

INSTRUMENT CLUSTER

TABLE OF CONTENTS

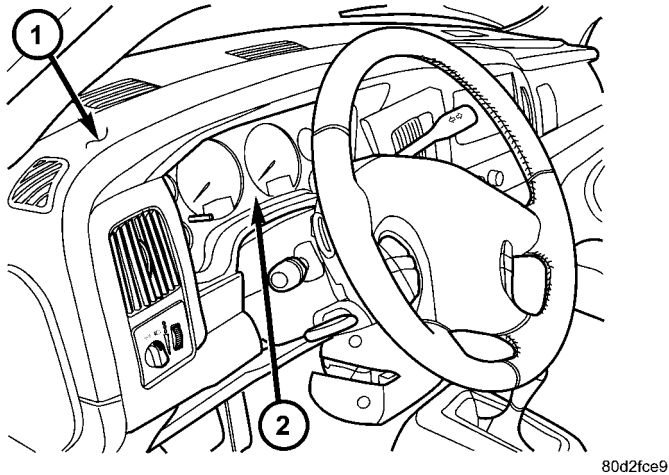
	page	page
INSTRUMENT CLUSTER		
DESCRIPTION	2	
OPERATION	6	
DIAGNOSIS AND TESTING - INSTRUMENT		
CLUSTER	10	
REMOVAL	14	
DISASSEMBLY	14	
ASSEMBLY	15	
INSTALLATION	16	
ABS INDICATOR		
DESCRIPTION	17	
OPERATION	17	
AIRBAG INDICATOR		
DESCRIPTION	18	
OPERATION	18	
BRAKE/PARK BRAKE INDICATOR		
DESCRIPTION	18	
OPERATION	19	
DIAGNOSIS AND TESTING - BRAKE		
INDICATOR	19	
CARGO LAMP INDICATOR		
DESCRIPTION	20	
OPERATION	20	
CHECK GAUGES INDICATOR		
DESCRIPTION	21	
OPERATION	21	
CRUISE INDICATOR		
DESCRIPTION	22	
OPERATION	22	
DOOR AJAR INDICATOR		
DESCRIPTION	23	
OPERATION	23	
ENGINE TEMPERATURE GAUGE		
DESCRIPTION	23	
OPERATION	23	
ETC INDICATOR		
DESCRIPTION	24	
OPERATION	25	
FUEL GAUGE		
DESCRIPTION	25	
OPERATION	26	
GEAR SELECTOR INDICATOR		
DESCRIPTION	26	
OPERATION	27	
HIGH BEAM INDICATOR		
DESCRIPTION	27	
OPERATION	28	
LAMP OUT INDICATOR		
DESCRIPTION	28	
OPERATION	28	
LOW FUEL INDICATOR		
DESCRIPTION	29	
OPERATION	29	
MALFUNCTION INDICATOR LAMP (MIL)		
DESCRIPTION	30	
OPERATION	30	
ODOMETER		
DESCRIPTION	31	
OPERATION	31	
OIL PRESSURE GAUGE		
DESCRIPTION	32	
OPERATION	32	
OVERDRIVE OFF INDICATOR		
DESCRIPTION	33	
OPERATION	33	
SEATBELT INDICATOR		
DESCRIPTION	34	
OPERATION	34	
SECURITY INDICATOR		
DESCRIPTION	34	
OPERATION	35	
SERVICE 4WD INDICATOR		
DESCRIPTION	35	
OPERATION	36	
SPEEDOMETER		
DESCRIPTION	36	
OPERATION	36	
TACHOMETER		
DESCRIPTION	37	
OPERATION	37	
TRANS TEMP INDICATOR		
DESCRIPTION	38	
OPERATION	38	
TURN SIGNAL INDICATOR		
DESCRIPTION	39	
OPERATION	39	
UPSHIFT INDICATOR		
DESCRIPTION	40	
OPERATION	40	
VOLTAGE GAUGE		
DESCRIPTION	40	
OPERATION	41	
WAIT-TO-START INDICATOR		
DESCRIPTION	42	
OPERATION	42	

WASHER FLUID INDICATOR

DESCRIPTION	42
OPERATION	42

WATER-IN-FUEL INDICATOR

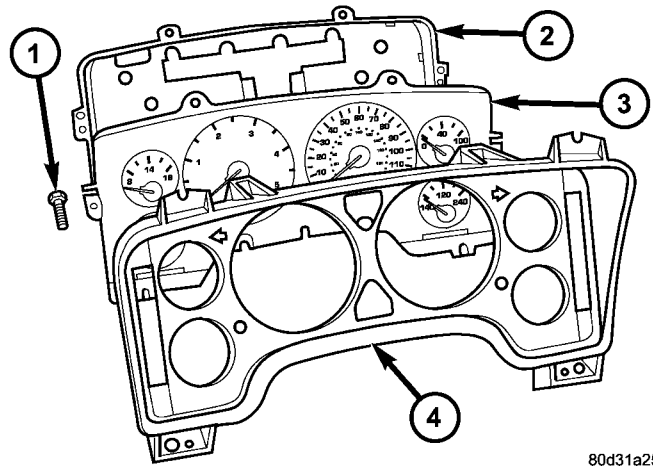
DESCRIPTION	43
OPERATION	43

INSTRUMENT CLUSTER**DESCRIPTION****Fig. 1 Instrument Cluster**

- 1 - INSTRUMENT PANEL
2 - INSTRUMENT CLUSTER

The instrument cluster for this model is an ElectroMechanical Instrument Cluster (EMIC) that is located in the instrument panel above the steering column opening, directly in front of the driver (Fig. 1). The remainder of the EMIC, including the mounts and the electrical connections, are concealed within the instrument panel behind the cluster bezel. Besides analog gauges and indicators, the EMIC module incorporates two blue-green digital Vacuum Fluorescent Display (VFD) units for displaying odometer/trip odometer information, engine hours, automatic transmission gear selector position (PRNDL), several warning or reminder indications and certain diagnostic information. The instrument cluster for this model also includes the hardware and software necessary to serve as the electronic body control module and is sometimes referred to as the Cab Compartment Node or CCN.

The EMIC gauges and indicators are visible through a dedicated opening in the cluster bezel on the instrument panel and are protected by a clear plastic cluster lens (Fig. 2) that is integral to a cluster lens, hood and mask unit. Just behind the cluster lens is the cluster hood and an integral cluster mask, which are constructed of molded black plastic. The cluster hood serves as a visor and shields the face of the cluster from ambient light and reflections to reduce glare, while the cluster mask serves to separate and define the individual gauges and indicators of the EMIC. A black plastic odometer/trip odometer



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Fig. 2 Instrument Cluster Components

- 1 - SCREW (9)
2 - REAR COVER
3 - CLUSTER HOUSING
4 - LENS, HOOD & MASK

switch button protrudes through dedicated holes in the cluster mask and the cluster lens, located near the lower edge of the cluster just to the left of the tachometer. The molded plastic EMIC lens, hood and mask unit has four integral mounting tabs, one each on the upper and lower outboard corners of the unit. These mounting tabs are used to secure the EMIC to the molded plastic instrument panel cluster carrier with four screws.

The rear of the cluster housing and the EMIC electronic circuitry are protected by a molded plastic rear cover, which is secured to the cluster housing with a single screw, while eight screws installed around the outside perimeter of the rear cover secure it to the cluster lens, hood and mask unit. The rear cover includes clearance holes for service access to each of the eleven incandescent bulb and bulb holder units installed on the cluster circuit board for general illumination lighting and for the cluster connector receptacles. The connector receptacles on the back of the cluster electronic circuit board connect the EMIC to the vehicle electrical system through three take outs with connectors from the instrument panel wire harness. The EMIC also has an integral interface connector on the back of the cluster circuit board that joins it to the optional external RKE receiver through a connector receptacle that is integral to that unit. The rear cover includes a molded receptacle and two latch features to secure the RKE receiver on vehicles that are so equipped.

Sandwiched between the rear cover and the lens, hood and mask unit is the cluster housing. The

INSTRUMENT CLUSTER (Continued)

molded plastic cluster housing serves as the carrier for the cluster circuit board and circuitry, the cluster connector receptacles, the RKE interface connector, the gauges, a Light Emitting Diode (LED) for each cluster indicator, two VFD units, an audible tone generator, the cluster overlay, the gauge pointers, the odometer/trip odometer switch and the switch button. The cluster overlay is a laminated plastic unit. The dark, visible, outer surface of the overlay is marked with all of the gauge dial faces and graduations, but this layer is also translucent. The darkness of this outer layer prevents the cluster from appearing cluttered or busy by concealing the cluster indicators that are not illuminated, while the translucence of this layer allows those indicators and icons that are illuminated to be readily visible. The underlying layer of the overlay is opaque and allows light from the LED for each of the various indicators and the incandescent illumination lamps behind it to be visible through the outer layer of the overlay only through predetermined stencil-like cutouts. A rectangular opening in the overlay at the base of both the speedometer and tachometer dial faces has a smoked clear lens through which the illuminated VFD units can be viewed.

Several versions of the EMIC module are offered on this model. These versions accommodate all of the variations of optional equipment and regulatory requirements for the various markets in which the vehicle will be offered. The microprocessor-based EMIC utilizes integrated circuitry and information carried on the Programmable Communications Interface (PCI) data bus network along with several hard wired analog and multiplexed inputs to monitor sensors and switches throughout the vehicle. In response to those inputs, the internal circuitry and programming of the EMIC allow it to control and integrate many electronic functions and features of the vehicle through both hard wired outputs and the transmission of electronic message outputs to other electronic modules in the vehicle over the PCI data bus. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - DESCRIPTION - PCI BUS).

Besides typical instrument cluster gauge and indicator support, the electronic functions and features that the EMIC supports or controls include the following:

- **Audible Warnings** - The EMIC electronic circuit board is equipped with an audible tone generator and programming that allows it to provide various audible alerts to the vehicle operator, including chime tones and beep tones. An electromechanical relay is also soldered onto the circuit board to produce audible clicks that emulate the sound of a conventional turn signal or hazard warning flasher.

(Refer to 8 - ELECTRICAL/CHIME/BUZZER - DESCRIPTION).

- **Brake Lamp Control** - The EMIC provides electronic brake lamp request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for brake lamp control, excluding control of the Center High Mounted Stop Lamp (CHMSL), which remains controlled by a direct hard wired output of the brake lamp switch.

- **Brake Transmission Shift Interlock Control** - The EMIC monitors inputs from the brake lamp switch, ignition switch, and the Transmission Range Sensor (TRS), then controls a high-side driver output to operate the Brake Transmission Shift Interlock (BTSI) solenoid that locks and unlocks the automatic transmission gearshift selector lever on the steering column.

- **Cargo Lamp Control** - The EMIC provides direct control of cargo lamp operation with a load shedding (battery saver) feature which will automatically turn off the cargo lamp if it remains on after a timed interval.

- **Central Locking** - The EMIC provides support for the central locking feature of the power lock system. This feature will lock or unlock all doors based upon the input from the door cylinder lock switch. Door cylinder lock switches are used only on models equipped with the optional Vehicle Theft Security System (VTSS).

- **Door Lock Inhibit** - The EMIC inhibits locking of the doors with the power lock switch when the key is in the ignition switch and the driver side front door is ajar. However, operation of the door locks is not inhibited under the same conditions when the Lock button of the optional RKE transmitter is depressed.

- **Enhanced Accident Response** - The EMIC monitors an input from the Airbag Control Module (ACM) and, following an airbag deployment, will immediately disable the power lock output, unlock all doors by activating the power unlock output, then enables the power lock output if the power lock switch input remains inactive for two seconds. This feature, like all other enhanced accident response features, is dependent upon a functional vehicle electrical system following the vehicle impact event.

- **Exterior Lighting Control** - The EMIC provides electronic head lamp and/or park lamp request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for the appropriate exterior lamp control of standard head and park lamps, as well as optional front fog lamps. This includes support for headlamp beam selection and the optical horn feature, also known as flash-to-pass.

- **Exterior Lighting Fail-safe** - In the absence of a headlamp switch input, the EMIC will turn on the

INSTRUMENT CLUSTER (Continued)

cluster illumination lamps and provide electronic headlamp low beam and park lamp request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for default exterior lamp operation. The FCM will also provide default park lamp and headlamp low beam operation and the EMIC will turn on the cluster illumination lamps if there is a failure of the electronic data bus communication between the EMIC and the FCM.

- **Heated Seat Control** - The EMIC monitors inputs from the ignition switch and electronic engine speed messages from the Powertrain Control Module (PCM) to control a high side driver output to the heated seat switch Light Emitting Diode (LED) indicators. This input allows the heated seat switches to wake up the heated seat module if the switch is actuated. The EMIC will de-energize the heated seat switch LED indicators, which deactivates the heated seat system, if the ignition switch is turned to any position except On or Start, or if the engine speed message indicates zero. (Refer to 8 - ELECTRICAL/HEATED SEATS - DESCRIPTION).

- **Interior Lamp Load Shedding** - The EMIC provides a battery saver feature which will automatically turn off all interior lamps that remain on after a timed interval of about fifteen minutes.

- **Interior Lamps - Enhanced Accident Response** - The EMIC monitors inputs from the Airbag Control Module (ACM) and the Powertrain Control Module (PCM) to automatically turn on the interior lighting after an airbag deployment event ten seconds after the vehicle speed is zero. The interior lighting remains illuminated until the ignition switch is turned to the Off position, at which time the interior lighting returns to normal operation and control. This feature, like all other enhanced accident response features, is dependent upon a functional vehicle electrical system following the vehicle impact event.

- **Interior Lighting Control** - The EMIC monitors inputs from the interior lighting switch, the door ajar switches, the cargo lamp switch, the reading lamp switches, and the Remote Keyless Entry (RKE) module to provide courtesy lamp control. This includes support for timed illuminated entry with theater-style fade-to-off and courtesy illumination defeat features.

- **Lamp Out Indicator Control** - The EMIC monitors electronic lamp outage messages from the Front Control Module (FCM) located on the Integrated Power Module (IPM) in order to provide lamp out indicator control for the headlamps (low and high beams), turn signal lamps, and the brake lamps (excluding CHMSL).

- **Panel Lamps Dimming Control** - The EMIC provides a hard wired 12-volt Pulse-Width Modulated

(PWM) output that synchronizes the dimming level of all panel lamps dimmer controlled lamps with that of the cluster illumination lamps.

- **Parade Mode** - The EMIC provides a parade mode (also known as funeral mode) that allows all Vacuum-Fluorescent Display (VFD) units in the vehicle to be illuminated at full (daytime) intensity while driving during daylight hours with the exterior lamps turned on.

- **Power Locks** - The EMIC monitors inputs from the power lock switches and the Remote Keyless Entry (RKE) receiver module (optional) to provide control of the power lock motors through high side driver outputs to the power lock motors. This includes support for rolling door locks (also known as automatic door locks), automatic door unlock, a door lock inhibit mode, and central locking (with the optional Vehicle Theft Security System only). (Refer to 8 - ELECTRICAL/POWER LOCKS - DESCRIPTION).

- **Remote Keyless Entry** - The EMIC supports the optional Remote Keyless Entry (RKE) system features, including support for the RKE Lock, Unlock (with optional driver-door-only unlock, and unlock-all-doors), Panic, audible chirp, optical chirp, illuminated entry modes, an RKE programming mode, as well as optional Vehicle Theft Security System (VTSS) arming (when the proper VTSS arming conditions are met) and disarming.

- **Remote Radio Switch Interface** - The EMIC monitors inputs from the optional remote radio switches and then provides the appropriate electronic data bus messages to the radio to select the radio operating mode, volume control, preset station scan and station seek features.

- **Rolling Door Locks** - The EMIC provides support for the power lock system rolling door locks feature (also known as automatic door locks). This feature will automatically lock all unlocked doors each time the vehicle speed reaches twenty-four kilometers-per-hour (fifteen miles-per-hour) and, following an automatic lock event, will automatically unlock all doors once the ignition is turned to the Off position and the driver side front door is opened.

- **Turn Signal & Hazard Warning Lamp Control** - The EMIC provides electronic turn and hazard lamp request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for turn and hazard lamp control. The EMIC also provides an audible click at one of two rates to emulate normal and bulb out turn or hazard flasher operation based upon electronic lamp outage messages from the FCM, and provides an audible turn signal on chime warning if a turn is signalled continuously for more than about 1.6 kilometers (one mile) and

INSTRUMENT CLUSTER (Continued)

the vehicle speed remains greater than about twenty-four kilometers-per-hour (fifteen miles-per-hour).

- **Vacuum Fluorescent Display Synchronization** - The EMIC transmits electronic panel lamp dimming level messages which allows all other electronic modules on the PCI data bus with Vacuum Fluorescent Display (VFD) units to coordinate their illumination intensity with that of the EMIC VFD units.

- **Vehicle Theft Security System** - The EMIC monitors inputs from the door cylinder lock switch(es), the door ajar switches, the ignition switch, and the Remote Keyless Entry (RKE) receiver module, then provides electronic horn and lighting request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for the appropriate VTSS alarm output features.

- **Wiper/Washer System Control** - The EMIC provides electronic wiper and/or washer request messages to the Front Control Module (FCM) located on the Integrated Power Module (IPM) for the appropriate wiper and washer system features. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS - DESCRIPTION).

