-install warning light relay, and with jumper still installed at connector (288), move key switch to ignition position. Does warning light illuminate?			ABS warning light circuits test good. Turn key off. Reconnect conn. (288) and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Locate open or poor connection in circuit A94E, then repair.

FE 300 With Hydraulic Brakes GEN 4

Table 32 FE 300 With Hydraulic Brakes GEN 4

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ABS ECU connector (279) and use a test jumper to connect pin 1 to ground. Move key switch to ignition position. Does ABS warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (279), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove (ABS) anti-lock brake warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off/ On	Disconnect connector (422), move key switch to ignition position, and measure voltage from circuit A94B to ground.	(422), A94B to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuits A28, A13N or A94B from fuse (F22), then repair.

Table 32 FE 300 With Hydraulic Brakes GEN 4 (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
4.	On	Remove warning light relay (R1), and at relay socket, measure voltage from circuit A94E to ground.	(R1), A94E to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A94E, then repair.
5.	On	At relay socket (R1),, measure voltage from circuit A94E to A94-GB.	(R1), A94E to A94-GB.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit A94-GB or A11-G, then repair.
6.	On	With jumper still connected at ECU, at relay socket (R1),, measure voltage from circuit A94E to A94H.	(R1,, A94E to A94H.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuits A94H, conn. (2), K94H, conn. (261), K94H, or gray wire, then repair.
7.	Off	Bench test warning light relay (R1), by measuring resistance from pin 30 to 87A.	Relay, pin 30 to 87A.	<1 ohm.	Go to next step.	Replace defective warning light relay.
8.	Off	Bench test warning light relay (R1), by applying +12V to pin 86, gnd. to pin 85, and measuring resistance from pin 30 to 87.	Energized relay, pin 30 to 87.	<1 ohm.	Go to next step.	Replace defective warning light relay.
9.	Off/ On	Re-install warning light relay, and with jumper still installed at connector (279), move key switch to ignition position. Does warning light illuminate?			ABS warning light circuits test good. Turn key off. Reconnect conn. (279) and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Locate open or poor connection in circuit A94E, then repair.

IC With Air Brakes

Table 33 IC With Air Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ABS ECU connector (288) and use a test jumper to connect pin E3 to ground. Move key switch to ignition position. Does ABS warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (288), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove antilock brake warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off/ On	Disconnect connector (297), move key switch to ignition position, and measure voltage from circuit 94D to ground.	(297), 94D to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28 or 94D from fuse (F24), then repair.
4.	On	Remove warning light relay (R4), and at relay socket, measure voltage from circuit 94F to ground.	(R4), 94F to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 94F, then repair.
5.	On	At relay socket (R4), measure voltage from circuit 94E to 94-GC.	(R4), 94E to 94-GC.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit 94-GB, circuit 94-GC or 11-G, then repair.
6.	On	With jumper still connected at ECU, at relay socket (R4), measure voltage from circuit 94H.	(R4), 94H.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit 94H, conn. (2), 94H or gray wire, then repair.
7.	Off	Bench test warning light relay (R4) by measuring resistance from pin 30 to 87A.	Relay, pin 30 to 87A.	<1 ohm.	Go to next step.	Replace defective warning light relay.

Table 33 IC With Air Brakes (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
8.	Off	Bench test warning light relay (R4) by applying +12V to pin 86, gnd. to pin 85, and measuring resistance from pin 30 to 87.	Energized relay, pin 30 to 87.	<1 ohm.	Go to next step.	Replace defective warning light relay.
9.	Off/ On	Re-install warning light relay, and with jumper still installed at connector (288), move key switch to ignition position. Does warning light illuminate?			ABS warning light circuits test good. Turn key off. Reconnect conn. (288) and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Locate open or poor connection in circuit 94E, then repair.

IC With Hydraulic Brakes

Table 34 IC With Hydraulic Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ABS ECU connector (279) and use a test jumper to connect pin 1 to ground. Move key switch to ignition position. Does ABS warning light illuminate?			Warning light circuits test good. Turn key off, reconnect conn. (279), and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Loosen cluster and remove antilock brake warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.

Table 34 IC With Hydraulic Brakes (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
3.	Off/ On	Disconnect connector (R4), move key switch to ignition position, and measure voltage from circuit 94D to ground.	(R4), 94D to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28 or 94D from fuse (F24), then repair.
4.	On	Remove warning light relay (R4), and at relay socket, measure voltage from circuit 94F to ground.	(R4), 94F to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 94F, then repair.
5.	On	At relay socket (R4), measure voltage from circuit 94E to 94-GC.	(R4), 94E to 94-GC.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit 94-GB, circuit 94-GC or 11-G, then repair.
6.	On	With jumper still connected at ECU, at relay socket (R4), measure voltage from circuit 94H.	(R4), 94H.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit 94H, conn. (2), 94H or gray wire, then repair.
7.	Off	Bench test warning light relay (R4) by measuring resistance from pin 30 to 87A.	Relay, pin 30 to 87A.	<1 ohm.	Go to next step.	Replace defective warning light relay.
8.	Off	Bench test warning light relay (R4) by applying +12V to pin 86, gnd. to pin 85, and measuring resistance from pin 30 to 87.	Energized relay, pin 30 to 87.	<1 ohm.	Go to next step.	Replace defective warning light relay.
9.	Off/ On	Re-install warning light relay, and with jumper still installed at connector (279), move key switch to ignition position. Does warning light illuminate?			ABS warning light circuits test good. Turn key off. Reconnect conn. (279) and turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Locate open or poor connection in circuit 94E, then repair.