The EMIC houses six analog gauges and has provisions for up to twenty-three indicators (Fig. 3) or (Fig. 4). The EMIC includes the following analog gauges:

- **Coolant Temperature Gauge**
- **Fuel Gauge**
- **Oil Pressure Gauge**
- **Speedometer**
- **Tachometer**
- **Voltage Gauge**

Some of the EMIC indicators are automatically configured when the EMIC is connected to the vehicle electrical system for compatibility with certain optional equipment or equipment required for regulatory purposes in certain markets. While each EMIC may have provisions for indicators to support every available option, the configurable indicators will not be functional in a vehicle that does not have the equipment that an indicator supports. The EMIC includes provisions for the following indicators (Fig. 3) or (Fig. 4):

- **Airbag Indicator (with Airbag System only)**
- **Antilock Brake System (ABS) Indicator (with ABS or Rear Wheel Anti-Lock [RWAL] brakes only)**
- **Brake Indicator**
- **Cargo Lamp Indicator**
- **Check Gauges Indicator**
- **Cruise Indicator (with Speed Control only)**
- **Door Ajar Indicator**
- **Electronic Throttle Control (ETC) Indicator (with 5.7L Gasoline Engine only)**

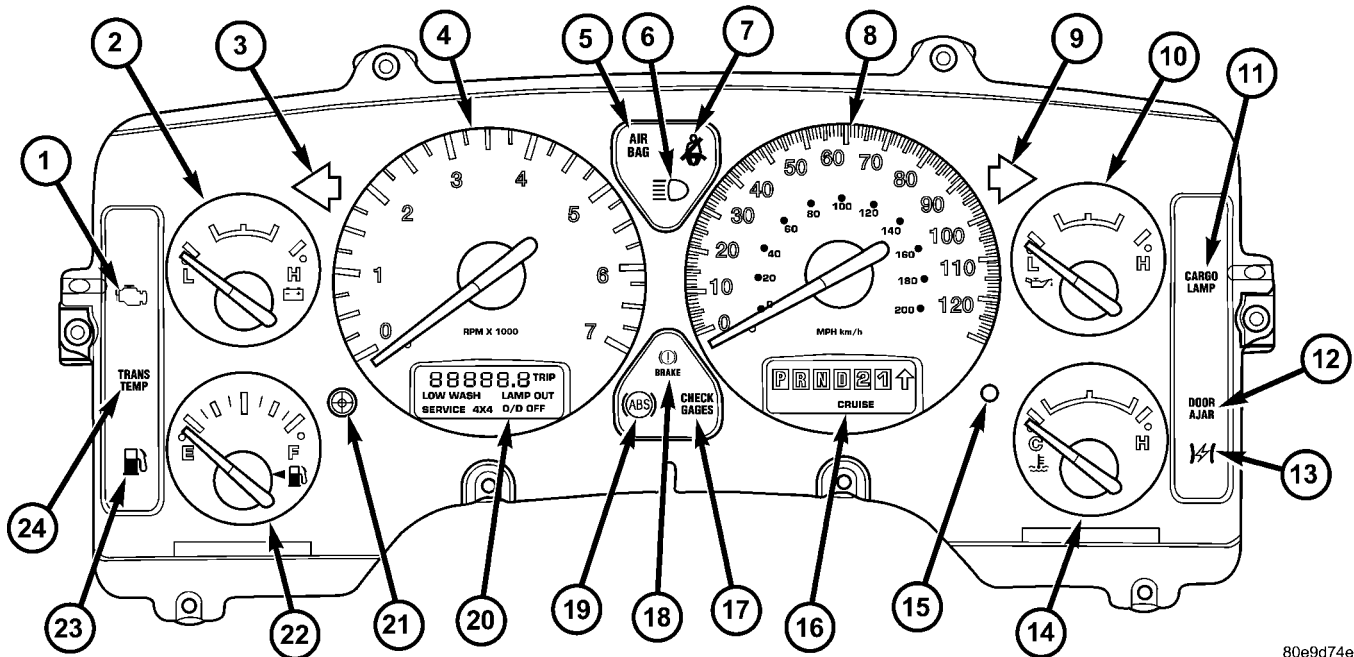
- **Gear Selector Indicator (with Automatic Transmission only)**
- **High Beam Indicator**
- **Lamp Out Indicator**
- **Low Fuel Indicator**
- **Malfunction Indicator Lamp (MIL)**
- **Overdrive-Off Indicator (with Automatic Transmission only)**
- **Seatbelt Indicator**
- **Security Indicator (with Sentry Key Immobilizer & Vehicle Theft Security Systems only)**
- **Service Four-Wheel Drive Indicator (with Four-Wheel Drive only)**
- **Transmission Overtemp Indicator (with Automatic Transmission only)**
- **Turn Signal (Right and Left) Indicators**
- **Upshift Indicator (with Manual Transmission only)**
- **Washer Fluid Indicator**
- **Wait-To-Start Indicator (with Diesel Engine only)**
- **Water-In-Fuel Indicator (with Diesel Engine only)**

Each indicator in the EMIC, except those located within one of the VFD units, is illuminated by a dedicated LED that is soldered onto the EMIC electronic circuit board. The LED units are not available for service replacement and, if damaged or faulty, the entire EMIC must be replaced. Cluster illumination is accomplished by dimmable incandescent back lighting, which illuminates the gauges for visibility when the exterior lighting is turned on. Each of the incandescent bulbs is secured by an integral bulb holder to the electronic circuit board from the back of the cluster housing.

Hard wired circuitry connects the EMIC to the electrical system of the vehicle. These hard wired circuits are integral to several wire harnesses, which are routed throughout the vehicle and retained by many different methods. These circuits may be connected to each other, to the vehicle electrical system and to the EMIC through the use of a combination of soldered splices, splice block connectors, and many different types of wire harness terminal connectors and insulators. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, further details on wire harness routing and retention, as well as pin-out and location views for the various wire harness connectors, splices and grounds.

The EMIC modules for this model are serviced only as complete units. The EMIC module cannot be adjusted or repaired. If a gauge, an LED indicator, a VFD unit, the electronic circuit board, the circuit board hardware, the cluster overlay, or the EMIC housing are damaged or faulty, the entire EMIC mod-

INSTRUMENT CLUSTER (Continued)



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Fig. 3 Gauges & Indicators - Gasoline Engine

- | | |
|--------------------------------|--|
| 1 - MALFUNCTION INDICATOR LAMP | 13 - ELECTRONIC THROTTLE CONTROL (ETC) INDICATOR |
| 2 - VOLTAGE GAUGE | 14 - ENGINE TEMPERATURE GAUGE |
| 3 - LEFT TURN INDICATOR | 15 - SECURITY INDICATOR |
| 4 - TACHOMETER | 16 - GEAR SELECTOR INDICATOR DISPLAY (INCLUDES CRUISE & UPSHIFT INDICATORS) |
| 5 - AIRBAG INDICATOR | 17 - CHECK GAUGES INDICATOR |
| 6 - HIGH BEAM INDICATOR | 18 - BRAKE INDICATOR |
| 7 - SEATBELT INDICATOR | 19 - ABS INDICATOR |
| 8 - SPEEDOMETER | 20 - ODOMETER/TRIP ODOMETER DISPLAY (INCLUDES ENGINE HOURS, WASHER FLUID, LAMP OUTAGE, OVERDRIVE-OFF & SERVICE 4x4 INDICATORS) |
| 9 - RIGHT TURN INDICATOR | 21 - ODOMETER/TRIP ODOMETER SWITCH BUTTON |
| 10 - OIL PRESSURE GAUGE | 22 - FUEL GAUGE |
| 11 - CARGO LAMP INDICATOR | 23 - LOW FUEL INDICATOR |
| 12 - DOOR AJAR INDICATOR | 24 - TRANSMISSION OVERTEMP INDICATOR |

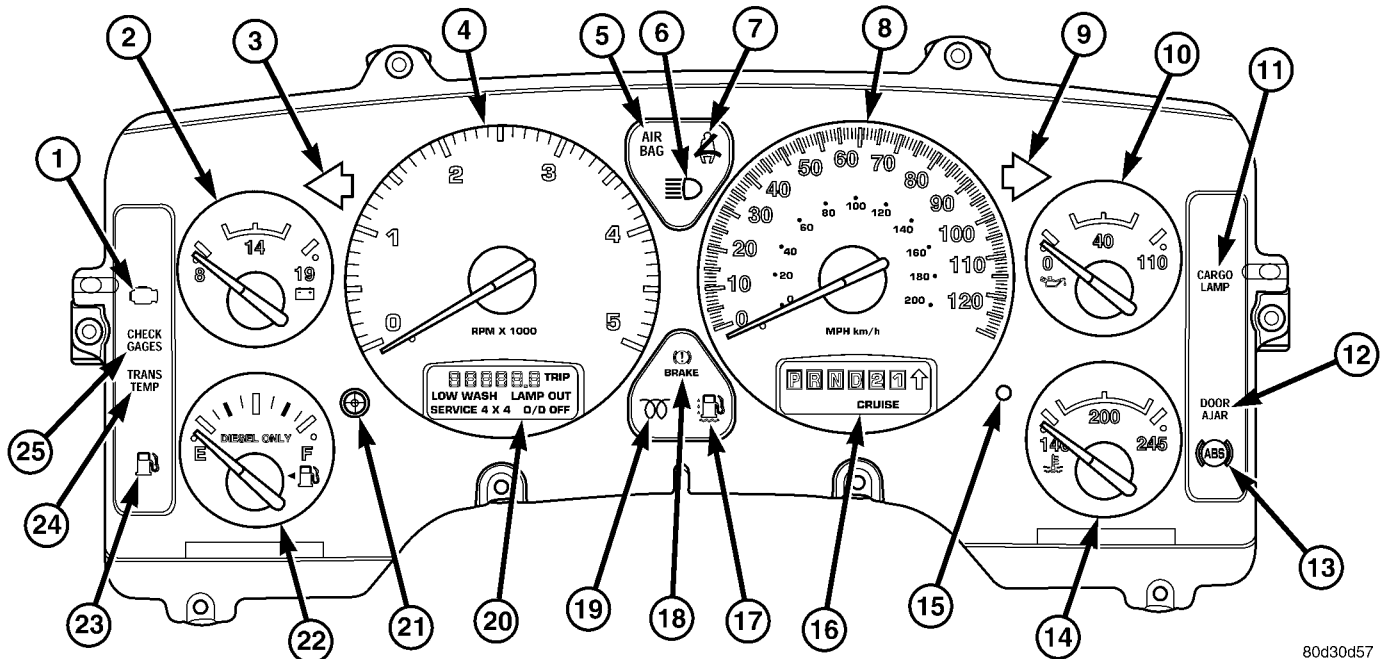
ule must be replaced. The cluster lens, hood and mask unit and the individual incandescent lamp bulbs with holders are available for individual service replacement.

OPERATION

The ElectroMechanical Instrument Cluster (EMIC) in this model also includes the hardware and software necessary to serve as the electronic body control module and is sometimes referred to as the Cab Compartment Node or CCN. The following information deals primarily with the instrument cluster functions of this unit. Additional details of the electronic body control functions of this unit may be found within the service information for the system or component that the EMIC controls. For example: Additional details of the audible warning functions of the EMIC are found within the Chime/Buzzer service information.

The EMIC is designed to allow the vehicle operator to monitor the conditions of many of the vehicle components and operating systems. The gauges and indicators in the EMIC provide valuable information about the various standard and optional powertrains, fuel and emissions systems, cooling systems, lighting systems, safety systems and many other convenience items. The EMIC is installed in the instrument panel so that all of these monitors can be easily viewed by the vehicle operator when driving, while still allowing relative ease of access for service. The microprocessor-based EMIC hardware and software uses various inputs to control the gauges and indicators visible on the face of the cluster. Some of these inputs are hard wired, but most are in the form of electronic messages that are transmitted by other electronic modules over the Programmable Communications Interface (PCI) data bus network. (Refer to 8 - ELECTRICAL/ELECTRONIC CONTROL MODULES/COMMUNICATION - OPERATION).

INSTRUMENT CLUSTER (Continued)



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Fig. 4 Gauges & Indicators - Diesel Engine

- | | |
|--------------------------------|--|
| 1 - MALFUNCTION INDICATOR LAMP | 14 - ENGINE TEMPERATURE GAUGE |
| 2 - VOLTAGE GAUGE | 15 - SECURITY INDICATOR |
| 3 - LEFT TURN INDICATOR | 16 - GEAR SELECTOR INDICATOR DISPLAY (INCLUDES CRUISE & UPSHIFT INDICATORS) |
| 4 - TACHOMETER | 17 - WATER-IN-FUEL INDICATOR |
| 5 - AIRBAG INDICATOR | 18 - BRAKE INDICATOR |
| 6 - HIGH BEAM INDICATOR | 19 - WAIT-TO-START INDICATOR |
| 7 - SEATBELT INDICATOR | 20 - ODOMETER/TRIP ODOMETER DISPLAY (INCLUDES ENGINE HOURS, WASHER FLUID, LAMP OUTAGE, OVERDRIVE-OFF & SERVICE 4x4 INDICATORS) |
| 8 - SPEEDOMETER | 21 - ODOMETER/TRIP ODOMETER SWITCH BUTTON |
| 9 - RIGHT TURN INDICATOR | 22 - FUEL GAUGE |
| 10 - OIL PRESSURE GAUGE | 23 - LOW FUEL INDICATOR |
| 11 - CARGO LAMP INDICATOR | 24 - TRANSMISSION OVERTEMP INDICATOR |
| 12 - DOOR AJAR INDICATOR | 25 - CHECK GAUGES INDICATOR |
| 13 - ABS INDICATOR | |

The EMIC microprocessor smooths the input data using algorithms to provide gauge readings that are accurate, stable and responsive to operating conditions. These algorithms are designed to provide gauge readings during normal operation that are consistent with customer expectations. However, when abnormal conditions exist such as high coolant temperature, the algorithm can drive the gauge pointer to an extreme position and the microprocessor can sound a chime through the on-board audible tone generator to provide distinct visual and audible indications of a problem to the vehicle operator. The instrument cluster circuitry may also produce audible warnings for other electronic modules in the vehicle based upon electronic tone request messages received over the PCI data bus. Each audible warning is intended to provide the vehicle operator with an audible alert to supplement a visual indication.

The EMIC circuitry operates on battery current received through a fused B(+) fuse in the Integrated Power Module (IPM) on a non-switched fused B(+) circuit, and on battery current received through a fused ignition switch output (run-start) fuse in the IPM on a fused ignition switch output (run-start) circuit. This arrangement allows the EMIC to provide some features regardless of the ignition switch position, while other features will operate only with the ignition switch in the On or Start positions. The EMIC circuitry is grounded through a ground circuit and take out of the instrument panel wire harness with an eyelet terminal connector that is secured by a ground screw to a ground location near the center of the instrument panel structural support.

The EMIC also has a self-diagnostic actuator test capability, which will test each of the PCI bus message-controlled functions of the cluster by lighting the appropriate indicators, positioning the gauge needle to the appropriate position, and operating the cruise control.

INSTRUMENT CLUSTER (Continued)

dles at several predetermined calibration points across the gauge faces, and illuminating all segments of the odometer/trip odometer and gear selector indicator Vacuum-Fluorescent Display (VFD) units. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). See the owner's manual in the vehicle glove box for more information on the features, use and operation of the EMIC.

GAUGES

All gauges receive battery current through the EMIC circuitry only when the ignition switch is in the On or Start positions. With the ignition switch in the Off position battery current is not supplied to any gauges, and the EMIC circuitry is programmed to move all of the gauge needles back to the low end of their respective scales. Therefore, the gauges do not accurately indicate any vehicle condition unless the ignition switch is in the On or Start positions.

All of the EMIC gauges are air core magnetic units. Two fixed electromagnetic coils are located within each gauge. These coils are wrapped at right angles to each other around a movable permanent magnet. The movable magnet is suspended within the coils on one end of a pivot shaft, while the gauge needle is attached to the other end of the shaft. One of the coils has a fixed current flowing through it to maintain a constant magnetic field strength. Current flow through the second coil changes, which causes changes in its magnetic field strength. The current flowing through the second coil is changed by the EMIC circuitry in response to messages received over the PCI data bus. The gauge needle moves as the movable permanent magnet aligns itself to the changing magnetic fields created around it by the electromagnets.

The gauges are diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the electronic data bus message inputs to the EMIC that control each gauge require the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific operation details for each gauge may be found elsewhere in this service information.

VACUUM-FLUORESCENT DISPLAYS

The Vacuum-Fluorescent Display (VFD) units are soldered to the EMIC electronic circuit board. With the ignition switch in the Off or Accessory positions, the odometer display is activated when the driver door is opened (Rental Car mode) and is deactivated when the driver door is closed. Otherwise, both display units are active when the ignition switch is in the On or Start positions, and inactive when the ignition switch is in the Off or Accessory positions.

The illumination intensity of the VFD units is controlled by the EMIC circuitry based upon an input from the headlamp switch and a dimming level input received from the headlamp dimmer switch. The EMIC synchronizes the illumination intensity of other VFD units with that of the units in the EMIC by sending electronic dimming level messages to other electronic modules in the vehicle over the PCI data bus.