6.11. HIGH BEAM INDICATOR

FE 300 With Douglas Turn Signal Switch (Tilt Column)

Table 35 FE 300 With Douglas Turn Signal Switch (Tilt Column)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off	Loosen cluster, remove HIGH BEAM indicator bulb, and test for continuity	Across light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and repeat test if problem persists.
2.	Off	Disconnect connector (11), move headlight switch to on, and dimmer switch to high beam position. Measure voltage from connector (11) pin 4, circuit A52A to ground.	(11), pin 4 to gnd.	12±1.5 volts.	Go to next step.	Go to Step 4.
3.	Off	With switches still set, measure voltage at connector (11) from pin 4, circuit A52A to pin 2, circuit A28-G.	(11), pin 4 to pin 2.	12±1.5 volts.	High beam circuits check good. Reconnect conn. (11) and replace cluster if warning light fails to illuminate.	Locate open or poor connection in circuit A28-G or A11-G, then repair.
4.	Off	Remove connector (4) and with switches still set, measure voltage from circuit A51B to ground.	(4), A51B to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A50C, switch and conn. (23) or circuit A51B, then repair.
5.	Off	On switch half of connector (4), measure resistance from green wire to brown wire with switch in high beam position.	(4), green to brown.	<1 ohm.	Go to next step.	Replace defective dimmer switch.
6.	Off	Reconnect connector (4), and with switches still set, at connector (11), measure voltage from circuit A52A to ground.	(11), A52A to gnd.	12±1.5 volts.	Circuits test good. Reconnect conn. (11) and replace cluster if warning light fails to illuminate.	Locate cause of low or no voltage in circuit A52 or 52A, then repair.

FE 300 With International Turn Signal Switch (Stationary Column)

Table 36 FE 300 With International Turn Signal Switch (Stationary Column)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off	Loosen cluster, remove HIGH BEAM indicator bulb, and test for continuity	Across light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and repeat test if problem persists.
2.	Off	Disconnect connector (11), move headlight switch to on, and dimmer switch to high beam position. Measure voltage from connector (11) pin 4, circuit A52A to ground.	(11), pin 4 to gnd.	12±1.5 volts.	Go to next step.	Go to Step 4.
3.	Off	With switches still set, measure voltage at connector (11) from pin 4, circuit A52A to pin 2, circuit A28-G.	(11), pin 4 to pin 2.	12±1.5 volts.	High beam circuits check good. If light fails to turn off, check relay or switch.	Locate open or poor connection in circuit A28-G or A11-G, then repair.
4.	Off	Remove lift-to-dim relay (100) and with switches still set, measure voltage from circuit A51A to ground.	Socket (100), A51A to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A50C, switch and conn. (23) or circuit A51A, then repair.
5.	Off	With switches still set, at relay socket (100), measure voltage from circuit A51F to ground.	Socket (100), A51F to gnd.	12±1.5 volts.	Go to next step.	Locate cause of low or no voltage in circuit A51F, then repair.
6.	Off	With switches still set, at relay socket (100), measure voltage from circuit A51F to A51D.	Socket (100), A51F to A51D.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit A51D, switch and conn. (6), circuit A51-G or A11-GBA to cab ground, then repair.
7.	Off	Bench test lift-to-dim relay (100) by measuring resistance from pin 30 to 87A.	Relay, pin 30 to 87A.	<1 ohm.	Go to next step.	Replace defective lift-to-dim relay.

Table 36 FE 300 With International Turn Signal Switch (Stationary Column) (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
8.	Off	Bench test lift-to-dim relay (100) by applying +12V to pin 85, gnd. to pin 86, and measuring resistance from pin 30 to 87.	Energized relay, pin 30 to 87.	<1 ohm.	Go to next step.	Replace defective lift-to-dim relay.
9.	Off	Re-install relay. With headlight switch in on position and dimmer switch in high beam position, at connector (11) measure voltage from pin 4, circuit A52A to ground.	(11), 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 cause of low or no voltage in circuit A52C or A52A, then repair.

IC With International Turn Signal Switch (Stationary Column)

Table 37 IC With International Turn Signal Switch (Stationary Column)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off	Loosen cluster, remove high beam indicator bulb, and test for open condition.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and repeat test if problem persists.
2.	Off	Re-install bulb, disconnect connector (27), move headlight switch to on, and dimmer switch to high beam position. Measure voltage from connector (27) pin 4/circuit 52A to ground.	(27), pin 4 to gnd.	12±1.5 volts.	Go to next step.	Go to Step 4.
3.	Off	With switches still set, measure voltage at connector (27) from pin 4/circuit 52A to pin 2/circuit 28-GA.	(27), pin 4 to pin 2.	12±1.5 volts.	High beam circuits check good. If light fails to turn off, check relay or switch.	Locate open or poor connection in circuit 28-GA or 11-G, then repair.

Table 37 IC With International Turn Signal Switch (Stationary Column) (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
4.	Off	Remove lift-to-dim relay (100) and with switches still set, measure voltage from circuit 51A to ground.	Socket (100), 51A to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 50, 50B, switch and conn. (35) or circuit 51A, then repair.
5.	Off	With switches still set, at relay socket (100), measure voltage from circuit 51C to ground.	Socket (100), 51C to gnd.	12±1.5 volts.	Go to next step.	Locate cause of low or no voltage in circuit 51C, then repair.
6.	Off	With switches still set, at relay socket (100), measure voltage from circuit 51A to 51D.	Socket (100), 51A to 51D.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit 51D, switch and conn. (100), circuit 51-G or 11-G to cab ground, then repair.
7.	Off	Bench test lift-to-dim relay (100) by measuring resistance from pin 30 to 87A.	Relay, pin 30 to 87A.	<1 ohm.	Go to next step.	Replace defective lift-to-dim relay.
8.	Off	Bench test lift-to-dim relay (100) by applying +12V to pin 85, gnd. to pin 86, and measuring resistance from pin 30 to 87.	Energized relay, pin 30 to 87.	<1 ohm.	Go to next step.	Replace defective lift-to-dim relay.
9.	Off	Re-install relay. With headlight switch in on position and dimmer switch in high beam position, at connector (27) measure voltage from pin 4/circuit 52A to ground.	(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 cause of low or no voltage in circuit 52C or 52A, then repair.