The EMIC VFD units have several display capabilities including odometer, trip odometer, engine hours, gear selector indication (PRNDL) for models with an automatic transmission, several warning or reminder indications, and various diagnostic information when certain fault conditions exist. An odometer/trip odometer switch on the EMIC circuit board is used to control some of the display modes. This switch is actuated manually by depressing the odometer/trip odometer switch button that extends through the lower edge of the cluster lens, just left of the tachometer. Actuating this switch momentarily with the ignition switch in the On position will toggle the VFD between the odometer and trip odometer modes. Depressing the switch button for about two seconds while the VFD is in the trip odometer mode will reset the trip odometer value to zero. While in the odometer mode with the ignition switch in the On position and the engine not running, depressing this switch for about six seconds will display the engine hours information. Holding this switch depressed while turning the ignition switch from the Off position to the On position will initiate the EMIC self-diagnostic actuator test. Refer to the appropriate diagnostic information for additional details on this VFD function. The EMIC microprocessor remembers which display mode is active when the ignition switch is turned to the Off position, and returns the VFD display to that mode when the ignition switch is turned On again.

The VFD units are diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the electronic data bus message inputs to the EMIC that control some of the VFD functions requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific operation details for the odometer, the trip odometer, the gear selector indicator and the various warning and reminder indicator functions of the VFD may be found elsewhere in this service information.

INDICATORS

Indicators are located in various positions within the EMIC and are all connected to the EMIC electronic circuit board. The cargo lamp indicator, door

INSTRUMENT CLUSTER (Continued)

ajar indicator, high beam indicator, and turn signal indicators operate based upon hard wired inputs to the EMIC. The brake indicator is controlled by PCI data bus messages from the Controller Antilock Brake (CAB) as well as by hard wired park brake switch inputs to the EMIC. The seatbelt indicator is controlled by the EMIC programming, PCI data bus messages from the Airbag Control Module (ACM), and a hard wired seat belt switch input to the EMIC. The Malfunction Indicator Lamp (MIL) is normally controlled by PCI data bus messages from the Powertrain Control Module (PCM); however, if the EMIC loses PCI data bus communication, the EMIC circuitry will automatically turn the MIL on until PCI data bus communication is restored. The EMIC uses PCI data bus messages from the Front Control Module (FCM), the PCM, the diesel engine only Engine Control Module (ECM), the ACM, the CAB, and the Sentry Key Immobilizer Module (SKIM) to control all of the remaining indicators.

The various EMIC indicators are controlled by different strategies; some receive fused ignition switch output from the EMIC circuitry and have a switched ground, while others are grounded through the EMIC circuitry and have a switched battery feed. However, all indicators are completely controlled by the EMIC microprocessor based upon various hard wired and electronic message inputs. All indicators are illuminated at a fixed intensity, which is not affected by the selected illumination intensity of the EMIC general illumination lamps.

In addition, certain indicators in this instrument cluster are automatically configured or self-configured. This feature allows the configurable indicators to be enabled by the EMIC circuitry for compatibility with certain optional equipment. The EMIC defaults for the ABS indicator and airbag indicator are enabled, and these configuration settings must be programmatically disabled in the EMIC using a DRBIII® scan tool for vehicles that do not have this equipment. The automatically configured or self-configured indicators remain latent in each EMIC at all times and will be active only when the EMIC receives the appropriate PCI message inputs for that optional system or equipment.

The hard wired indicator inputs may be diagnosed using conventional diagnostic methods. However, the EMIC circuitry and PCI bus message controlled indicators are diagnosed using the EMIC self-diagnostic actuator test. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). Proper testing of the PCI data bus and the electronic message inputs to the EMIC that control an indicator requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information. Specific details of

the operation for each indicator may be found elsewhere in this service information.

CLUSTER ILLUMINATION

The EMIC has several illumination lamps that are illuminated when the exterior lighting is turned on with the headlamp switch. The illumination intensity of these lamps is adjusted when the interior lighting thumbwheel on the headlamp switch is rotated (down to dim, up to brighten) to one of six available minor detent positions. The EMIC monitors a resistor multiplexed input from the headlamp switch on a dimmer input circuit. In response to that input, the EMIC electronic circuitry converts a 12-volt input it receives from a fuse in the Integrated Power Module (IPM) on a hard wired panel lamps dimmer switch signal circuit into a 12-volt Pulse Width Modulated (PWM) output. The EMIC uses this PWM output to power the cluster illumination lamps and the VFD units on the EMIC circuit board, then provides a synchronized PWM output on the various hard wired fused panel lamps dimmer switch signal circuits to control and synchronize the illumination intensity of other incandescent illumination lamps in the vehicle. The cluster illumination lamps are grounded at all times.

The EMIC also sends electronic dimming level messages over the PCI data bus to other electronic modules in the vehicle to control and synchronize the illumination intensity of their VFD units to that of the EMIC VFD units. In addition, the thumbwheel on the headlamp switch has a Parade Mode position to provide a parade mode. The EMIC monitors the request for this mode from the headlamp switch, then sends an electronic dimming level message over the PCI data bus to illuminate all VFD units in the vehicle at full (daytime) intensity for easier visibility when driving in daylight with the exterior lighting turned on.

The hard wired headlamp switch and EMIC panel lamps dimmer inputs and outputs may be diagnosed using conventional diagnostic methods. However, proper testing of the PWM output of the EMIC and the electronic dimming level messages sent by the EMIC over the PCI data bus requires the use of a DRBIII® scan tool. Refer to the appropriate diagnostic information.

INPUT AND OUTPUT CIRCUITS

HARD WIRED INPUTS

The hard wired inputs to the EMIC include the following:

- **Brake Lamp Switch Output**
- **Driver Cylinder Lock Switch Sense**
- **Driver Door Ajar Switch Sense**

INSTRUMENT CLUSTER (Continued)

- **Driver Door Lock Switch MUX - with Power Locks**

- Fused B(+) - Ignition-Off Draw
- Fused B(+) - Power Lock Feed - with Power Locks

- **Fused Ignition Switch Output (Accessory-Run)**

- **Fused Ignition Switch Output (Off-Run-Start)**

- Fused Ignition Switch Output (Run-Start)
- Headlamp Dimmer Switch MUX
- Headlamp Switch MUX
- Horn Relay Control
- Key-In Ignition Switch Sense
- Left Rear Door Ajar Switch Sense
- Panel Lamps Dimmer Switch Signal
- Park Brake Switch Sense
- Passenger Door Ajar Switch Sense
- Passenger Door Lock Switch MUX - with Power Locks

- **Radio Control MUX**
- **Right Rear Door Ajar Switch Sense**
- **RKE Supply - with RKE**
- **Seat Belt Switch Sense**
- **Transmission Range Sensor MUX - with Auto Trans**

- Turn/Hazard Switch MUX
- Washer/Beam Select Switch MUX
- Wiper Switch MUX

Refer to the appropriate wiring information for additional details.

- **Turn/Hazard Switch MUX**
- **Washer/Beam Select Switch MUX**
- **Wiper Switch MUX**

Refer to the appropriate wiring information for additional details.

HARD WIRED OUTPUTS

The hard wired outputs of the EMIC include the following:

- **Accessory Switch Bank Illumination Driver**
- **BTSI Driver - with Auto Trans**
- **Cargo Lamp Driver**
- **Dome/Overhead Lamp Driver**
- **Driver Door Unlock Driver - with Power Locks**

- **Headlamp Switch Illumination Driver**
- **Heated Seat Switch Indicator Driver - with Heated Seats**

- **Heater-A/C Control Illumination Driver**
- **Left Door Lock Driver - with Power Locks**
- **Left Rear Door Unlock Driver - with Power Locks**

- **Map/Glove Box Lamp Driver**

- **Radio Illumination Driver**
- **Right Door Lock Driver - with Power Locks**
- **Right Door Unlock Driver - with Power Locks**

- **Transfer Case Switch Illumination Driver - with Four-Wheel Drive**

- **Radio Illumination Driver**
- **Right Door Lock Driver - with Power Locks**
- **Right Door Unlock Driver - with Power Locks**

- **Transfer Case Switch Illumination Driver - with Four-Wheel Drive**

Refer to the appropriate wiring information for additional details.

GROUND S

The EMIC receives and supplies a ground path to several switches and sensors through the following hard wired circuits:

- **Ground - Illumination (2 Circuits)**
- **Ground - Power Lock - with Power Locks**
- **Ground - Signal**
- **Headlamp Switch Return**
- **Multi-Function Switch Return**
- **Transmission Range Sensor Return - with Auto Trans**

Refer to the appropriate wiring information for additional details.

COMMUNICATION

The EMIC has provisions for the following communication circuits:

- **PCI Data Bus**
- **RKE Program Serial Data - with RKE**
- **RKE Transmit Serial Data - with RKE**

Refer to the appropriate wiring information for additional details.

DIAGNOSIS AND TESTING - INSTRUMENT CLUSTER

If all of the instrument cluster gauges and/or indicators are inoperative, refer to PRELIMINARY DIAGNOSIS. If an individual gauge or Programmable Communications Interface (PCI) data bus message-controlled indicator is inoperative, refer to ACTUATOR TEST. If an individual hard wired indicator is inoperative, refer to the diagnosis and testing information for that specific indicator.

Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

INSTRUMENT CLUSTER (Continued)

CAUTION: Instrument clusters used in this model automatically configure themselves for compatibility with the features and optional equipment in the vehicle in which they are initially installed. The instrument cluster is programmed to do this by embedding the Vehicle Identification Number (VIN) and other information critical to proper cluster operation into electronic memory. This embedded information is learned through electronic messages received from other electronic modules in the vehicle over the Programmable Communications Interface (PCI) data bus, and through certain hard wired inputs received when the cluster is connected to the vehicle electrically. Once configured, the instrument cluster memory may be irreparably damaged and certain irreversible configuration errors may occur if the cluster is connected electrically to another vehicle; or, if an electronic module from another vehicle is connected that provides data to the instrument cluster (including odometer values) that conflicts with that which was previously learned and stored. Therefore, the practice of exchanging (swapping) instrument clusters and other electronic modules in this vehicle with those removed from another vehicle must always be avoided. Failure to observe this caution may result in instrument cluster damage, which is not reimbursable under the terms of the product warranty. Service replacement instrument clusters are provided with the correct VIN, and the certified odometer and engine hours values embedded into cluster memory, but will otherwise be automatically configured for compatibility with the features and optional equipment in the vehicle in which they are initially installed.

NOTE: Certain indicators in this instrument cluster are automatically configured. This feature allows those indicators to be activated or deactivated for compatibility with certain optional equipment. If the problem being diagnosed involves improper illumination of the cruise indicator, the electronic throttle control indicator, the overdrive-off indicator, the service four-wheel drive indicator, the transmission overtemp indicator, the upshift indicator, the security indicator or the gear selector indicator, disconnect and isolate the battery negative cable. After about five minutes, reconnect the battery negative cable and turn the ignition switch to the On position. The instrument cluster should automatically relearn the equipment in the vehicle and properly configure the configurable indicators accordingly.

PRELIMINARY DIAGNOSIS

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Check the fused B(+) fuse (Fuse 28 - 10 ampere) in the Integrated Power Module (IPM). If OK, go to Step 2. If not OK, repair the shorted circuit or component as required and replace the faulty fuse.

(2) Check for battery voltage at the fused B(+) fuse (Fuse 28 - 10 ampere) in the IPM. If OK, go to Step 3. If not OK, repair the open fused B(+) circuit between the IPM and the battery as required.

(3) Disconnect and isolate the battery negative cable. Remove the instrument cluster. Reconnect the battery negative cable. Check for battery voltage at the fused B(+) circuit cavity of the instrument panel wire harness connector (Connector C1) for the instrument cluster. If OK, go to Step 4. If not OK, repair the open fused B(+) circuit between the instrument cluster and the IPM as required.

(4) Check for continuity between the signal ground circuit cavity of the instrument panel wire harness connector (Connector C1) for the instrument cluster and a good ground. There should be continuity. If OK, refer to ACTUATOR TEST. If not OK, repair the open ground circuit to ground (G202) as required.

INSTRUMENT CLUSTER (Continued)

ACTUATOR TEST

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

The instrument cluster actuator test will put the instrument cluster into its self-diagnostic mode. In this mode the instrument cluster can perform a self-diagnostic test that will confirm that the instrument cluster circuitry, the gauges, and the indicators are capable of operating as designed. During the actuator test the instrument cluster circuitry will position each of the gauge needles at various calibration points, illuminate all of the segments in the Vacuum Fluorescent Display (VFD) units, turn all of the indicators on and off again, display any Diagnostic Trouble Code (DTC) information, and display the number of ignition key cycles that have occurred since the DTC was detected. It is suggested that a note pad and pencil be used to write down any fault information that is displayed during the test for reference.

Successful completion of the actuator test will confirm that the instrument cluster is operational. However, there may still be a problem with the PCI data bus, the Powertrain Control Module (PCM), the Engine Control Module (ECM), the Front Control Module (FCM), the Transmission Control Module (TCM), the Transfer Case Control Module (TCCM), the Airbag Control Module (ACM), the Controller Anti-lock Brake (CAB), or the inputs to one of these electronic control modules. Use a DRBIII® scan tool

to diagnose these components. Refer to the appropriate diagnostic information.

(1) Begin the test with the ignition switch in the Off position.

(2) Depress the odometer/trip odometer switch button.

(3) While still holding the odometer/trip odometer switch button depressed, turn the ignition switch to the On position, but do not start the engine.

(4) Release the odometer/trip odometer switch button.

(5) The instrument cluster will simultaneously illuminate all of the operational segments in both VFD units, perform a bulb check of each operational LED indicator. The VFD segments and LED indicators remain illuminated as each gauge needle is swept to several calibration points and back. If a VFD segment or an LED indicator fails to illuminate, or if a gauge needle fails to sweep through the calibration points and back during this test, the instrument cluster must be replaced. Following these tests, the actuator test will proceed as described in Step 6.

(6) The text "C Code" is displayed in the odometer VFD for about three seconds. If there is no stored fault information, the display will show two pairs of zeroes in the format "00" "00", which indicate that the display of fault information is done. If there is stored fault information, two sets of two-digit alpha and alpha-numeric fault codes will appear in the odometer display for a three second interval. The first pair of digits represents a Diagnostic Trouble Code (DTC), or fault code for the instrument cluster. The second pair of digits is a counter for the number of ignition key cycles that have occurred since the displayed DTC was set. The instrument cluster will continue to display additional sets of two pairs of digits at three second intervals until all of the stored codes have been displayed, which is again signaled by a code of "00" "00". Refer to the Instrument Cluster Failure Message table for a description of each fault code that the instrument cluster displays. If an instrument cluster fault is displayed, use a DRBIII® scan tool to diagnose the problem. Refer to the appropriate diagnostic information.

INSTRUMENT CLUSTER FAILURE MESSAGE		
Fault Code	Description	Correction
01	Airbag warning indicator output circuit shorted.	Refer to the appropriate diagnostic information.
02	Airbag warning indicator output circuit open.	Refer to the appropriate diagnostic information.
03	ABS indicator output circuit shorted.	Refer to the appropriate diagnostic information.
04	ABS indicator output circuit open.	Refer to the appropriate diagnostic information.
05	MIL indicator output circuit shorted.	Refer to the appropriate diagnostic information.
06	MIL indicator output circuit open.	Refer to the appropriate diagnostic information.

INSTRUMENT CLUSTER (Continued)

INSTRUMENT CLUSTER FAILURE MESSAGE		
Fault Code	Description	Correction
07	Wait to start indicator circuit shorted.	Refer to the appropriate diagnostic information.
08	Wait to start indicator circuit open.	Refer to the appropriate diagnostic information.
0B	BTSI output circuit shorted or open.	Refer to the appropriate diagnostic information.
22	Headlamp switch input circuit shorted.	Refer to the appropriate diagnostic information.
23	Headlamp switch input circuit open.	Refer to the appropriate diagnostic information.
24	Turn hazard switch input circuit shorted.	Refer to the appropriate diagnostic information.
25	Turn hazard switch input circuit open.	Refer to the appropriate diagnostic information.
27	Courtesy/dome output circuit shorted or open.	Refer to the appropriate diagnostic information.
28	Glovebox/map lamp output circuit shorted or open.	Refer to the appropriate diagnostic information.
29	Cargo lamp output circuit shorted or open.	Refer to the appropriate diagnostic information.
40	Wiper switch input circuit shorted.	Refer to the appropriate diagnostic information.
41	Wiper switch input circuit open.	Refer to the appropriate diagnostic information.
42	Wash/beam input circuit shorted.	Refer to the appropriate diagnostic information.
60	Passenger door lock switch input circuit shorted.	Refer to the appropriate diagnostic information.
61	Passenger door lock switch input circuit open.	Refer to the appropriate diagnostic information.
62	Passenger door lock switch input circuit stuck.	Refer to the appropriate diagnostic information.
63	Driver door lock switch input circuit shorted.	Refer to the appropriate diagnostic information.
64	Driver door lock switch input circuit open.	Refer to the appropriate diagnostic information.
65	Driver door lock switch input circuit stuck.	Refer to the appropriate diagnostic information.
66	All door lock output circuit shorted to ground or voltage.	Refer to the appropriate diagnostic information.
67	All door unlock output circuit shorted to ground or voltage.	Refer to the appropriate diagnostic information.
68	Driver door unlock output circuit shorted to ground or voltage.	Refer to the appropriate diagnostic information.
6C	Driver cylinder lock switch input circuit shorted.	Refer to the appropriate diagnostic information.
6E	Driver cylinder lock switch input circuit stuck.	Refer to the appropriate diagnostic information.
80	Incorrect odometer value found.	Refer to the appropriate diagnostic information.
81	Remote radio switch input circuit high.	Refer to the appropriate diagnostic information.
82	Remote radio switch stuck.	Refer to the appropriate diagnostic information.
A0	Internal module FLASH memory checksum failure.	Refer to the appropriate diagnostic information.
A1	Internal module bootloader failure.	Refer to the appropriate diagnostic information.
A3	Battery voltage open.	Refer to the appropriate diagnostic information.
A5	TCCM messages not received.	Refer to the appropriate diagnostic information.
A7	VIN checksum error.	Refer to the appropriate diagnostic information.
A8	VIN previously stored.	Refer to the appropriate diagnostic information.
A9	PCI bus internal failure.	Refer to the appropriate diagnostic information.
AA	PCM messages not received.	Refer to the appropriate diagnostic information.
AB	TCM messages not received.	Refer to the appropriate diagnostic information.
AC	ABS messages not received.	Refer to the appropriate diagnostic information.

INSTRUMENT CLUSTER (Continued)

INSTRUMENT CLUSTER FAILURE MESSAGE		
Fault Code	Description	Correction
AD	FCM messages not received.	Refer to the appropriate diagnostic information.
AE	ACM messages not received.	Refer to the appropriate diagnostic information.
AF	SKIM messages not received.	Refer to the appropriate diagnostic information.
B0	RKE fob batteries low.	Refer to the appropriate diagnostic information.
B1	RKE module communication link.	Refer to the appropriate diagnostic information.
00	Done	All Diagnostic Trouble Codes (DTC) have been displayed.

(7) The actuator test is now completed. The instrument cluster will automatically exit the self-diagnostic mode and return to normal operation at the completion of the test, if the ignition switch is turned to the Off position during the test, or if a vehicle speed message indicating that the vehicle is moving is received from the PCM over the PCI data bus during the test.

(8) Go back to Step 1 to repeat the test, if necessary.

REMOVAL

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Disconnect and isolate the battery negative cable.

(2) Remove the cluster bezel from the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - REMOVAL).

(3) Remove the four screws that secure the instrument cluster to the instrument panel structural support (Fig. 5).

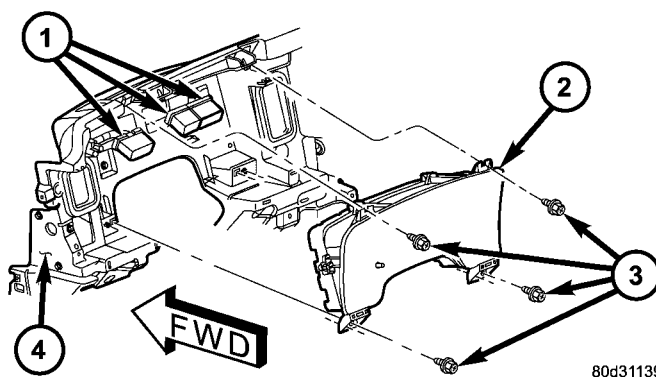


Fig. 5 Instrument Cluster Remove/Install

- 1 - WIRE HARNESS CONNECTOR (3)
- 2 - INSTRUMENT CLUSTER
- 3 - SCREW (4)
- 4 - INSTRUMENT PANEL STRUCTURAL SUPPORT

(4) Pull the instrument cluster rearward far enough to access and disconnect the instrument panel wire harness connectors for the cluster from the connector receptacles on the back of the cluster housing.

(5) Remove the instrument cluster from the instrument panel.

DISASSEMBLY

Some of the components for the instrument cluster used in this vehicle are serviced individually. The serviced components include the incandescent instrument cluster illumination lamp bulbs (including the integral bulb holders), and the cluster lens, hood and mask unit. Following are the procedures for disassembling these components from the instrument cluster unit.

INSTRUMENT CLUSTER (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

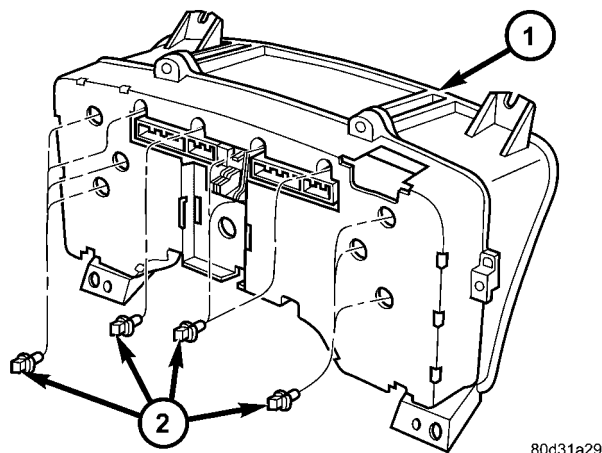
CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp bulb and bulb holder units. If the vehicle is equipped with the optional Remote Keyless Entry (RKE) system, the RKE receiver module must be removed from the instrument cluster rear cover to access the lower center cluster illumination lamp, which is located on the circuit board directly behind the RKE module. (Refer to 8 - ELECTRICAL/POWER LOCKS/REMOTE KEYLESS ENTRY MODULE - REMOVAL).

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) Turn the bulb holder counterclockwise about sixty degrees on the cluster electronic circuit board (Fig. 6).

**Fig. 6 Cluster Bulb Remove/Install**

- 1 - INSTRUMENT CLUSTER
2 - BULB & HOLDER (11)

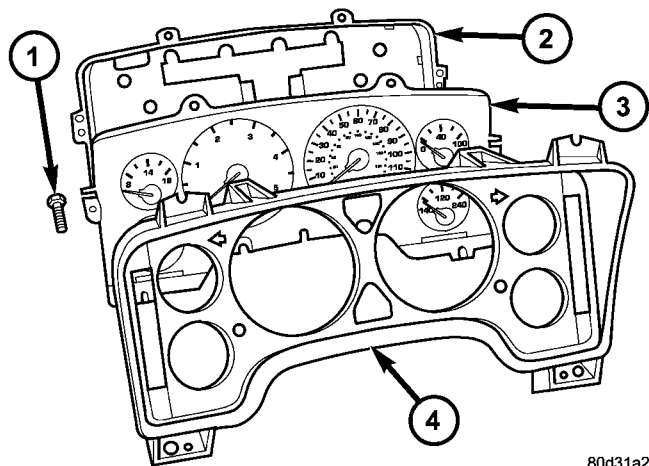
(4) Pull the bulb and bulb holder unit straight back to remove it from the bulb mounting hole in the cluster electronic circuit board.

CLUSTER LENS, HOOD, AND MASK

(1) Disconnect and isolate the battery negative cable.

(2) Remove the instrument cluster from the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - REMOVAL).

(3) From the back of the instrument cluster, remove the eight screws around the outer perimeter of the rear cover that secure the lens, hood, and mask unit to the cluster housing (Fig. 7).



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Fig. 7 Instrument Cluster Components

- 1 - SCREW (9)
2 - REAR COVER
3 - CLUSTER HOUSING
4 - LENS, HOOD & MASK

(4) Remove the lens, hood, and mask unit from the face of the instrument cluster.

ASSEMBLY

Some of the components for the instrument cluster used in this vehicle are serviced individually. The serviced components include the incandescent instrument cluster illumination lamp bulbs (including the integral bulb holders), and the cluster lens, hood and mask unit. Following are the procedures for assembling these components to the instrument cluster unit.

INSTRUMENT CLUSTER (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

CLUSTER BULB

This procedure applies to each of the incandescent cluster illumination lamp bulb and bulb holder units. If the vehicle is equipped with the optional Remote Keyless Entry (RKE) system, and the RKE receiver module was removed from the instrument cluster rear cover to access the lower center cluster illumination lamp, reinstall the RKE module after the bulb is replaced on the circuit board. (Refer to 8 - ELECTRICAL/POWER LOCKS/REMOTE KEYLESS ENTRY MODULE - INSTALLATION).

CAUTION: Always use the correct bulb size and type for replacement. An incorrect bulb size or type may overheat and cause damage to the instrument cluster, the electronic circuit board and/or the gauges.

(1) Insert the bulb and bulb holder unit straight into the correct bulb mounting hole in the cluster electronic circuit board (Fig. 6).

(2) With the bulb holder fully seated against the cluster electronic circuit board, turn the bulb holder clockwise about sixty degrees to lock it into place.

(3) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(4) Reconnect the battery negative cable.

CLUSTER LENS, HOOD, AND MASK

(1) Position the cluster lens, hood, and mask unit over the face of the instrument cluster (Fig. 7). Be certain that the odometer/trip odometer switch button is inserted through the proper clearance holes in the mask and the lens.

(2) From the back of the instrument cluster, install and tighten the eight screws around the outer perimeter of the rear cover that secure the lens, hood, and mask unit to the cluster housing. Tighten the screws to 1 N·m (10 in. lbs.).

(3) Reinstall the instrument cluster onto the instrument panel. (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - INSTALLATION).

(4) Reconnect the battery negative cable.

INSTALLATION

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

(1) Position the instrument cluster to the instrument panel.

(2) Reconnect the instrument panel wire harness connectors for the cluster to the connector receptacles on the back of the cluster housing.

(3) Position the instrument cluster into the instrument panel.

(4) Install and tighten the four screws that secure the instrument cluster to the instrument panel structural support (Fig. 5). Tighten the screws to 4 N·m (31 in. lbs.).

(5) Reinstall the cluster bezel onto the instrument panel. (Refer to 23 - BODY/INSTRUMENT PANEL/CLUSTER BEZEL - INSTALLATION).

(6) Reconnect the battery negative cable.

INSTRUMENT CLUSTER (Continued)

NOTE: Certain indicators in this instrument cluster are automatically configured. This feature allows those indicators to be activated or deactivated for compatibility with certain optional equipment. If the problem being diagnosed involves improper illumination of the cruise indicator, the electronic throttle control indicator, the overdrive-off indicator, the service four-wheel drive indicator, the transmission overtemp indicator, the upshift indicator, the security indicator or the gear selector indicator, disconnect and isolate the battery negative cable. After about five minutes, reconnect the battery negative cable and turn the ignition switch to the On position. The instrument cluster should automatically relearn the equipment in the vehicle and properly configure the configurable indicators accordingly.

ABS INDICATOR

DESCRIPTION

An Antilock Brake System (ABS) indicator is standard equipment on all instrument clusters. However, the instrument cluster can be programmed to disable this indicator on vehicles that are not equipped with the ABS or Rear Wheel Anti-Lock (RWAL) brake systems, which are not available in some markets. On vehicles equipped with a gasoline engine, the ABS indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. On vehicles equipped with a diesel engine, the ABS indicator is located on the right side of the instrument cluster, to the right of the engine temperature gauge. The ABS indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Failure of Anti-lock Braking System" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The ABS indicator is serviced as a unit with the instrument cluster.

OPERATION

The ABS indicator gives an indication to the vehicle operator when the ABS system is faulty or inoperative. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Controller Antilock Brake (CAB)

over the Programmable Communications Interface (PCI) data bus. The ABS indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the ABS indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the ABS indicator is illuminated by the cluster for about two seconds as a bulb test.

- **ABS Lamp-On Message** - Each time the cluster receives a lamp-on message from the CAB, the ABS indicator will be illuminated. The indicator remains illuminated until the cluster receives a lamp-off message from the CAB, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Communication Error** - If the cluster receives no lamp-on or lamp-off messages from the CAB for three consecutive seconds, the ABS indicator is illuminated. The indicator remains illuminated until the cluster receives a valid message from the CAB, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the instrument cluster is put through the actuator test, the ABS indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

- **ABS Diagnostic Test** - The ABS indicator is blinked on and off by lamp-on and lamp-off messages from the CAB during the performance of the ABS diagnostic tests.

The CAB continually monitors the ABS circuits and sensors to decide whether the system is in good operating condition. The CAB then sends the proper lamp-on or lamp-off messages to the instrument cluster. If the CAB sends a lamp-on message after the bulb test, it indicates that the CAB has detected a system malfunction and/or that the ABS system has become inoperative. The CAB will store a Diagnostic Trouble Code (DTC) for any malfunction it detects. Each time the ABS indicator fails to light due to an open or short in the cluster ABS indicator circuit, the cluster sends a message notifying the CAB of the condition, then the instrument cluster and the CAB will each store a DTC. For proper diagnosis of the antilock brake system, the CAB, the PCI data bus, or the electronic message inputs to the instrument cluster

ABS INDICATOR (Continued)

ter that control the ABS indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

AIRBAG INDICATOR

DESCRIPTION

An airbag indicator is standard equipment on all instrument clusters. However, the instrument cluster can be programmed to disable this indicator on vehicles that are not equipped with the airbag system, which is not available in some markets. The airbag indicator is located near the upper edge of the instrument cluster, between the tachometer and the speedometer. The airbag indicator consists of a stencil-like cutout of the words "AIR BAG" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "AIR BAG" text to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The airbag indicator is serviced as a unit with the instrument cluster.

OPERATION

The airbag indicator gives an indication to the vehicle operator when the airbag system is faulty or inoperative. The airbag indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Airbag Control Module (ACM) over the Programmable Communications Interface (PCI) data bus. The airbag indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the airbag indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the airbag indicator is illuminated for about six seconds. The entire six second bulb test is a function of the ACM.
- **ACM Lamp-On Message** - Each time the cluster receives a lamp-on message from the ACM, the airbag indicator will be illuminated. The indicator

remains illuminated for about twelve seconds or until the cluster receives a lamp-off message from the ACM, whichever is longer.

- **Communication Error** - If the cluster receives no airbag messages for three consecutive seconds, the airbag indicator is illuminated. The indicator remains illuminated until the cluster receives a single lamp-off message from the ACM.

- **Actuator Test** - Each time the cluster is put through the actuator test, the airbag indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry. The actuator test illumination of the airbag indicator is a function of the instrument cluster.

The ACM continually monitors the airbag system circuits and sensors to decide whether the system is in good operating condition. The ACM then sends the proper lamp-on or lamp-off messages to the instrument cluster. If the ACM sends a lamp-on message after the bulb test, it indicates that the ACM has detected a system malfunction and/or that the airbags and seat belt tensioners may not deploy when required, or may deploy when not required. The ACM will store a Diagnostic Trouble Code (DTC) for any malfunction it detects. Each time the airbag indicator fails to illuminate due to an open or short in the cluster airbag indicator circuit, the cluster sends a message notifying the ACM of the condition, the instrument cluster and the ACM will each store a DTC, and the cluster will flash the seatbelt indicator on and off as a backup to notify the vehicle operator. For proper diagnosis of the airbag system, the ACM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the airbag indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

BRAKE/PARK BRAKE INDICATOR

DESCRIPTION

A brake indicator is standard equipment on all instrument clusters. The brake indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. The brake indicator consists of stencil-like cutouts of the word "BRAKE" and the International Control and Display Symbol icon for "Brake Failure" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "BRAKE" text and the icon to appear in red through

BRAKE/PARK BRAKE INDICATOR (Continued)

the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The brake indicator is serviced as a unit with the instrument cluster.

OPERATION

The brake indicator gives an indication to the vehicle operator when the parking brake is applied, when there are certain brake hydraulic system malfunctions as indicated by a low brake hydraulic fluid level condition, or when the brake fluid level switch is disconnected. The brake indicator can also give an indication when certain faults are detected in the Antilock Brake System (ABS). This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming, electronic messages received by the cluster from the Controller Antilock Brake (CAB) over the Programmable Communications Interface (PCI) data bus, and a hard wired input from the park brake switch. The brake indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the brake indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the brake indicator is illuminated by the instrument cluster for about two seconds as a bulb test.

- **Brake Lamp-On Message** - Each time the cluster receives a lamp-on message from the CAB, the brake indicator will be illuminated. The CAB can also send brake lamp-on messages as feedback during ABS diagnostic procedures. The indicator remains illuminated until the cluster receives a lamp-off message from the CAB, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Park Brake Switch Input** - Each time the cluster detects ground on the park brake switch sense circuit (park brake switch closed = park brake applied or not fully released) while the ignition switch is in the On position, the brake indicator flashes on and off. The indicator continues to flash until the park brake switch sense input to the cluster is an open circuit (park brake switch open = park brake fully released), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the instrument cluster is put through the actuator test, the brake indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The park brake switch on the park brake pedal mechanism provides a hard wired ground input to the instrument cluster circuitry through the park brake switch sense circuit whenever the park brake is applied or not fully released. The CAB continually monitors the ABS system circuits and sensors, including the brake fluid level switch on the brake master cylinder reservoir, to decide whether the system is in good operating condition. The CAB then sends the proper lamp-on or lamp-off messages to the instrument cluster. If the CAB sends a lamp-on message after the bulb test, it indicates that the CAB has detected a brake hydraulic system malfunction and/or that the ABS system has become inoperative. The CAB will store a Diagnostic Trouble Code (DTC) for any malfunction it detects.