6.12. RIGHT TURN INDICATOR

FE 300 With International Turn Signal Switch (Stationary Column)

Table 38 FE 300 With International Turn Signal Switch (Stationary Column)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off	Move turn signal switch (62) to right turn position. Does right turn signal light illuminate?			Go to next step.	Refer to Electrical Troubleshooting Manual (ETM) for troubleshooting of turn signal lights and switch.
2.	Off	Loosen cluster and remove RIGHT TURN signal indicator light bulb. Test for continuity.	Across indicator light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (11), and measure voltage from circuit A57B to ground.	(11), A57B to gnd.	Pulsating 12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A57B, then repair. Reconnect connectors.
4.	Off	At connector (11), measure voltage from circuit A57B to circuit A28-G with turn signal in right turn position.	(11), A57B to A28-G.	Pulsating 12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit A28-G, or A11-G to cab ground, then repair.
5.	Off	Reconnect connector (11). Does turn signal indicator blink with turn signal lights?			Right turn indicator and circuits test good.	Replace defective cluster assembly.

FE 300 With Douglas Turn Signal Switch (Tilt Column)

Table 39 FE 300 With Douglas Turn Signal Switch (Tilt Column)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off	Move turn signal switch (95) to right turn position. Does right turn signal light illuminate?			Go to next step.	Refer to Electrical Troubleshooting Manual (ETM) for troubleshooting of turn signal lights and switch.
2.	Off	Loosen cluster and remove RIGHT TURN signal indicator light bulb. Test for continuity.	Across indicator light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (11), and measure voltage from circuit A57B to ground.	(11), A57B to gnd.	Pulsating 12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A57B, then repair. Reconnect connectors.

Table 39 FE 300 With Douglas Turn Signal Switch (Tilt Column) (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
4.	Off	At connector (11), measure voltage from circuit A57B to circuit A28-G with turn signal in right turn position.	(11), A57B to A28-G.	Pulsating 12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit A28-G or A11-G to platform ground, then repair.
5.	Off	Reconnect connector (11). Does turn signal indicator blink with turn signal lights?			Right turn indicator and circuits test good.	Replace defective cluster assembly.

IC With International Turn Signal Switch (Stationary Column and Tilt Column)

Table 40 IC With International Turn Signal Switch (Stationary Column and Tilt Column)

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?			Go to next step.	Refer to Electrical Troubleshooting Manual (ETM) for troubleshooting of turn signal lights and switch.
2.	Off	Loosen cluster and remove right turn signal indicator light bulb. Test for continuity.	Across indicator light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	Disconnect connector (27), and measure voltage from circuit 57C to ground.	(27), 57C to gnd.	Pulsating 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 connector (27), measure voltage from circuit 57C to circuit 28-GA with turn signal in right turn position.	(27), 57C to 28-GA.	Pulsating 12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit 28-GA, or 11-G to cab ground, then repair.
5.	Off	Reconnect connector (27). Does turn signal indicator blink with turn signal lights?			Right turn indicator and circuits test good.	Replace defective cluster assembly.

6.13. WAIT-TO-START

FE 300 With International Engines

Table 41 FE 300 With International Engines

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 Data-link?	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 MSM1 connector (3111). 2. Connect pin 10 to ground.	(3111), 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 light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb. Repeat all tests if problem persists.
5.	Off	1. Instrument cluster removed. 2. Measure resistance from disconnected conn. (12), pin 5, circuit A97AE to MSM1 disconnected conn. (3111) pin 10.	(12), pin 5, cir. A97AE to (3111) pin 10.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A97AE or cluster, then repair.

Table 41 FE 300 With International Engines (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. (12), pin 8, circuit A28C to ground.	(12), pin 8, cir. A28C to gnd.	12±1.5 volts.	Install cluster. Go to next step.	Locate cause of no or low voltage in circuits A28C, A28 or fuse F22, then repair.
7.	Off/ On	1. Leave J1939 sniffer connected		Is the engine (0x00) on the Data-link?	Go to step 8.	Go to step 11.
8.	Off/ On	1. Turn the key to OFF. 2. Disconnect MSM1 connector (3111). 3. Measure resistance across data—link pins 5 & 6, in wiring harness	(3111), pins 5 and 6.	Is the resistance approx. 60 ohms?	Go to step 9.	Fix data-link wiring, cir A5DMS(-) and A5DMS(+), retest
9.	Off/ On	1. Turn the key to Ignition. 2. Measure the voltage at the MSM1 conn. (3111) harness ignition pin 7 to ground.	(3111), pin 7, cir A13MS.	Is the voltage 12-16 volts?	Go to step 7.	Fix wiring cir A13MS. or fuse F31, retest.
10.	Off/ On	1. Measure the resistance between the MSM1 conn. (3111) harness ground pin 8 and ground	(3111), pin 8, cir A11–GM, A11–G to gnd.	Is the resistance less than 10 ohms?	Replace MSM and retest	Fix ground wiring cir A11–GM, A11–G and platform 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 data-link?	Check the engine's power connections and data link wiring.	Verify sniffer is working properly

IC With International T444E Engine

Table 42 IC With International T444E Engine

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ECM connector (379) and use a test jumper to connect circuit 18-G to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. If warning light fails to illuminate during bulb check, reprogram/ replace ECM.	Go to next step.
2.	On	Remove wait-to-start indicator bulb and check for open condition.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and repeat test if problem persists.
3.	Off	With jumper still in place, disconnect connector (28) and measure resistance from pin 5/circuit 18-G to ground.	(28), 18-G to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 18-G, conn. (2), or circuit 18-G, then repair.
4.	On	With jumper still in place, move key switch to ignition position, and at connector (28), measure voltage from pin 8/circuit 28D to pin 5/circuit 18-G.	(28), 28D to 18-G.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28 or 28D from fuse F24, then repair.
5.	On	With jumper still installed at connector (379), reconnect connector (28). Does warning light illuminate?			Warning light circuits test good. Test complete. Reconnect conn.	Replace defective cluster assembly. Reconnect connector and clear fault codes.

6.14. PDL

FE 300 AND IC SE item not covered at this time.

6.15. PARK BRAKE

FE 300 With Hydraulic Brakes

Table 43 FE 300 With Hydraulic Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect park brake switch conn. (218), and connect a jumper wire from circuit K44A to ground. Move key switch to ignition position. Does park brake warning light illuminate?			Go to Step 6.	Go to next step.
2.	On	Remove instrument cluster and remove PARK BRAKE indicator bulb. Test bulb for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	With jumper still in place, disconnect connector (12) and at pin 17, circuit A44, measure resistance to ground.	(12), A44 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A44 or K44A, then repair.
4.	On	With jumper still in place, move key switch to ignition position, and at connector (12), measure voltage from pin 8, circuit A28C to pin 17, circuit A44.	(12), A28C to A44.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28 or A28C from fuse F22, then repair.
5.	On	With jumper still installed, reconnect connector (12). Does warning light illuminate?			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 (218).	Across switch (218).	<1 ohm.	Go to next step.	Replace defective park brake switch.
7.	Off	At park brake switch (218), measure resistance from circuit K44-G to ground.	(218), K44-G to gnd.	<1 ohm.	Warning light circuits test good. Reconnect circuits.	Locate open or poor connection in K44-G, K11-GD to start ground, then repair.

FE 300 With Air Brakes

Table 44 FE 300 With Air Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect park brake air switch conn. (218), and connect a jumper wire from circuit A44 to ground. Move key switch to ignition position. Does park brake warning light illuminate?			Go to Step 6.	Go to next step.
2.	On	Remove instrument cluster and remove PARK BRAKE indicator bulb. Test bulb for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	With jumper still in place, disconnect connector (12) and at pin 17, circuit A44, measure resistance to ground.	(12), A44 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A44, then repair.
4.	On	With jumper still in place, move key switch to ignition position, and at connector (12), measure voltage from pin 8, circuit A28C to pin 17, circuit A44.	(12), A28C to A44.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28 or A28C from fuse F22, then repair.
5.	On	With jumper still installed, reconnect connector (12). Does warning light illuminate?			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 air switch (218).	Across switch.	<1 ohm.	Go to next step.	Replace defective park brake air switch.
7.	Off	At connector (218), measure resistance from circuit A44GA to ground.	(218), A44GA to gnd.	<1 ohm.	Warning light circuits test good. Reconnect circuits.	Locate open or poor connection in A44GA to cab ground, then repair.

IC With Hydraulic Brakes

Table 45 IC With Hydraulic Brakes

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect park brake switch conn. (218), and connect a jumper wire from black wire, going to warning light, to ground. Move key switch to ignition position. Does warning light illuminate?			Go to Step 6.	Go to next step.
2.	On	Loosen cluster, remove indicator bulb and test for open condition.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and repeat test if problem persists.
3.	Off	Re-install bulb. With jumper still in place, disconnect connector (28) and at pin 17/circuit 44, measure resistance to ground.	(28), 44 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 44, 44A [circuit 44A, diode (212), and circuit 44B with DRL], a black wire, or another black wire, then repair.
4.	On	With jumper still in place, move key switch to ignition position, and at connector (28), measure voltage from pin 8/circuit 28C to pin 17/circuit 44.	(28), 28C to 44.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28 or 28C from fuse F24, then repair.
5.	On	With jumper still installed, reconnect connector (28). Does warning light illuminate?			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.
7.	Off	At park brake switch, measure resistance from white wire to ground.	Near switch, white wire to gnd.	<1 ohm.	Warning light circuits test good. Reconnect circuits.	Locate open or poor connection in white wire, conn. (214), circuit 44-GA with DRL), or 44-G, then repair.

6.16. ((P)) LOW AIR

FE 300 SE item not covered at this time.