For further diagnosis of the brake indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). The park brake switch input to the instrument cluster can be diagnosed using conventional diagnostic tools and methods. For proper diagnosis of the brake fluid level switch, the ABS, the CAB, the PCI data bus, or the electronic message inputs to the instrument cluster that control the brake indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

DIAGNOSIS AND TESTING - BRAKE INDICATOR

The diagnosis found here addresses an inoperative brake indicator condition. If there are problems with several indicators in the instrument cluster, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the brake indicator stays on with the ignition switch in the On position and the park brake released, or comes on while driving, the brake system must be diagnosed and repaired prior to performing the following tests. (Refer to 5 - BRAKES - DIAGNOSIS AND TESTING). If no brake system problem is found, the following procedures will help to locate a shorted or open circuit, or a faulty park brake switch input. Refer to the appropriate wiring information. The wiring information includes wiring diagrams, proper wire and connector repair procedures, details of wire harness routing and retention, connector pin-out information and location views for the various wire harness connectors, splices and grounds.

BRAKE/PARK BRAKE INDICATOR (Continued)

WARNING: ON VEHICLES EQUIPPED WITH AIRBAGS, DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM BEFORE ATTEMPTING ANY STEERING WHEEL, STEERING COLUMN, DRIVER AIRBAG, PASSENGER AIRBAG, SEAT BELT TENSIONER, SIDE CURTAIN AIRBAG, OR INSTRUMENT PANEL COMPONENT DIAGNOSIS OR SERVICE. DISCONNECT AND ISOLATE THE BATTERY NEGATIVE (GROUND) CABLE, THEN WAIT TWO MINUTES FOR THE SYSTEM CAPACITOR TO DISCHARGE BEFORE PERFORMING FURTHER DIAGNOSIS OR SERVICE. THIS IS THE ONLY SURE WAY TO DISABLE THE SUPPLEMENTAL RESTRAINT SYSTEM. FAILURE TO TAKE THE PROPER PRECAUTIONS COULD RESULT IN ACCIDENTAL AIRBAG DEPLOYMENT AND POSSIBLE PERSONAL INJURY.

INDICATOR ILLUMINATES DURING BULB TEST, BUT DOES NOT WHEN PARK BRAKE APPLIED

(1) Disconnect and isolate the battery negative cable. Disconnect the body wire harness connector for the park brake switch from the switch terminal. Apply the parking brake. Check for continuity between the park brake switch terminal and a good ground. There should be continuity. If OK, go to Step 2. If not OK, replace the faulty park brake switch.

(2) Disconnect the instrument panel wire harness connector (Connector C1) for the instrument cluster from the cluster connector receptacle. Check for continuity between the park brake switch sense circuit cavities of the body wire harness connector for the park brake switch and the instrument panel wire harness connector for the instrument cluster. There should be continuity. If not OK, repair the open park brake switch sense circuit between the park brake switch and the instrument cluster as required.

INDICATOR REMAINS ILLUMINATED - BRAKE SYSTEM CHECKS OK

(1) Disconnect and isolate the battery negative cable. Disconnect the body wire harness connector for the park brake switch from the switch terminal. Check for continuity between the terminal of the park brake switch and a good ground. There should be no continuity with the park brake released, and continuity with the park brake applied. If OK, go to Step 2. If not OK, replace the faulty park brake switch.

(2) Disconnect the instrument panel wire harness connector (Connector C1) for the instrument cluster from the cluster connector receptacle. Check for continuity between the park brake switch sense circuit cavity of the body wire harness connector for the park brake switch and a good ground. There should be no continuity. If not OK, repair the shorted park

brake switch sense circuit between the park brake switch and the instrument cluster as required.

CARGO LAMP INDICATOR

DESCRIPTION

A cargo lamp indicator is standard equipment on all instrument clusters. The cargo lamp indicator is located on the right side of the instrument cluster, to the right of the oil pressure gauge. The cargo lamp indicator consists of a stencil-like cutout of the words "CARGO LAMP" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "CARGO LAMP" text to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The cargo lamp indicator is serviced as a unit with the instrument cluster.

OPERATION

The cargo lamp indicator gives an indication to the vehicle operator when the exterior cargo lamp is illuminated. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming, a hard wired multiplex input received by the cluster from the headlamp panel lamps dimmer switch on the headlamp dimmer switch mux circuit, and electronic unlock request messages received from the optional Remote Keyless Entry (RKE) receiver module. The cargo lamp indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow only this indicator to operate whenever the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the cargo lamp indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the cargo lamp indicator is illuminated for about two seconds as a bulb test.

- **Cargo Lamp-On Input** - Each time the cluster detects a cargo lamp-on input from the headlamp switch on the headlamp dimmer switch mux circuit, the cargo lamp and the cargo lamp indicator will be illuminated. The cargo lamp and indicator remain illuminated until the cluster receives a cargo lamp-off

CARGO LAMP INDICATOR (Continued)

input from the headlamp switch, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the cargo lamp indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The instrument cluster continually monitors the headlamp dimmer switch circuit to determine the proper interior lamps features and panel lamps illumination levels to provide. The cluster then energizes and de-energizes a low side driver circuit to control the exterior cargo lamp. Each time the instrument cluster energizes the cargo lamp driver and the ignition switch is in the On or start positions, the cluster also turns on the cargo lamp indicator. For further diagnosis of the cargo lamp indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the cargo lamp or the headlamp switch inputs to the instrument cluster that control the cargo lamp indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

CHECK GAUGES INDICATOR

DESCRIPTION

A check gauges indicator is standard equipment on all instrument clusters. On vehicles equipped with a gasoline engine, the check gauges indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. On vehicles equipped with a diesel engine, the check gauges indicator is located on the left side of the instrument cluster, to the left of the voltage gauge. The check gauges indicator consists of a stencil-like cutout of the words "CHECK GAGES" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "CHECK GAGES" text to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The check gauges indicator is serviced as a unit with the instrument cluster.

OPERATION

The check gauges indicator gives an indication to the vehicle operator when certain instrument cluster gauge readings reflect a condition requiring immedi-

ate attention. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles equipped with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The check gauges indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the check gauges indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the check gauges indicator is illuminated for about two seconds as a bulb test.

- **Engine Temperature High Message** - Each time the cluster receives a message from the PCM or ECM indicating the engine coolant temperature of a gasoline engine is about 122° C (252° F) or higher, or of a diesel engine is about 112° C (233° F) or higher, the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating that the engine coolant temperature of a gasoline engine is below about 122° C (252° F), or of a diesel engine is below about 112° C (233° F), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Engine Oil Pressure Low Message** - Each time the cluster receives a message from the PCM or ECM indicating the engine oil pressure is about 41 kPa (6 psi) or lower, the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating that the engine oil pressure is above about 41 kPa (6 psi), or until the ignition switch is turned to the Off position, whichever occurs first. The cluster will only turn the indicator on in response to an engine oil pressure low message if the engine speed is greater than zero.

- **System Voltage Low (Charge Fail) Message** - Each time the cluster receives a message from the PCM or ECM indicating the electrical system voltage is less than about 11.5 volts (charge fail condition), the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating the electrical system voltage is greater than about

CHECK GAUGES INDICATOR (Continued)

12.0 volts (but less than 16.0 volts), or until the ignition switch is turned to the Off position, whichever occurs first.

- **System Voltage High Message** - Each time the cluster receives a message from the PCM or ECM indicating the electrical system voltage is greater than about 16.0 volts, the check gauges indicator will be illuminated. The indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating the electrical system voltage is less than about 15.5 volts (but greater than 11.5 volts), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the check gauges indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the engine temperature, oil pressure, and electrical system voltage, then sends the proper messages to the instrument cluster. On vehicles with a diesel engine, the ECM continually monitors the engine temperature, oil pressure, and electrical system voltage, then sends the proper messages to the instrument cluster. For further diagnosis of the check gauges indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the check gauges indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

CRUISE INDICATOR

DESCRIPTION

A cruise indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional speed control system, this indicator is electronically disabled. The cruise indicator consists of the word "CRUISE", which appears in the lower portion of the gear selector indicator Vacuum-Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the speedometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The word "CRUISE" appears in a blue-green color and at the same lighting level as the gear selector indicator information when it is illuminated by the instrument

cluster electronic circuit board. The cruise indicator is serviced as a unit with the VFD in the instrument cluster.

OPERATION

The cruise indicator gives an indication to the vehicle operator when the speed control system is turned On, regardless of whether the speed control is engaged. This indicator is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The cruise indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the cruise indicator for the following reasons:

- **Cruise Lamp-On Message** - Each time the cluster receives a cruise lamp-on message from the PCM indicating the speed control system has been turned On, the cruise indicator is illuminated. The indicator remains illuminated until the cluster receives a cruise lamp-off message from the PCM or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the cruise indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

The PCM continually monitors the speed control switches to determine the proper outputs to the speed control servo. The PCM then sends the proper cruise indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the cruise indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the speed control system, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the cruise indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

DOOR AJAR INDICATOR

DESCRIPTION

A door ajar indicator is standard equipment on all instrument clusters. The door ajar indicator is located on the right side of the instrument cluster, to the right of the engine temperature gauge. The door ajar indicator consists of a stencil-like cutout of the words "DOOR AJAR" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "DOOR AJAR" text to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The door ajar indicator is serviced as a unit with the instrument cluster.

OPERATION

The door ajar indicator gives an indication to the vehicle operator that one or more of the passenger compartment doors may be open or not completely latched. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and hard wired inputs received by the cluster from the door ajar switches located in each door latch unit. The door ajar indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow this indicator to operate whenever the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the door ajar indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the door ajar indicator is illuminated for about two seconds as a bulb test.
- **Door Ajar Switch Input** - Each time the cluster detects ground on any one of the door ajar switch sense circuits (door ajar switch closed = door is open or not completely latched) the door ajar indicator will be illuminated. The indicator remains illuminated until all of the door ajar switch sense inputs to the cluster are an open circuit (door ajar switch open = door fully closed), or until the ignition switch is turned to the Off position, whichever occurs first.
- **Actuator Test** - Each time the cluster is put through the actuator test, the door ajar indicator will be turned on, then off again during the bulb check

portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The instrument cluster continually monitors the door ajar switches to determine the status of the doors. For further diagnosis of the door ajar indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the door ajar switches and circuits, (Refer to 8 - ELECTRICAL/LAMPS/LIGHTING - INTERIOR/DOOR AJAR SWITCH - DIAGNOSIS AND TESTING).

ENGINE TEMPERATURE GAUGE

DESCRIPTION

An engine coolant temperature gauge is standard equipment on all instrument clusters. The engine coolant temperature gauge is located in the lower right quadrant of the instrument cluster, below the oil pressure gauge. The engine coolant temperature gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from "C" (or Cold) to "H" (or Hot) for gasoline engines. On vehicles with a diesel engine, the scale reads from "60"° C to "120"° C in markets where a metric instrument cluster is specified, or from "140"° F to "245"° F in all other markets. An International Control and Display Symbol icon for "Engine Coolant Temperature" is located on the cluster overlay, directly below the left end of the gauge scale. The engine coolant temperature gauge graphics are black against a white field except for two red graduations at the high end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear blue and the red graphics still appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The engine coolant temperature gauge is serviced as a unit with the instrument cluster.

OPERATION

The engine coolant temperature gauge gives an indication to the vehicle operator of the engine coolant temperature. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by

ENGINE TEMPERATURE GAUGE (Continued)

the cluster from the Powertrain Control Module (PCM) on vehicles equipped with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The engine coolant temperature gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Engine Temperature Message** - Each time the cluster receives a message from the PCM or ECM indicating the engine coolant temperature is between the low end of normal [about 54° C (130° F) for gasoline engines, or about 60° C (140° F) for diesel engines] and the high end of normal [about 122° C (252° F) for gasoline engines, or about 116° C (240° F) for diesel engines], the gauge needle is moved to the actual relative temperature position on the gauge scale.

- **Engine Temperature Low Message** - Each time the cluster receives a message from the PCM or ECM indicating the engine coolant temperature is below the low end of normal [about 54° C (130° F) for gasoline engines, or about 60° C (140° F) for diesel engines], the gauge needle is held at the graduation on the far left end of the gauge scale. The gauge needle remains at the left end of the gauge scale until the cluster receives a message from the PCM or ECM indicating that the engine temperature is above about 54° C (130° F) for gasoline engines, or about 60° C (140° F) for diesel engines, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Engine Temperature High Message** - Each time the cluster receives a message from the PCM or ECM indicating the engine coolant temperature is above about 122° C (252° F) for gasoline engines, or about 116° C (240° F) for diesel engines, the gauge needle is moved into the red zone at the far right end of gauge scale, the check gauges indicator is illuminated, and a single chime tone is sounded. The gauge needle remains in the red zone and the check gauges indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating that the engine temperature is below about 122° C (252° F) for gasoline engines, or about 116° C (240° F) for diesel engines, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the check gauges indicator is

cycled off and then on again by the appropriate engine temperature messages from the PCM or ECM.

- **Communication Error** - If the cluster fails to receive an engine temperature message, it will hold the gauge needle at the last indication for about five seconds or until the ignition switch is turned to the Off position, whichever occurs first. After five seconds, the cluster will move the gauge needle to the low end of the gauge scale.

- **Actuator Test** - Each time the cluster is put through the actuator test, the engine coolant temperature gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the engine coolant temperature sensor to determine the engine operating temperature. On vehicles with a diesel engine, the ECM continually monitors the engine coolant temperature sensor to determine the engine operating temperature. The PCM or ECM then sends the proper engine coolant temperature messages to the instrument cluster. For further diagnosis of the engine coolant temperature gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the check gauges indicator due to a high engine temperature gauge reading, it may indicate that the engine or the engine cooling system requires service. For proper diagnosis of the engine coolant temperature sensor, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the engine coolant temperature gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

ETC INDICATOR

DESCRIPTION

An Electronic Throttle Control (ETC) indicator is standard equipment on all gasoline engine instrument clusters. However, on vehicles not equipped with the optional 5.7 liter gasoline engine, this indicator is electronically disabled. The ETC indicator is located on the right side of the instrument cluster, to the right of the engine temperature gauge. The ETC indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Electronic Throttle Control" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque

ETC INDICATOR (Continued)

layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The ETC indicator is serviced as a unit with the instrument cluster.

OPERATION

The Electronic Throttle Control (ETC) indicator gives an indication to the vehicle operator when the ETC system is faulty or inoperative. The ETC indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The ETC indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the ETC indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the ETC indicator is illuminated for about six seconds. The entire six second bulb test is a function of the PCM.

- **ETC Lamp-On Message** - Each time the cluster receives a lamp-on message from the PCM, the ETC indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the PCM message. The indicator remains illuminated solid or continues to flash for about twelve seconds or until the cluster receives a lamp-off message from the PCM, whichever is longer. If the indicator is illuminated solid with the engine running the vehicle will usually remain drivable. If the indicator is flashing with the engine running the vehicle may require towing. A flashing indicator means the ETC system requires immediate service.

- **Communication Error** - If the cluster receives no ETC lamp messages for three consecutive seconds, the ETC indicator is illuminated. The indicator remains illuminated until the cluster receives a single lamp-off message from the PCM.

- **Actuator Test** - Each time the cluster is put through the actuator test, the ETC indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry. The actuator test illumination of the ETC indicator is a function of the PCM.

The PCM continually monitors the ETC system circuits and sensors to decide whether the system is in good operating condition. The PCM then sends the proper lamp-on or lamp-off messages to the instrument cluster. If the PCM sends a lamp-on message after the bulb test, it indicates that the PCM has detected a system malfunction and/or that the ETC system is inoperative. The PCM will store a Diagnostic Trouble Code (DTC) for any malfunction it detects. Each time the ETC indicator fails to illuminate due to an open or short in the cluster ETC indicator circuit, the cluster sends a message notifying the PCM of the condition, the instrument cluster and the PCM will each store a DTC. For proper diagnosis of the ETC system, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the ETC indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

FUEL GAUGE

DESCRIPTION

A fuel gauge is standard equipment on all instrument clusters. The fuel gauge is located in the lower left quadrant of the instrument cluster, below the voltage gauge. The fuel gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from "E" (or Empty) to "F" (or Full). An International Control and Display Symbol icon for "Fuel" is located on the cluster overlay, directly below the right end of the gauge scale. An arrowhead pointed to the left side of the vehicle is imprinted on the cluster overlay next to the "Fuel" icon in the fuel gauge to provide the driver with a reminder as to the location of the fuel filler access. On vehicles equipped with a diesel engine, text that specifies "DIESEL ONLY" is located across the fuel gauge below the gauge scale, but above the hub of the gauge needle. The fuel gauge graphics are black against a white field except for a single red graduation at the low end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear blue and the red graphics still appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The fuel gauge is serviced as a unit with the instrument cluster.

FUEL GAUGE (Continued)

OPERATION

The fuel gauge gives an indication to the vehicle operator of the level of fuel in the fuel tank. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles equipped with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The fuel gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Percent Tank Full Message** - Each time the cluster receives a message from the PCM or ECM indicating the percent tank full, the cluster programming applies an algorithm to calculate the proper gauge needle position, then moves the gauge needle to the proper relative position on the gauge scale. The algorithm is used to dampen gauge needle movement against the negative effect that fuel sloshing within the fuel tank can have on accurate inputs from the fuel tank sending unit to the PCM or ECM.