6.17. ((P)) LOW AIR

IC

Table 46 IC

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off	Disconnect low air pressure switch (230), and use a test jumper to connect circuit 40-GB to ground. Does warning light illuminate?			Go to Step 6.	Go to next step.
2.	On	Loosen cluster, remove indicator bulb and test for open condition.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and repeat test if problem persists.
3.	Off	Re-install bulb. With jumper still in place, disconnect connector (28) and measure resistance from pin 7/circuit 40-GC to ground.	(28), 44-GC to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 40-GC or 40-GB, then repair.
4.	On	With jumper still in place, move key switch to ignition position, and at connector (28), measure voltage from pin 8/circuit 28C to pin 7/circuit 40-GC.	(28), 28C to 40-GC.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 28 or 28C from fuse F24, then repair.
5.	On	With jumper still installed, reconnect connector (28). Does warning light illuminate?			Go to next step.	Replace defective cluster assembly. Reconnect connector.
6.	Off	Drain air from suspension system and measure resistance across low air pressure switch (230) terminals.	Across switch.	<1 ohm.	Go to next step.	Replace defective air pressure switch.
7.	Off	At air pressure switch connector (230) and circuit 61-GA, measure resistance to ground.	(230), 61-GA to gnd.	<1 ohm.	Warning light circuits test good. Reconnect circuits.	Locate open or poor connection in circuit 61-GA, then repair.

6.18. WINDSHIELD WASHER FLUID

FE 300 AND IC SE item not covered at this time.

6.19. FRONT AXLE

FE 300 AND IC SE item not covered at this time.

6.20. DIFF LOCK ENGAGED

FE 300 AND IC SE item not covered at this time.

6.21. SUSP LOW AIR

FE 300 AND IC (With Hyd Brakes) SE item not covered at this time.

6.22. WATER-IN-FUEL

FE 300 (I6 ENGINE)

Table 47 FE 300 (I6 ENGINE)

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 data-link?	Go to step 2.	Go to step 4.
2.	Off/ On	1. Disconnect J1939 sniffer. 2. Connect Master Diagnostics 3. Monitor the "Water-In-Fuel" output.		Does the "Water-In-Fuel" output change?	Go to step 3.	ECM2 is not updating "Water-In-Fuel" output. See engine troubleshooting guide.
3.	Off/ On	1. Disconnect MSM2 connector (3111). 2. Connect pin 3 to ground.	(3111), pin 3 to gnd.	Does the "Water-In-Fuel" lamp turn on?	Replace MSM and retest	Go to next step.

Table 47 FE 300 (I6 ENGINE) (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
4.	Off	1. Remove instrument cluster. 2. Remove WATER-IN-FUEL indicator bulb. 3. Test bulb for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
5.	Off	1. Instrument cluster removed. 2. Measure resistance from disconnected conn. (9), pin A, circuit A19F to MSM2 disconnected conn. (3111) pin 3.	(9), pin A, cir. A19F to (3111) pin 3.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A19F, conn. (3111), pin 3, circuit A19F or cluster, then repair.
6.	Off/ On	1. Instrument cluster removed. 2. Move key switch to ignition. 3. Measure voltage from conn. (9), pin B, circuit A19E to ground.	(9), pin B, cir. A19E to gnd.	12±1.5 volts.	Install cluster. Go to next step.	Locate cause of no or low voltage in circuit A19E, Heated Fuel Relay (R5), circuit A11–GA, circuit A19D or fuse F20, then repair.
7.	Off/ On	1. Leave J1939 sniffer connected		Is the engine (0x00) on the data-link?	Go to step 8.	Go to step 11.
8.	Off/ On	1. Turn the key to OFF. 2. Disconnect MSM1 connector (3111). 3. Measure resistance across data-link pins 5 & 6, in wiring harness	(3111), pins 5 and 6.	Is the resistance approx. 60 ohms?	Go to step 9.	Fix data-link wiring, cir A5DMS(-) and A5DMS(+), retest

Table 47 FE 300 (I6 ENGINE) (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 MSM1 conn. (3111) harness ignition pin 7 to ground.	(3111), pin 7, cir A13MS.	Is the voltage 12-16 volts?	Go to step 7.	Fix wiring cir A13MS or fuse F31, retest.
10.	Off/ On	1. Measure the resistance between the MSM1 conn. (3111) harness ground pin 8 and ground	(3111), pin 8, cir A11–GM, A11–G to gnd.	Is the resistance less than 10 ohms?	Replace MSM and retest	Fix ground wiring cir A11–GM, A11–G and platform ground, retest.
11.	Off/ On	1. Leave J1939 sniffer connected NOTE: This assumes the "Water-In-Fuel" output can be monitored using MD.		Is the MSM (aka ESC) on the data-link?	Check the engine's power connections and data link wiring.	Verify sniffer is working properly

IC With International Engines

Table 48 IC With International Engines

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	On	Disconnect circuit 19C from water probe, and connect it with a jumper wire to ground. Does warning light illuminate?			Warning light circuits test good.	Go to next step.
2.	On	Remove water-in-fuel indicator bulb and check for open condition.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and repeat tests if problem persists.
3.	Off	With jumper still in place, disconnect water-in-fuel module connector (470) and measure resistance from circuit 19C to ground.	(470), 19C to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 19C, conn. (401), or circuit 19E, then repair.

Table 48 IC With International Engines (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
4.	On	Move key switch to ignition position, and with jumper still in place, measure voltage at connector (470) from circuit 19E to 19C.	(470), 19E to 19C.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 19E, conn. (401) or 92C, then repair.
5.	On	At warning light bulb socket (433), measure resistance from circuit 19-G to ground.	(433), 19-G to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 19-G, then repair.
6.	On	Re-install warning light bulb and use a jumper wire to connect circuit 19B to 19B. Does warning light illuminate?			Go to next step.	Locate cause of low or no voltage in circuit 19B, then repair.
7.	On	Reconnect water-in-fuel module (470) and leave jumper at circuit 19C connected. Does warning light illuminate?			Warning light circuits test good. Remove jumper and reconnect circuit 19C.	Replace defective water-in-fuel module (470).