- **Less Than Twenty Percent Tank Full Message** - Each time the cluster receives messages from the PCM or ECM indicating the percent tank full is about twenty percent or less for ten consecutive seconds and the vehicle speed is zero, or for sixty consecutive seconds and the vehicle speed is greater than zero, the gauge needle is moved to the one-eighth graduation or below on the gauge scale, the low fuel indicator is illuminated, and a single chime tone is sounded. The low fuel indicator remains illuminated until the cluster receives messages from the PCM or ECM indicating that the percent tank full is greater than about twenty percent for ten consecutive seconds and the vehicle speed is zero, or for sixty consecutive seconds and the vehicle speed is greater than zero, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the low fuel indicator is cycled off and then on again by the appropriate percent tank full messages from the PCM or ECM.

- **Less Than Empty Percent Tank Full Message** - Each time the cluster receives a message from the PCM or ECM indicating the percent tank full is less than empty, the gauge needle is moved to the far left end of the gauge scale and the low fuel indicator

is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM or ECM is a short circuit.

- **More Than Full Percent Tank Full Message**

- Each time the cluster receives a message from the PCM or ECM indicating the percent tank full is more than full, the gauge needle is moved to the far left end of the gauge scale and the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM or ECM is an open circuit.

- **Communication Error** - If the cluster fails to receive a percent tank full message, it will hold the gauge needle at the last indication about five seconds or until the ignition switch is turned to the Off position, whichever occurs first. After five seconds, the cluster will move the gauge needle to the low end of the gauge scale.

- **Actuator Test** - Each time the cluster is put through the actuator test, the fuel gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the fuel tank sending unit to determine the level of the fuel in the fuel tank. On vehicles with a diesel engine, the ECM continually monitors the fuel tank sending unit to determine the level of the fuel in the fuel tank. The PCM or ECM then sends the proper fuel level messages to the instrument cluster. For further diagnosis of the fuel gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the fuel tank sending unit, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the fuel gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

GEAR SELECTOR INDICATOR

DESCRIPTION

An electronic automatic transmission gear selector indicator is standard factory-installed equipment on this model. The gear selector indicator information is displayed in a Vacuum-Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the speedometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated.

GEAR SELECTOR INDICATOR (Continued)

The gear selector indicator displays the following characters from left to right: "P," "R," "N," "D," "2," and "1." Respectively, these characters represent the park, reverse, neutral, drive, second gear, and first gear positions of the transmission gear selector lever on the steering column. The VFD illuminates a rectangular box around the character that represents the currently selected lever position.

The gear selector indicator characters and graphics appear in the same blue-green color and at the same lighting level as the odometer/trip odometer information when illuminated by the instrument cluster electronic circuit board. During daylight hours (exterior lamps Off) the gear selector indicator VFD is illuminated at full brightness for clear visibility. At night (exterior lamps are On) the VFD lighting level is adjusted with the other cluster illumination lamps using the panel lamps dimmer thumbwheel on the headlamp switch. However, a "Parade" mode position of the panel lamps dimmer thumbwheel allows the VFD to be illuminated at full brightness when the vehicle is driven in daylight hours with the exterior lamps turned On. The gear selector indicator VFD is serviced as a unit with the instrument cluster.

OPERATION

The electronic gear selector indicator gives an indication to the vehicle operator of the transmission gear that has been selected with the automatic transmission gear selector lever. This indicator is controlled by the instrument cluster circuit board based upon cluster programming. The cluster circuitry automatically configures itself for the proper transmission and automatic transmission model based upon the hard wired transmission range sensor mux circuit input to the cluster. The gear selector indicator information is displayed by a dedicated Vacuum Fluorescent Display (VFD) unit on the instrument cluster electronic circuit board, and the VFD will not display the gear selector indicator information after the ignition switch is turned to the Off position. The instrument cluster circuitry configures the gear selector indicator VFD based upon the following inputs from the transmission range sensor:

- **Open Circuit** - If the cluster is configured for an automatic transmission and the transmission range sensor mux circuit is open, the cluster circuitry controls the gear selector indicator display based upon electronic messages received from the electronic Transmission Control Module (TCM) over the Programmable Communications Interface (PCI) data bus. If the transmission range sensor mux circuit is open and no electronic messages are received from the TCM within two seconds, the instrument cluster circuitry will not display any gear selector position until the condition is resolved or until the ignition

switch is turned to the Off position, whichever occurs first.

- **Resolved Circuit** - If the transmission range sensor mux circuit is resolved, the cluster circuitry controls the gear selector indicator display based upon the resistance value of the hard wired input from the transmission range sensor. If the cluster is configured for an automatic transmission with a transmission range sensor input and detects a short to ground or an open in the transmission range sensor mux input, the instrument cluster circuitry will not display any gear selector position in the VFD. The VFD display for the short-to-ground and open circuit conditions will continue until the condition is resolved or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the gear selector indicator VFD will display all of its characters at once during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

On models with a TCM, the TCM continually monitors the transmission range sensor, then sends the proper gear selector indicator position messages to the instrument cluster. On models without a TCM, the instrument cluster continually monitors the hard wired transmission range sensor multiplexed input. For further diagnosis of the gear selector indicator or the instrument cluster circuitry that controls this function, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For further diagnosis of the transmission range sensor on models without a TCM, (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 42RE/TRANSMISSION RANGE SENSOR - DIAGNOSIS AND TESTING) or (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 46RE/TRANSMISSION RANGE SENSOR - DIAGNOSIS AND TESTING). On models with a TCM, for proper diagnosis of the transmission range sensor, the TCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the gear selector indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

HIGH BEAM INDICATOR

DESCRIPTION

A high beam indicator is standard equipment on all instrument clusters. The high beam indicator is located near the upper edge of the instrument cluster, between the tachometer and the speedometer. The high beam indicator consists of a stencil-like cut-out of the International Control and Display Symbol icon for "High Beam" in the opaque layer of the

HIGH BEAM INDICATOR (Continued)

instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A blue Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in blue through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The high beam indicator is serviced as a unit with the instrument cluster.

OPERATION

The high beam indicator gives an indication to the vehicle operator whenever the headlamp high beams are illuminated. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and a hard wired multiplex input received by the cluster from the headlamp beam select switch circuitry of the multi-function switch on the washer/beam select switch mux circuit. The high beam indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow this indicator to operate whenever the instrument cluster receives a battery current input on the fused B(+) circuit. Therefore, the LED can be illuminated regardless of the ignition switch position. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the high beam indicator for the following reasons:

- **High Beam Headlamps-On Input** - Each time the cluster detects a high beam headlamps-on input from the headlamp beam select switch circuitry of the multi-function switch on the washer/beam select switch mux circuit, the headlamp high beams and the high beam indicator will be illuminated. The headlamp high beams and the high beam indicator remain illuminated until the cluster receives a high beam headlamps-off input from the multi-function switch, or until the exterior lamp load shedding (battery saver) timed interval expires, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the high beam indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The instrument cluster continually monitors the headlamp switch and the multi-function switch to determine the proper headlamp low beam and high beam control. The instrument cluster then sends the proper low beam and high beam lamp-on and lamp-off messages to the Front Control Module (FCM) over the Programmable Communications Interface (PCI)

data bus and turns the high beam indicator on or off accordingly. For further diagnosis of the high beam indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the headlamps, or the headlamp switch and multi-function switch inputs to the instrument cluster that control the high beam indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

LAMP OUT INDICATOR

DESCRIPTION

A lamp out indicator is standard equipment on all instrument clusters. The lamp out indicator consists of the words "LAMP OUT", which appear in the lower portion of the odometer/trip odometer Vacuum-Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the tachometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The words "LAMP OUT" appear in an amber color and at the same lighting level as the odometer/trip odometer information when they are illuminated by the instrument cluster electronic circuit board. The lamp out indicator is serviced as a unit with the VFD in the instrument cluster.

OPERATION

The lamp out indicator gives an indication to the vehicle operator when an exterior lamp has failed. This indicator is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Front Control Module (FCM) over the Programmable Communications Interface (PCI) data bus. The lamp out indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the lamp out indicator for the following reasons:

- **Lamp Out Indicator Lamp-On Message** - Each time the cluster receives a lamp out indicator lamp-on message from the FCM indicating that an inoperative headlamp (low or high beam), turn signal

LAMP OUT INDICATOR (Continued)

lamp, or brake lamp (excluding Center High Mounted Stop Lamp [CHMSL]) circuit has been detected, the lamp out indicator is illuminated. The indicator remains illuminated until the cluster receives a lamp out indicator lamp-off message from the FCM or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the lamp out indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

The FCM monitors each of the headlamp, turn signal lamp, and brake lamp (except CHMSL) circuits to determine the condition of these exterior lamps. The FCM then sends the proper lamp out indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the lamp out indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the exterior lighting system circuits, the FCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the lamp out indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

LOW FUEL INDICATOR

DESCRIPTION

A low fuel indicator is standard equipment on all instrument clusters. The low fuel indicator is located on the left side of the instrument cluster, to the left of the fuel gauge. The low fuel indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Fuel" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The low fuel indicator is serviced as a unit with the instrument cluster.

OPERATION

The low fuel indicator gives an indication to the vehicle operator when the level of fuel in the fuel tank becomes low. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic mes-

sages received by the cluster from the Powertrain Control Module (PCM) on vehicles equipped with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The low fuel indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the low fuel indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the low fuel indicator is illuminated for about two seconds as a bulb test.

- **Less Than Twenty Percent Tank Full Message** - Each time the cluster receives messages from the PCM or ECM indicating the percent tank full is about twenty percent or less for ten consecutive seconds and the vehicle speed is zero, or for sixty consecutive seconds and the vehicle speed is greater than zero, the fuel gauge needle is moved to the one-eighth graduation or below on the gauge scale, the low fuel indicator is illuminated and a single chime tone is sounded. The low fuel indicator remains illuminated until the cluster receives messages from the PCM or ECM indicating that the percent tank full is greater than about twenty percent for ten consecutive seconds and the vehicle speed is zero, or for sixty consecutive seconds and the vehicle speed is greater than zero, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the low fuel indicator is cycled off and then on again by the appropriate percent tank full messages from the PCM or ECM.

- **Less Than Empty Percent Tank Full Message** - Each time the cluster receives a message from the PCM or ECM indicating the percent tank full is less than empty, the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM or ECM is a short circuit.

- **More Than Full Percent Tank Full Message** - Each time the cluster receives a message from the PCM or ECM indicating the percent tank full is more than full, the low fuel indicator is illuminated immediately. This message would indicate that the fuel tank sender input to the PCM or ECM is an open circuit.

LOW FUEL INDICATOR (Continued)

• **Actuator Test** - Each time the cluster is put through the actuator test, the low fuel indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the fuel tank sending unit to determine the level of fuel in the fuel tank. On vehicles with a diesel engine, the ECM continually monitors the fuel tank sending unit to determine the level of fuel in the fuel tank. The PCM or ECM then sends the proper fuel level messages to the instrument cluster. For further diagnosis of the low fuel indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the fuel tank sending unit, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the low fuel indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

MALFUNCTION INDICATOR LAMP (MIL)

DESCRIPTION

A Malfunction Indicator Lamp (MIL) is standard equipment on all instrument clusters. The MIL is located on the left side of the instrument cluster, to the left of the voltage gauge. The MIL consists of a stencil-like cutout of the International Control and Display Symbol icon for "Engine" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The MIL is serviced as a unit with the instrument cluster.

OPERATION

The Malfunction Indicator Lamp (MIL) gives an indication to the vehicle operator when the Powertrain Control Module (PCM) on vehicles with a gasoline engine, or the Engine Control Module (ECM) on vehicles with a diesel engine has recorded a Diagnostic Trouble Code (DTC) for an On-Board Diagnostics II (OBDII) emissions-related circuit or component malfunction. The MIL is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by

the cluster from the PCM or ECM over the Programmable Communications Interface (PCI) data bus. The MIL Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the MIL for the following reasons:

• **Bulb Test** - Each time the ignition switch is turned to the On position the indicator is illuminated for about two seconds as a bulb test. The entire two second bulb test is a function of the PCM or ECM.

• **MIL Lamp-On Message** - Each time the cluster receives a MIL lamp-on message from the PCM or ECM, the indicator will be illuminated. The indicator can be flashed on and off, or illuminated solid, as dictated by the PCM or ECM message. For some DTC's, if a problem does not recur, the PCM or ECM will send a lamp-off message automatically. Other DTC's may require that a fault be repaired and the PCM or ECM be reset before a lamp-off message will be sent. For more information on the PCM, the ECM, and the DTC set and reset parameters, (Refer to 25 - EMISSIONS CONTROL - OPERATION).

• **Communication Error** - If the cluster receives no lamp-on message from the PCM or ECM for ten seconds, the MIL is illuminated by the instrument cluster to indicate a loss of bus communication. The indicator remains controlled and illuminated by the cluster until a valid lamp-on message is received from the PCM or ECM.

• **Actuator Test** - Each time the cluster is put through the actuator test, the MIL indicator will be turned on during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the fuel and emissions system circuits and sensors to decide whether the system is in good operating condition. On vehicles with a diesel engine, the ECM continually monitors the fuel and emissions system circuits and sensors to decide whether the system is in good operating condition. The PCM or ECM then sends the proper lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the MIL or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the MIL after the bulb test, it may indicate that a malfunction has occurred and that the fuel and emis-

MALFUNCTION INDICATOR LAMP (MIL) (Continued)

sions systems may require service. For proper diagnosis of the fuel and emissions systems, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the MIL, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

ODOMETER

DESCRIPTION

An odometer and trip odometer are standard equipment in all instrument clusters. The odometer, trip odometer, and engine hours information are displayed in a common electronic, blue-green Vacuum-Fluorescent Display (VFD). The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the tachometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents it from being clearly visible when it is not illuminated. However, the odometer, trip odometer, and engine hours information are not displayed simultaneously. The trip odometer reset switch on the instrument cluster circuit board toggles the display between odometer and trip odometer modes by depressing the odometer/trip odometer switch button that extends through the lower edge of the cluster lens, just left of the odometer VFD. When the trip odometer information is displayed, the word "TRIP" is also illuminated in the upper right corner of the VFD in a blue-green color and at the same lighting level as the trip odometer information. The engine hours information replaces the selected odometer or trip odometer information whenever the ignition switch is in the On position and the engine is not running.

The odometer, trip odometer, and engine hours information is stored in the instrument cluster memory. This information can be increased when the proper inputs are provided to the instrument cluster, but the information cannot be decreased. The odometer can display values up to 999,999 kilometers (999,999 miles). The odometer latches at these values, and will not roll over to zero. The trip odometer can display values up to 9,999.9 kilometers (9,999.9 miles) before it rolls over to zero. The odometer display does not have a decimal point and will not show values less than a full unit (kilometer or mile), while the trip odometer display does have a decimal point and will show tenths of a unit (kilometer or mile). The unit of measure (kilometers or miles) for the odometer and trip odometer display is not shown in the VFD. The unit of measure for the instrument cluster odometer/trip odometer is selected at the time that it is manufactured, and cannot be changed.

Engine hours are displayed in the format, "hr9999". The cluster will accumulate values up to 9,999 hours before the display rolls over to zero.

The odometer has a "Rental Car" mode, which will illuminate the odometer information in the VFD whenever the driver side front door is opened with the ignition switch in the Off or Accessory positions. During daylight hours (exterior lamps are Off) the VFD is illuminated at full brightness for clear visibility. At night (exterior lamps are On) the VFD lighting level is adjusted with the other cluster illumination lamps using the panel lamps dimmer thumbwheel on the headlamp switch. However, a "Parade" mode position of the panel lamps dimmer thumbwheel allows the VFD to be illuminated at full brightness if the exterior lamps are turned On during daylight hours.

The VFD, the trip odometer switch, and the trip odometer switch button are serviced as a unit with the instrument cluster.

OPERATION

The odometer and trip odometer give an indication to the vehicle operator of the distance the vehicle has traveled. The engine hours give an indication of the cumulative engine-on time. This indicator is controlled by the instrument cluster circuitry based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The odometer, trip odometer and engine hours information is displayed by the instrument cluster Vacuum Fluorescent Display (VFD). The VFD will display the odometer information whenever any door is opened with the ignition switch in the Off or Accessory positions, and will display the last previously selected odometer or trip odometer information when the ignition switch is turned to the On or Start positions. The instrument cluster circuitry controls the VFD and provides the following features:

- **Odometer/Trip Odometer Display Toggling** - Actuating the trip odometer reset switch button momentarily with the VFD illuminated will toggle the display between the odometer and trip odometer information. Each time the VFD is illuminated with the ignition switch in the On or Start positions, the display will automatically return to the last mode previously selected (odometer or trip odometer).

- **Engine Hours Display Toggling** - When the trip odometer reset switch button is pressed and held for longer than about six seconds with the ignition switch in the On position and the engine speed message from the PCM is zero, the trip odometer information will be momentarily displayed, then the engine hours information will be displayed. The VFD

ODOMETER (Continued)

must be displaying the odometer information when the trip odometer reset switch button is pressed in order to toggle to the engine hours display. The engine hours will remain displayed for about thirty seconds, until the engine speed message is greater than zero, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Trip Odometer Reset** - When the trip odometer reset switch button is pressed and held for longer than about two seconds with the ignition switch in the On or Start positions, the trip odometer will be reset to 0.0 kilometers (miles). The VFD must be displaying the trip odometer information in order for the trip odometer information to be reset.

- **Communication Error** - If the cluster fails to receive a distance message during normal operation, it will hold and display the last data received until the ignition switch is turned to the Off position. If the cluster does not receive a distance message within one second after the ignition switch is turned to the On position, it will display the last distance message stored in the cluster memory. If the cluster is unable to display distance information due to an error internal to the cluster, the VFD display will be dashes.

- **Actuator Test** - Each time the cluster is put through the actuator test, the odometer VFD will display all of its segments simultaneously during the VFD portion of the test to confirm the functionality of each of the VFD segments and the cluster control circuitry.

The PCM continually monitors the vehicle speed pulse information received from the vehicle speed sensor and engine speed pulse information received from the crankshaft position sensor, then sends the proper distance and engine speed messages to the instrument cluster. For further diagnosis of the odometer/trip odometer or the instrument cluster circuitry that controls these functions, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the vehicle speed sensor, the crankshaft position sensor, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the odometer/trip odometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

OIL PRESSURE GAUGE

DESCRIPTION

An oil pressure gauge is standard equipment on all instrument clusters. The oil pressure gauge is located in the upper right quadrant of the instrument cluster, above the coolant temperature gauge. The oil

pressure gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from "L" (or Low) to "H" (or High) for gasoline engines. On vehicles with a diesel engine the scale reads from "0" kPa to "760" kPa in markets where a metric instrument cluster is specified, or from "0" psi to "110" psi in all other markets. An International Control and Display Symbol icon for "Engine Oil" is located on the cluster overlay, directly below the left end of the gauge scale. The oil pressure gauge graphics are black against a white field except for two red graduations at the low end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear blue and the red graphics still appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The oil pressure gauge is serviced as a unit with the instrument cluster.

OPERATION

The oil pressure gauge gives an indication to the vehicle operator of the engine oil pressure. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The oil pressure gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Engine Oil Pressure Message** - The instrument cluster circuitry restricts the oil pressure gauge needle operation in order to provide readings that are consistent with customer expectations. Each time the cluster receives a message from the PCM or ECM indicating the engine oil pressure is above about 41 kPa (6 psi) the cluster holds the gauge needle at a point near the middle increment within the normal range on the gauge scale.

- **Engine Oil Pressure Low Message** - Each time the cluster receives a message from the PCM or

OIL PRESSURE GAUGE (Continued)

ECM indicating the engine oil pressure is below about 41 kPa (6 psi), the gauge needle is moved to the graduation at the far left end of the gauge scale, the check gauges indicator is illuminated, and a single chime tone is generated. The gauge needle remains at the left end of the gauge scale and the check gauges indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating that the engine oil pressure is above about 41 kPa (6 psi), or until the ignition switch is turned to the Off position, whichever occurs first. The cluster will only turn the check gauges indicator on in response to an engine oil pressure low message if the engine speed message is greater than zero.

- **Communication Error** - If the cluster fails to receive an engine oil pressure message, it will hold the gauge needle at the last indication about five seconds or until the ignition switch is turned to the Off position, whichever occurs first. After five seconds, the cluster will move the gauge needle to the left end of the gauge scale.

- **Actuator Test** - Each time the cluster is put through the actuator test, the oil pressure gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the engine oil pressure sensor to determine the engine oil pressure. On vehicles with a diesel engine, the ECM continually monitors the engine oil pressure sensor to determine the engine oil pressure. The PCM or ECM then sends the proper engine oil pressure messages to the instrument cluster. For further diagnosis of the oil pressure gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the check gauges indicator due to a low oil pressure gauge reading, it may indicate that the engine or the engine oiling system requires service. For proper diagnosis of the engine oil pressure sensor, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the oil pressure gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

OVERDRIVE OFF INDICATOR

DESCRIPTION

An overdrive off indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional overdrive automatic transmission, this indicator is electronically disabled.

The overdrive off indicator consists of the words "O/D OFF", which appear in the lower portion of the odometer/trip odometer indicator Vacuum Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the tachometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The words "O/D OFF" appear in an amber color and at the same lighting level as the odometer/trip odometer information when they are illuminated by the instrument cluster electronic circuit board. The overdrive off indicator is serviced as a unit with the VFD in the instrument cluster.

OPERATION

The overdrive off indicator gives an indication to the vehicle operator when the Off position of the overdrive off switch has been selected, disabling the electronically controlled overdrive feature of the automatic transmission. This indicator is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The overdrive off indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the overdrive off indicator for the following reasons:

- **Overdrive Off Lamp-On Message** - Each time the cluster receives an overdrive off lamp-on message from the PCM indicating that the Off position of the overdrive off switch has been selected, the overdrive off indicator will be illuminated. The indicator remains illuminated until the cluster receives an overdrive off lamp-off message from the PCM, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the overdrive off indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

The PCM continually monitors the overdrive off switch to determine the proper outputs to the automatic transmission. The PCM then sends the proper overdrive off lamp-on and lamp-off messages to the

OVERDRIVE OFF INDICATOR (Continued)

instrument cluster. For further diagnosis of the overdrive off indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the overdrive control system, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the overdrive off indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SEATBELT INDICATOR

DESCRIPTION

A seatbelt indicator is standard equipment on all instrument clusters. The seatbelt indicator is located on the upper edge of the instrument cluster, between the tachometer and the speedometer. The seatbelt indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Seat Belt" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The seatbelt indicator is serviced as a unit with the instrument cluster.

OPERATION

The seatbelt indicator gives an indication to the vehicle operator of the status of the driver side front seatbelt. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and a hard wired input from the seatbelt switch in the driver side front seatbelt buckle through the seat belt indicator driver circuit. The seatbelt indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the seatbelt indicator for the following reasons:

- **Seatbelt Reminder Function** - Each time the cluster receives a battery current input on the fused ignition switch output (run-start) circuit, the indica-

tor will be illuminated as a seatbelt reminder for about six seconds, or until the ignition switch is turned to the Off position, whichever occurs first. This reminder function will occur regardless of the status of the seatbelt switch input to the cluster.

- **Driver Side Front Seatbelt Not Buckled** - Following the seatbelt reminder function, each time the cluster detects an open circuit on the seat belt indicator driver circuit (seatbelt switch open = seatbelt unbuckled) with the ignition switch in the Start or On positions, the indicator will be illuminated. The seatbelt indicator remains illuminated until the seat belt indicator driver input to the cluster is closed to ground (seatbelt switch closed = seatbelt buckled), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Airbag Indicator Backup** - If the instrument cluster detects a fault in the airbag indicator circuit it will send a message indicating the fault to the Airbag Control Module (ACM), store a Diagnostic Trouble Code (DTC) in the cluster memory, then flash the seatbelt indicator on and off. The cluster will continue to flash the seatbelt indicator until the airbag indicator circuit fault is resolved, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the seatbelt indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The seatbelt switch is connected in series between ground and the seat belt indicator driver input to the instrument cluster. The seatbelt switch input to the instrument cluster circuitry may be diagnosed using conventional diagnostic tools and methods. For further diagnosis of the seatbelt indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING).

SECURITY INDICATOR

DESCRIPTION

A security indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional Vehicle Theft Security System (VTSS), this indicator is electronically disabled. The security indicator is located in the lower right quadrant of the instrument cluster, between the speedometer and the coolant temperature gauge. The security indicator consists of a small round cutout in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illumi-

SECURITY INDICATOR (Continued)

nated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the indicator to appear in red through the translucent outer layer of the overlay when it is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The security indicator is serviced as a unit with the instrument cluster.

OPERATION

The security indicator gives an indication to the vehicle operator when the Vehicle Theft Security System (VTSS) is arming or is armed. On models equipped with the Sentry Key Immobilizer System (SKIS), the security indicator also gives an indication to the vehicle operator of the status of the SKIS. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming, hard wired inputs to the cluster from the various security system components, electronic messages received by the cluster from the Remote Keyless Entry (RKE) receiver module over a dedicated serial bus, and electronic messages received by the cluster from the Sentry Key Immobilizer Module (SKIM) over the Programmable Communications Interface (PCI) data bus. The security indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow this indicator to operate whenever the instrument cluster receives a battery current input on the fused B(+) circuit. Therefore, the LED can be illuminated regardless of the ignition switch position. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the security indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position, the SKIM tells the cluster to illuminate the SKIS indicator for about two seconds as a bulb test.
- **VTSS Indication** - During the sixteen second VTSS arming function, the cluster will flash the security indicator on and off repeatedly at a steady, fast rate to indicate that the VTSS is in the process of arming. Following successful VTSS arming, the cluster flashes the security indicator on and off continuously at a slower rate to indicate that the VTSS is armed. The security indicator continues flashing at the slower rate until the VTSS is disarmed or triggered. If the VTSS has alarmed and rearmed, the cluster will flash the security indicator at a steady, slow rate for about thirty seconds after the VTSS is disarmed.
- **SKIM Lamp-On Message** - Each time the cluster receives a lamp-on message from the SKIM, the security indicator will be illuminated. The indicator

can be flashed on and off, or illuminated solid, as dictated by the SKIM message. The indicator remains illuminated solid or continues to flash until the cluster receives a lamp-off message from the SKIM, or until the ignition switch is turned to the Off position, whichever occurs first. For more information on the SKIS and the security indicator control parameters, (Refer to 8 - ELECTRICAL/VEHICLE THEFT SECURITY/SENTRY KEY IMMOBILIZER SYSTEM - OPERATION).

- **Communication Error** - If the cluster receives no SKIS lamp-on or lamp-off messages from the SKIM for twenty consecutive seconds, the SKIS indicator is illuminated by the instrument cluster. The indicator remains controlled and illuminated by the cluster until a valid SKIS lamp-on or lamp-off message is received from the SKIM.

- **Actuator Test** - Each time the instrument cluster is put through the actuator test, the security indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The instrument cluster circuitry controls the security indicator whenever the ignition switch is in the Off position and the VTSS is arming, armed, or alarming. Whenever the ignition switch is in the On or Start positions, the SKIM performs a self-test to decide whether the SKIS is in good operating condition and whether a valid key is present in the ignition lock cylinder. The SKIM then sends the proper lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the security indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster flashes the SKIS indicator upon ignition On, or turns on the SKIS indicator solid after the bulb test, it indicates that a SKIS malfunction has occurred or that the SKIS is inoperative. For proper diagnosis of the VTSS, the SKIS, the SKIM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the security indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SERVICE 4WD INDICATOR

DESCRIPTION

A service 4WD indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with the optional four-wheel drive system and electronically shifted transfer case, this indicator is electronically disabled. The service 4WD indicator consists of the words "SERVICE 4x4", which appears in the lower portion of the odometer/trip odometer

SERVICE 4WD INDICATOR (Continued)

Vacuum Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the tachometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The words "SERVICE 4x4" appear in an amber color and at the same lighting level as the odometer/trip odometer information when they are illuminated by the instrument cluster electronic circuit board. The service 4WD indicator is serviced as a unit with the VFD in the instrument cluster.

OPERATION

The service 4WD indicator gives an indication to the vehicle operator when the Transfer Case Control Module (TCCM) has recorded a Diagnostic Trouble Code (DTC) for an electronic transfer case circuit or component malfunction. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the TCCM over the Programmable Communications Interface (PCI) data bus. The service 4WD indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the service 4WD indicator for the following reasons:

- **Service 4WD Lamp-On Message** - Each time the cluster receives a service 4WD lamp-on message from the TCCM, the indicator will be illuminated. The indicator remains illuminated until the cluster receives a service 4WD lamp-off message from the TCCM, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Communication Error** - If the cluster receives no messages from the TCCM for five seconds, the service 4WD indicator is illuminated by the instrument cluster to indicate a loss of TCCM communication. The indicator remains controlled and illuminated by the cluster until a valid message is received from the TCCM.

- **Actuator Test** - Each time the cluster is put through the actuator test, the service 4WD indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

The TCCM continually monitors the electronic transfer case switch and circuits to determine the condition of the system. The TCCM then sends the proper lamp-on or lamp-off messages to the instrument cluster. For further diagnosis of the service 4WD indicator or the instrument cluster circuitry that controls the VFD, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the TCCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the service 4WD indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

SPEEDOMETER

DESCRIPTION

A speedometer is standard equipment on all instrument clusters. The speedometer is located next to the tachometer, just to the right of center in the instrument cluster. The speedometer consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 210 degree primary scale on the gauge dial face that reads left-to-right either from "0" to "120" mph, or from "0" to "200" km/h, depending upon the market for which the vehicle is manufactured. Each version also has a secondary inner scale on the gauge dial face that provides the equivalent opposite units from the primary scale. Text appearing on the cluster overlay just below the hub of the speedometer needle abbreviates the unit of measure for the primary scale (i.e.: MPH or km/h), followed by the unit of measure for the secondary scale. The speedometer graphics are black (primary scale) and blue (secondary scale) against a white field, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear dark blue and the blue graphics appear light blue. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The speedometer is serviced as a unit with the instrument cluster.

OPERATION

The speedometer gives an indication to the vehicle operator of the vehicle road speed. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The speedometer is an

SPEEDOMETER (Continued)

air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Vehicle Speed Message** - Each time the cluster receives a vehicle speed message from the PCM it will calculate the correct vehicle speed reading and position the gauge needle at that relative speed position on the gauge scale. The cluster will receive a new vehicle speed message and reposition the gauge pointer accordingly about every 88 milliseconds. The gauge needle will continue to be positioned at the actual vehicle speed position on the gauge scale until the ignition switch is turned to the Off position.

- **Communication Error** - If the cluster fails to receive a speedometer message, it will hold the gauge needle at the last indication for about three seconds, or until the ignition switch is turned to the Off position, whichever occurs first. After three seconds, the gauge needle will return to the left end of the gauge scale.

- **Actuator Test** - Each time the cluster is put through the actuator test, the speedometer needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

The PCM continually monitors the vehicle speed sensor to determine the vehicle road speed. The PCM then sends the proper vehicle speed messages to the instrument cluster. For further diagnosis of the speedometer or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the vehicle speed sensor, the PCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the speedometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

TACHOMETER

DESCRIPTION

A tachometer is standard equipment on all instrument clusters. The tachometer is located to the left of the speedometer, just to the left of center in the instrument cluster. The tachometer consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 210 degree scale on the gauge dial face that reads left-to-right

from "0" to "7" for gasoline engines. On vehicles with a diesel engine, the scale reads from "0" to "5". The text "RPM X 1000" imprinted on the cluster overlay directly below the hub of the tachometer needle identifies that each number on the tachometer scale is to be multiplied by 1000 rpm. The tachometer graphics are black against a white field, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear blue. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The tachometer is serviced as a unit with the instrument cluster.

OPERATION

The tachometer gives an indication to the vehicle operator of the engine speed. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The tachometer is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the low end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **Engine Speed Message** - Each time the cluster receives an engine speed message from the PCM or ECM it will calculate the correct engine speed reading and position the gauge needle at that relative speed position on the gauge scale. The cluster will receive a new engine speed message and reposition the gauge pointer accordingly about every 88 milliseconds. The gauge needle will continually be repositioned at the relative engine speed position on the gauge scale until the engine stops running, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Communication Error** - If the cluster fails to receive an engine speed message, it will hold the gauge needle at the last indication for about three seconds, or until the ignition switch is turned to the Off position, whichever occurs first. After three sec-

TACHOMETER (Continued)

onds, the gauge needle will return to the left end of the gauge scale.

- **Actuator Test** - Each time the cluster is put through the actuator test, the tachometer needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the crankshaft position sensor to determine the engine speed. On vehicles with a diesel engine, the ECM continually monitors the engine speed sensor to determine the engine speed. The PCM or ECM then sends the proper engine speed messages to the instrument cluster. For further diagnosis of the tachometer or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the crankshaft position sensor, the engine speed sensor, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the tachometer, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

TRANS TEMP INDICATOR

DESCRIPTION

A transmission over-temperature indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with an optional automatic transmission, this indicator is electronically disabled. The transmission over-temperature indicator is located on the left side of the instrument cluster, to the left of the fuel gauge. The transmission over-temperature indicator consists of a stencil-like cutout of the words "TRANS TEMP" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the "TRANS TEMP" text to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The transmission over-temperature indicator is serviced as a unit with the instrument cluster.

OPERATION

The transmission over-temperature indicator gives an indication to the vehicle operator when the transmission fluid temperature is excessive, which may lead to accelerated transmission component wear or

failure. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) over the Programmable Communications Interface (PCI) data bus. The transmission over-temperature indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the transmission over-temperature indicator for the following reasons:

- **Bulb Test** - Each time the ignition switch is turned to the On position the transmission over-temperature indicator is illuminated for about two seconds as a bulb test.

- **Trans Over-Temp Lamp-On Message** - Each time the cluster receives a trans over-temp lamp-on message from the PCM indicating that the transmission fluid temperature is 135° C (275° F) or higher, the indicator will be illuminated and a single chime tone is sounded. The indicator remains illuminated until the cluster receives a trans over-temp lamp-off message from the PCM, or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the transmission over-temperature indicator is cycled off and then on again by the appropriate trans over-temp messages from the PCM.