6.23. FUEL FILTER

FE 300

Table 49 FE 300

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 data-link?	Go to step 2.	Go to step 4.
2.	Off/ On	1. Disconnect J1939 sniffer. 2. Connect Master Diagnostics 3. Monitor the "FUEL FILTER" output.		Does the "FUEL FILTER" output change?	Go to step 3.	ECM2 is not updating "FUEL FILTER" output. See engine troubleshooting guide.

Table 49 FE 300 (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
3.	Off/ On	1. Disconnect MSM2 connector (3111). 2. Connect pin 1 to ground.	(3111), pin 1 to gnd.	Does the "FUEL FILTER" lamp turn on?	Replace MSM and retest	Go to next step.
4.	Off	1. Remove instrument cluster. 2. Remove FUEL FILTER indicator bulb. 3. Test bulb for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
5.	Off	1. Instrument cluster removed. 2. Measure resistance from disconnected conn. (69), pin B, circuit A19K to MSM2 disconnected conn. (3111) pin 1.	(69), pin B, cir. A19K to (3111) pin 1.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A19K, conn. (69), pin B or cluster, then repair.
6.	Off/ On	1. Instrument cluster removed. 2. Move key switch to ignition. 3. Measure voltage from conn. (69), pin A, circuit A19J to ground.	(69), pin A, cir. A19J to gnd.	12±1.5 volts.	Install cluster. Go to next step.	Locate cause of no or low voltage in circuit A19J, conn. (69), pin A or fuse F22, then repair.
7.	Off/ On	1. Leave J1939 sniffer connected		Is the engine (0x00) on the data-link?	Go to step 8.	Go to step 11.

Table 49 FE 300 (cont.)

Step	Key	Action	Test Points	Spec.	Yes - In Spec.	No - Out of Spec.
8.	Off/ On	1. Turn the key to OFF. 2. Disconnect MSM1 connector (3111). 3. Measure resistance across data-link pins 5 & 6, in wiring harness	(3111), pins 5 and 6.	Is the resistance approx. 60 ohms?	Go to step 9.	Fix data-link wiring, cir A5DMS(-) and A5DMS(+), retest
9.	Off/ On	1. Turn the key to Ignition. 2. Measure the voltage at the MSM1 conn. (3111) harness ignition pin 7 to ground.	(3111), pin 7, cir A13MS.	Is the voltage 12-16 volts?	Go to step 7.	Fix wiring cir A13MS or fuse F31, retest.
10.	Off/ On	1. Measure the resistance between the MSM1 conn. (3111) harness ground pin 8 and ground	(3111), pin 8, cir A11–GM, A11–G to gnd.	Is the resistance less than 10 ohms?	Replace MSM and retest	Fix ground wiring cir A11–GM, A11–G and platform ground, retest.
11.	Off/ On	1. Leave J1939 sniffer connected NOTE: This assumes the "FUEL FILTER" output can be monitored using MD.		Is the MSM (aka ESC) on the data-link?	Check the engine's power connections and data link wiring.	Verify sniffer is working properly

IC Series With International Engines

Table 50 IC With International Engines

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect connector (401) from fuel filter vacuum switch, and connect circuit 19B to ground with a jumper wire. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Reconnect conn. (401). If warning light fails to illuminate when filter becomes restricted, replace vacuum switch.	Go to next step.
2.	On	Remove fuel filter indicator bulb and test for open condition.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and repeat tests if problem persists.
3.	Off	With jumper still in place, at bulb socket (434), measure resistance from circuit 19B to ground.	(434), 19B to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 19D, conn. (1150), circuit 19D, conn. (2), or circuit 19B, then repair.
4.	Off/ On	Re-install bulb and move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Reconnect conn. (401). If warning light fails to illuminate when filter becomes restricted, replace vacuum switch.	Locate cause of low or no voltage in circuit 19D, conn. (1150), circuit 19B or 19D, then repair.

6.24. POWER TAKE OFF (PTO)

FE 300 AND IC SE item not covered at this time.

6.25. LOW BRAKE FLUID

FE 300

Table 51 FE 300

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect connector (90) from brake fluid level sensor, and connect circuit N90P, going to warning light, to ground with a jumper wire. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Reconnect conn. (90). If warning light fails to illuminate when reservoir level is low, replace level sensor.	Go to next step.
2.	Off	Loosen cluster and remove LOW BRAKE FLUID warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	With jumper still in place, at bulb socket (89), measure resistance from circuit A90V to ground.	(89), A90V to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuits A90V, N90P, conn. (2), circuits N90P, N11–GF, or N11–GB, then repair.
4.	Off/ On	Re-install bulb and move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Reconnect conn. (90). If warning light fails to illuminate when reservoir level is low, replace level sensor.	Locate cause of low or no voltage in circuit A28, or A90R from fuse F22, then repair.

IC

Table 52 IC

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect connector (90) from brake fluid level sensor, and connect circuit 90U, going to warning light, to ground with a jumper wire. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Reconnect conn. (90). If warning light fails to illuminate when reservoir level is low, replace level sensor.	Go to next step.
2.	On	Remove brake fluid indicator bulb and test for open condition.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and repeat tests if problem persists.
3.	Off	With jumper still in place, at bulb socket (89), measure resistance from circuit 90U to ground.	(89), 90U to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 90U, conn. (84), circuit 90U, conn. (88), or circuit 90U, then repair.
4.	Off/ On	Re-install bulb and move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Reconnect conn. (90). If warning light fails to illuminate when reservoir level is low, replace level sensor.	Locate cause of low or no voltage in circuit 13E, conn. (47) or 90U from fuse F19, then repair.

6.26. RETARD ON

FE 300 With Allison WTEC III XMSN GEN 4

Table 53 FE 300 With Allison WTEC III XMSN GEN 4

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ECU connector (7202), pin 18, connect a test jumper from circuit K125 to ground, and move key switch to ignition position. Does RETARD ON warning light illuminate?	(7202), pin 18, K125. to gnd.	12±1.5 volts.	Warning light circuitry tests good. Refer to Electrical Troubleshooting Manual to locate problem with transmission circuitry.	Go to next step.
2.	Off	Remove RETARD ON warning light bulb conn. (926). Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and repeat all tests if problem persists.
3.	Off/ On	Remove retard on relay (7807), move key switch to ignition position, and measure voltage from circuit V146D to ground.	Relay socket (7807), V146D to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit V146C or V146D from fuse F4, then repair.
4.	On	With key switch still in ignition position, at relay socket, measure voltage from circuit V146D to ground.	Relay socket, V146D to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit V146D then repair.
5.	On	With key switch still in ignition position and jumper still installed, at relay socket, measure voltage from circuit V146D to K125.	Relay socket, V146D to K125.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit K125., then repair.
6.	Off	Bench test retard on relay by measuring resistance from pin 30 to 87A.	Relay, pin 30 to 87A.	<1 ohm.	Go to next step.	Replace defective relay.
7.	Off	Bench test retard on relay by applying +12V to pin 85, gnd. to pin 86, and measuring resistance from pin 30 to 87.	Energized relay, pin 30 to 87.	<1 ohm.	Go to next step.	Replace defective relay.

Table 53 FE 300 With Allison WTEC III XMSN GEN 4 (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
8.	Off/ On	Re-install retard on relay, and with jumper still installed, move key switch to ignition position. Remove warning light bulb and measure voltage from circuit A92H to ground.	Socket, A92H to gnd.	12±1.5 volts.	Go to next step.	Locate cause of low or no voltage in circuit A92H, conn. (1601–A), circuit N92H, conn. (523–V), circuit K92H, conn. (7100–L), or circuit V92H, then repair.
9.	On	With jumper still installed, re-install warning light bulb. Does warning light illuminate?			retard on warning light circuits test good. Turn key off. Reconnect conn. (7202). If problems persist, reprogram/ replace ECU after checking input circuits.	Locate open or poor connection in circuit A92-GA, A186, conn. (377–A), circuit A186 or A11-G to ground, then repair.

IC With Allison MD Transmission

Table 54 IC With Allison MD Transmission

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ECU connector (632), connect a test jumper from circuit 125 to ground, and move key switch to ignition position. Does retarder on warning light illuminate?			Warning light circuitry tests good. Refer to Electrical Troubleshooting Manual to locate problem with transmission circuitry.	Go to next step.
2.	Off	Remove retarder on warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and repeat all tests if problem persists.
3.	Off/ On	Remove retarder on relay, move key switch to ignition position, and measure voltage from circuit 146E to ground.	Relay socket, 146E to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 97K, conn. (3), circuit 97K, 24B, conn. (789), circuit 24B or 146E from fuse F24, then repair.

Table 54 IC With Allison MD Transmission (cont.)

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
4.	On	With key switch still in ignition position, at relay socket, measure voltage from circuit 146F to ground.	Relay socket, 146F to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 146F, then repair.
5.	On	With key switch still in ignition position and jumper still installed, at relay socket, measure voltage from circuit 146F to 125.	Relay socket, 146F to 125.	12±1.5 volts.	Go to next step.	Locate open or poor connection in circuit 125, then repair.
6.	Off	Bench test retarder on relay by measuring resistance from pin 30 to 87A.	Relay, pin 30 to 87A.	<1 ohm.	Go to next step.	Replace defective relay.
7.	Off	Bench test retarder on relay by applying +12V to pin 85, gnd. to pin 86, and measuring resistance from pin 30 to 87.	Energized relay, pin 30 to 87.	<1 ohm.	Go to next step.	Replace defective relay.
8.	Off/ On	Re-install retarder on relay, and with jumper still installed, move key switch to ignition position. Remove warning light bulb and measure voltage from circuit 92H to ground.	Socket, 92H to gnd.	12±1.5 volts.	Go to next step.	Locate cause of low or no voltage in circuit 92H, conn. (499), or circuit 92H, then repair.
9.	On	With jumper still installed, re-install warning light bulb. Does warning light illuminate?			Retarder on warning light circuits test good. Turn key off. Reconnect conn. (632). If problems persist, reprogram/ replace ECU after checking input circuits.	Locate open or poor connection in circuit 92-GZ, 92-GY, 94-GC, conn. (377), circuit 94-GC or 11-G to ground, then repair.

6.27. CHANGE TRANS FILTER

FE 300 With Allison WTEC III XMSN GEN 4

Table 55 FE 300 With Allison WTEC III XMSN GEN 4

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect black wire from transmission filter and connect to ground with a test jumper. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off and reconnect black wire.	Go to next step.
2.	Off	Remove CHANGE TRANS FILTER warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect black wire to filter. Repeat all tests if problem persists.
3.	Off	Disconnect connector (94), and with jumper still attached at black wire, measure resistance from connector (94) circuit A31-GA to ground.	(94), A31-GA to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A31-GA, connector (344), a blue wire, conn. (N/L), or a black wire, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (94) circuit A31D to ground.	(94), A31D to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A31D from fuse F10, then repair. Reconnect connectors.
5.	Off	With jumper still installed at black wire, reconnect connector (94). Does warning light illuminate?			Warning light circuits test good. Reconnect conn. (94) and black wire.	Replace defective socket assembly. Reconnect conn. (94) and black wire.