- **Actuator Test** - Each time the cluster is put through the actuator test, the transmission over-temperature indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The PCM continually monitors the transmission temperature sensor to determine the transmission operating condition. The PCM then sends the proper trans over-temp lamp-on or lamp-off messages to the instrument cluster. If the instrument cluster turns on the transmission over-temperature indicator due to a high transmission oil temperature condition, it may indicate that the transmission and/or the transmission cooling system are being overloaded or that they require service. For further diagnosis of the transmission over-temperature indicator or the instrument cluster circuitry that controls the LED, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the transmission temperature sensor, the PCM, the PCI

TRANS TEMP INDICATOR (Continued)

data bus, or the electronic message inputs to the instrument cluster that control the transmission over-temperature indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

TURN SIGNAL INDICATOR

DESCRIPTION

Two turn signal indicators, one right and one left, are standard equipment on all instrument clusters. The turn signal indicators are located near the upper edge of the instrument cluster, between the speedometer and the tachometer. Each turn signal indicator consists of a stencil-like cutout of the International Control and Display Symbol icon for "Turn Warning" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents these icons from being clearly visible when they are not illuminated. A green Light Emitting Diode (LED) behind each turn signal indicator cutout in the opaque layer of the overlay causes the icon to appear in green through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The turn signal indicators are serviced as a unit with the instrument cluster.

OPERATION

The turn signal indicators give an indication to the vehicle operator that the turn signal (left or right indicator flashing) or hazard warning (both left and right indicators flashing) have been selected and are operating. These indicators are controlled by transistors on the instrument cluster electronic circuit board based upon the cluster programming, a hard wired multiplex input received by the cluster from the turn signal and hazard warning switch circuitry of the multi-function switch on the turn/hazard switch mux circuit, and electronic messages received from the Front Control Module (FCM) over the Programmable Communications Interface (PCI) data bus. Each turn signal indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will allow this indicator to operate whenever the instrument cluster receives a battery current input on the fused B(+) circuit. Therefore, each LED can be illuminated regardless of the ignition switch position. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the turn signal indicators for the following reasons:

- **Turn Signal-On Input** - Each time the cluster detects a turn signal-on input from the turn signal switch circuitry of the multi-function switch on the turn/hazard switch mux circuit, the requested turn signal lamps and turn signal indicator will be flashed on and off, and an electromechanical relay soldered onto the cluster electronic circuit board will produce a clicking sound to emulate a conventional turn signal flasher. The turn signals and the turn signal indicators continue to flash on and off until the cluster receives a turn signal-off input from the multi-function switch, or until the ignition switch is turned to the Off position, whichever occurs first. The instrument cluster also sends an electronic message to the FCM over the PCI data bus, and the FCM flashes the appropriate exterior turn signal lamps. If the FCM detects an inoperative turn signal circuit, it increases the flash rate for the remaining operative turn signals and sends an electronic message to the instrument cluster. The instrument cluster then increases the flash rate of the turn signal indicator and the clicking rate of the electromechanical relay to provide an indication of the problem to the vehicle operator.

- **Hazard Warning-On Input** - Each time the cluster detects a hazard warning-on input from the hazard warning switch circuitry of the multi-function switch on the turn/hazard switch mux circuit, all of the turn signal lamps and both turn signal indicators will be flashed on and off, and an electromechanical relay soldered onto the cluster electronic circuit board will produce a clicking sound to emulate a conventional hazard warning flasher. The turn signals and the turn signal indicators continue to flash on and off until the cluster receives a hazard warning-off input from the multi-function switch. The instrument cluster also sends an electronic message to the FCM over the PCI data bus, and the FCM flashes all of the exterior turn signal lamps. If the FCM detects an inoperative turn signal circuit, it increases the flash rate for the remaining operative turn signals and sends an electronic message to the instrument cluster. The instrument cluster then increases the flash rate of both turn signal indicators and the clicking rate of the electromechanical relay to provide an indication of the problem to the vehicle operator.

- **Actuator Test** - Each time the cluster is put through the actuator test, the turn signal indicators will be turned on, then off again during the bulb check portion of the test to confirm the functionality of each LED and the cluster control circuitry.

The instrument cluster continually monitors the multi-function switch to determine the proper turn signal and hazard warning system control. The instrument cluster then sends the proper turn signal and hazard warning flasher-on and flasher-off mes-

TURN SIGNAL INDICATOR (Continued)

sages to the Front Control Module (FCM) over the Programmable Communications Interface (PCI) data bus and flashes the turn signal indicators on and off accordingly. For further diagnosis of the turn signal indicators or the instrument cluster circuitry that controls the indicators, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the turn signal and hazard warning system, the multi-function switch, the FCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the turn signal indicators, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

UPSHIFT INDICATOR

DESCRIPTION

An upshift indicator is standard equipment on all instrument clusters. However, on vehicles not equipped with a manual transmission, this indicator is electronically disabled. The upshift indicator consists of an upward pointed arrow icon, which appears on the right side of the electronic gear selector indicator Vacuum Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the speedometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The icon appears in a blue-green color and at the same lighting level as the odometer/trip odometer information when it is illuminated by the instrument cluster electronic circuit board. The upshift indicator is serviced as a unit with the instrument cluster.

OPERATION

The upshift indicator gives an indication to the vehicle operator when the manual transmission should be shifted to the next highest gear in order to achieve the best fuel economy. This indicator is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles with a gasoline engine, or from the Engine Control Module (ECM) on vehicles with a diesel engine over the Programmable Communications Interface (PCI) data bus. The upshift indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in

any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the upshift indicator for the following reasons:

- **Upshift Lamp-On Message** - Each time the cluster receives an upshift lamp-on message from the PCM or ECM indicating the engine speed and load conditions are right for a transmission upshift to occur, the upshift indicator is illuminated. The indicator remains illuminated until the cluster receives an upshift lamp-off message from the PCM or ECM, or until the ignition switch is turned to the Off position, whichever occurs first. The PCM or ECM will normally send an upshift lamp-off message three to five seconds after a lamp-on message, if an upshift is not performed. The indicator will then remain off until the vehicle stops accelerating and is brought back into the range of indicator operation, or until the transmission is shifted into another gear.

- **Actuator Test** - Each time the cluster is put through the actuator test, the upshift indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the engine speed and load conditions to determine the proper fuel and ignition requirements. On vehicles with a diesel engine, the ECM continually monitors the engine speed and load conditions to determine the proper fuel requirements. The PCM or ECM then sends the proper upshift indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the upshift indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the upshift indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

VOLTAGE GAUGE

DESCRIPTION

A voltage gauge is standard equipment on all instrument clusters. The voltage gauge is located in the upper left quadrant of the instrument cluster, above the fuel gauge. The voltage gauge consists of a movable gauge needle or pointer controlled by the instrument cluster circuitry and a fixed 90 degree scale on the cluster overlay that reads left-to-right from "L" (or Low) to "H" (or High) for gasoline engines. On vehicles with a diesel engine, the scale

VOLTAGE GAUGE (Continued)

reads from “8” to “18” volts. An International Control and Display Symbol icon for “Battery Charging Condition” is located on the cluster overlay, directly below the right end of the gauge scale. The voltage gauge graphics are black against a white field except for a single red graduation at each end of the gauge scale, making them clearly visible within the instrument cluster in daylight. When illuminated from behind by the panel lamps dimmer controlled cluster illumination lighting with the exterior lamps turned On, the black graphics appear blue and the red graphics still appear red. The orange gauge needle is internally illuminated. Gauge illumination is provided by replaceable incandescent bulb and bulb holder units located on the instrument cluster electronic circuit board. The voltage gauge is serviced as a unit with the instrument cluster.

OPERATION

The voltage gauge gives an indication to the vehicle operator of the electrical system voltage. This gauge is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Powertrain Control Module (PCM) on vehicles equipped with a gasoline engine, or from the Engine Control Module (ECM) on vehicles equipped with a diesel engine over the Programmable Communications Interface (PCI) data bus. The voltage gauge is an air core magnetic unit that receives battery current on the instrument cluster electronic circuit board through the fused ignition switch output (run-start) circuit whenever the ignition switch is in the On or Start positions. The cluster is programmed to move the gauge needle back to the left end of the scale after the ignition switch is turned to the Off position. The instrument cluster circuitry controls the gauge needle position and provides the following features:

- **System Voltage Message** - Each time the cluster receives a system voltage message from the PCM or ECM indicating the system voltage is between about 9.5 volts and about 15 volts, the gauge needle is moved to the relative voltage position on the gauge scale.

- **System Voltage Low (Charge Fail) Message** - Each time the cluster receives three consecutive messages from the PCM or ECM indicating the electrical system voltage is less than about 9 volts (charge fail condition), the gauge needle is moved to the graduation on the far left end of the gauge scale and the check gauges indicator is illuminated. The gauge needle remains at the far left end of the gauge scale and the check gauges indicator remains illuminated until the cluster receives a single message from the PCM or ECM indicating the electrical sys-

tem voltage is greater than about 9.5 volts (but less than about 15.5 volts), or until the ignition switch is turned to the Off position, whichever occurs first. On vehicles equipped with the optional diesel engine, the ECM is programmed to restrict the voltage gauge needle to a position above the graduation on the far left end of the gauge scale and suppress the check engine indicator operation until after the engine intake manifold air heater has completed a pre-heat or post-heat cycle.

- **System Voltage High Message** - Each time the cluster receives three consecutive messages from the PCM or ECM indicating the electrical system voltage is greater than about 15.5 volts, the gauge needle is moved to the graduation on the far right end of the gauge scale and the check gauges indicator is illuminated. The gauge needle remains at the right end of the gauge scale and the check gauges indicator remains illuminated until the cluster receives a message from the PCM or ECM indicating the electrical system voltage is less than about 15.0 volts (but greater than about 9.5 volts), or until the ignition switch is turned to the Off position, whichever occurs first.

- **Communication Error** - If the cluster fails to receive a system voltage message, it will hold the gauge needle at the last indication for about five seconds or until the ignition switch is turned to the Off position, whichever occurs first. After five seconds, the cluster will move the gauge needle to the far left end of the gauge scale.

- **Actuator Test** - Each time the cluster is put through the actuator test, the voltage gauge needle will be swept to several calibration points on the gauge scale in a prescribed sequence in order to confirm the functionality of the gauge and the cluster control circuitry.

On vehicles with a gasoline engine, the PCM continually monitors the system voltage to control the generator output. On vehicles with a diesel engine, the ECM continually monitors the system voltage to control the generator output. The PCM or ECM then sends the proper system voltage messages to the instrument cluster. For further diagnosis of the voltage gauge or the instrument cluster circuitry that controls the gauge, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). If the instrument cluster turns on the check gauges indicator due to a charge fail or voltage high condition, it may indicate that the charging system requires service. For proper diagnosis of the charging system, the PCM, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the voltage gauge, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

WAIT-TO-START INDICATOR

DESCRIPTION

A wait-to-start indicator is only found in the instrument clusters for vehicles equipped with an optional diesel engine. The wait-to-start indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. The wait-to-start indicator consists of stencil-like cutout of the International Control and Display Symbol icon for "Diesel Preheat" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. An amber Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in amber through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The wait-to-start indicator is serviced as a unit with the instrument cluster.

OPERATION

The wait-to-start indicator gives an indication to the vehicle operator when the air temperature within the diesel engine intake manifold is too cool for efficient and reliable engine starting, and that the intake air heater grids are energized in their pre-heat operating mode. This indicator is controlled by a transistor on the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Engine Control Module (ECM) over the Programmable Communications Interface (PCI) data bus. The wait-to-start indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the wait-to-start indicator for the following reasons:

- **Wait-To-Start Lamp-On Message** - Each time the cluster receives a wait-to-start lamp-on message from the ECM indicating that the air temperature within the intake manifold is too cool for efficient and reliable engine starting, the wait-to-start indicator will be illuminated. The indicator remains illuminated until the cluster receives a wait-to-start lamp-off message, until the ECM detects that the engine is running or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the wait-to-start indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The ECM continually monitors the engine intake air temperature sensor to determine when the intake air heater grids should be energized in their pre-heat operating mode. The ECM then sends the proper wait-to-start lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the wait-to-start indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the engine intake air temperature sensor, the intake air heater grid control circuits, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the wait-to-start indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

WASHER FLUID INDICATOR

DESCRIPTION

A washer fluid indicator is standard equipment on all instrument clusters. The washer fluid indicator consists of the words "LOW WASH", which appear in the lower portion of the odometer/trip odometer Vacuum-Fluorescent Display (VFD) unit. The VFD is soldered onto the cluster electronic circuit board and is visible through a window with a smoked clear lens located on the lower edge of the tachometer gauge dial face of the cluster overlay. The dark lens over the VFD prevents the indicator from being clearly visible when it is not illuminated. The "LOW WASH" text appears in an amber color and at the same lighting level as the odometer/trip odometer information when it is illuminated by the instrument cluster electronic circuit board. The washer fluid indicator is serviced as a unit with the VFD in the instrument cluster.

OPERATION

The washer fluid indicator gives an indication to the vehicle operator that the fluid level in the washer reservoir is low. This indicator is controlled by the instrument cluster circuit board based upon cluster programming and electronic messages received by the cluster from the Front Control Module (FCM) over the Programmable Communications Interface (PCI) data bus. The washer fluid indicator is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a bat-

WASHER FLUID INDICATOR (Continued)

tery current input on the fused ignition switch output (run-start) circuit. Therefore, the indicator will always be off when the ignition switch is in any position except On or Start. The indicator only illuminates when it is switched to ground by the instrument cluster circuitry. The instrument cluster will turn on the washer fluid indicator for the following reasons:

- **Washer Fluid Indicator Lamp-On Message -**

Each time the cluster receives a washer fluid indicator lamp-on message from the FCM indicating that a low washer condition has been detected for sixty consecutive seconds, the washer fluid indicator is illuminated and a single chime tone is sounded. The indicator remains illuminated until the cluster receives a washer fluid indicator lamp-off message for sixty consecutive seconds from the FCM or until the ignition switch is turned to the Off position, whichever occurs first. The chime tone feature will only repeat during the same ignition cycle if the washer fluid indicator is cycled off and then on again by the appropriate washer fluid lamp messages from the FCM.

- **Actuator Test -** Each time the cluster is put through the actuator test, the washer fluid indicator will be turned on, then off again during the VFD portion of the test to confirm the functionality of the VFD and the cluster control circuitry.

The FCM continually monitors the washer fluid level switch in the washer reservoir to determine the level of the washer fluid. The FCM then sends the proper washer fluid indicator lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the washer fluid indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the washer fluid level switch, the FCM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the washer fluid indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.

WATER-IN-FUEL INDICATOR

DESCRIPTION

A water-in-fuel indicator is only found in the instrument clusters for vehicles equipped with an optional diesel engine. The water-in-fuel indicator is located near the lower edge of the instrument cluster, between the tachometer and the speedometer. The water-in-fuel indicator consists of stencil-like cutout of the International Control and Display Symbol icon for "Water In Fuel" in the opaque layer of the instrument cluster overlay. The dark outer layer of the overlay prevents the indicator from being clearly visible when it is not illuminated. A red Light Emitting Diode (LED) behind the cutout in the opaque layer of the overlay causes the icon to appear in red through the translucent outer layer of the overlay when the indicator is illuminated from behind by the LED, which is soldered onto the instrument cluster electronic circuit board. The water-in-fuel indicator is serviced as a unit with the instrument cluster.

OPERATION

The water-in-fuel indicator gives an indication to the vehicle operator when there is excessive water in the fuel system. This indicator is controlled by a transistor on the instrument cluster circuit board based upon the cluster programming and electronic messages received by the cluster from the Engine Control Module (ECM) over the Programmable Communications Interface (PCI) data bus. The water-in-fuel indicator Light Emitting Diode (LED) is completely controlled by the instrument cluster logic circuit, and that logic will only allow this indicator to operate when the instrument cluster receives a battery current input on the fused ignition switch output (run-start) circuit. Therefore, the LED will always be off when the ignition switch is in any position except On or Start. The LED only illuminates when it is provided a path to ground by the instrument cluster transistor. The instrument cluster will turn on the water-in-fuel indicator for the following reasons:

WATER-IN-FUEL INDICATOR (Continued)

- **Bulb Test** - Each time the ignition switch is turned to the On position the water-in-fuel indicator is illuminated for about two seconds as a bulb test.

- **Water-In-Fuel Lamp-On Message** - Each time the cluster receives a water-in-fuel lamp-on message from the ECM indicating that there is excessive water in the diesel fuel system, the water-in-fuel indicator will be illuminated. The indicator remains illuminated until the cluster receives a water-in-fuel lamp-off message, or until the ignition switch is turned to the Off position, whichever occurs first.

- **Actuator Test** - Each time the cluster is put through the actuator test, the water-in-fuel indicator will be turned on, then off again during the bulb check portion of the test to confirm the functionality of the LED and the cluster control circuitry.

The ECM continually monitors the water-in-fuel sensor to determine whether there is excessive water in the diesel fuel system. The ECM then sends the proper water-in-fuel lamp-on and lamp-off messages to the instrument cluster. For further diagnosis of the water-in-fuel indicator or the instrument cluster circuitry that controls the indicator, (Refer to 8 - ELECTRICAL/INSTRUMENT CLUSTER - DIAGNOSIS AND TESTING). For proper diagnosis of the water-in-fuel sensor, the ECM, the PCI data bus, or the electronic message inputs to the instrument cluster that control the water-in-fuel indicator, a DRBIII® scan tool is required. Refer to the appropriate diagnostic information.