IC With Allison AT

Table 56 IC With Allison AT

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect black wire from transmission filter and connect to ground with a test jumper. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off and reconnect black wire.	Go to next step.
2.	Off	Remove transmission filter warning light bulb. Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect black wire to filter. Repeat all tests if problem persists.
3.	Off	Disconnect connector (760B), and with jumper still attached at black wire, measure resistance from connector (760) circuit 31-GA to ground.	(760B), 31-GA to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 31-GA, connector (837), a blue wire, conn. (N/L), or a black wire, then repair. Reconnect connectors.
4.	On	Move key switch to ignition position and measure voltage from connector (760) circuit 31D to ground.	(760), 31D to gnd.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit 31D from fuse F24, then repair. Reconnect connectors.
5.	Off	With jumper still installed at black wire, reconnect connector (760). Does warning light illuminate?			Warning light circuits test good. Reconnect conn. (94) and black wire.	Replace defective socket assembly. Reconnect conn. (760) and black wire.

6.28. RETARD OVER HEAT

FE 300 With Allison WTEC III XMSN

Table 57 FE 300 With Allison WTEC III XMSN

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ECU connector (7202) and use a test jumper to connect pin 19 circuit K105. to ground. Move key switch to ignition position. Does warning light illuminate?	(7202), pin 19, K105. to gnd.	12±1.5 volts.	Warning light circuits test good. Turn key off and reconnect conn. (7202). Turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Remove RETARDER OVER HEAT warning light bulb conn. (925). Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	With jumper still attached at conn. (7202), measure resistance at socket from circuit K105. to ground.	Socket, K105. to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A105B, connector (1601), circuit N105B, connector (523), circuit K105B, connector (7999), or circuits K105B/K105A, K105, then repair. Reconnect connector and bulb.
4.	On	Move key switch to ignition position and measure voltage from circuit A13J to ground.	Socket, A13J to gnd.	12±1.5 volts.	Warning light circuits test good. Reconnect conn. (7202).	Locate cause of no or low voltage in circuit A13J, conn. (377), circuits A13J, or A28, from fuse F22, then repair. Reconnect connector.

FE 300 With Allison WTEC III XMSN GEN 4

Table 58 FE 300 With Allison WTEC III XMSN GEN 4

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ECU connector (7150) and use a test jumper to connect pin 64 circuit K164. to ground. Move key switch to ignition position. Does warning light illuminate?	(7150), pin 64, K164. to gnd.	12±1.5 volts.	Warning light circuits test good. Turn key off and reconnect conn. (7150). Turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Remove RETARDER OVER HEAT warning light bulb conn. (925). Test for continuity.	Across warning light bulb.	<100 ohms.	Re-install bulb. Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	With jumper still attached at conn. (7150), measure resistance at socket from circuit K164. to ground.	Socket, K164. to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit A164B, connector (1601), circuit N164B, connector (523), circuit K164B, connector (7999), or circuits K164B/K164A, K164, then repair. Reconnect connector and bulb.
4.	On	Move key switch to ignition position and measure voltage from circuit A13J to ground.	Socket, A13J to gnd.	12±1.5 volts.	Warning light circuits test good. Reconnect conn. (7150).	Locate cause of no or low voltage in circuit A13J, conn. (377), circuits A13J, or A28, from fuse F22, then repair. Reconnect connector.

IC With Allison MD Transmission

Table 59 IC With Allison MD Transmission

Step	Key	Action	Test Points	Spec.	Yes-In Spec.	No-Out of Spec
1.	Off/ On	Disconnect ECU connector (632) and use a test jumper to connect pin 19 circuit 105 to ground. Move key switch to ignition position. Does warning light illuminate?			Warning light circuits test good. Turn key off and reconnect conn. (632). Turn key on. If warning light does not illuminate during bulb check, reprogram/ replace ECU.	Go to next step.
2.	Off	Remove retarder overheat warning light bulb. Test for continuity.	Across bulb.	<100 ohms.	Go to next step.	Replace defective bulb and reconnect connector. Repeat all tests if problem persists.
3.	Off	With jumper still attached at conn. (632), measure resistance at socket from circuit 105 to ground.	Socket, 105 to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 105, connector (499), or circuit 105, then repair. Reconnect connector and bulb.
4.	On	Move key switch to ignition position and measure voltage from circuit 13E to ground.	Socket, 13E to gnd.	12±1.5 volts.	Warning light circuits test good. Reconnect conn. (632) and bulb.	Locate cause of no or low voltage in circuit 13E, conn. (377) or circuit 13E, then repair. Reconnect connector and bulb.

6.29. ALTERNATOR

FE 300

Table 60 FE 300

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 ALTERNATOR 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.	Off	Disconnect conn. (12). With jumper still in place, measure resistance from pin 16 of wire harness conn. (12), circuit 1C to ground.	Conn. (12), pin 16, cir. 1C to gnd.	<1 ohm.	Go to next step.	Locate open or poor connection in circuit 1C, then repair.
4.	On	Move key switch to ignition position and measure voltage at pin 10 of wiring harness conn. (11), circuit A28B.	Conn. (11), pin 10, cir. A28B.	12±1.5 volts.	Go to next step.	Locate cause of no or low voltage in circuit A28B, conn. (11), fuse F22, then repair.
5.	On	With jumper still installed at circuit 1C, reconnect connector (12). 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.

6.30. ALTERNATOR

IC SE item not covered at this time.

6.31. ((P)) LOW AIR

SE item not covered at this time.