MAZDASPEED 6
DRIVING EVENT

mazda®

Technical Training

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MAZDASPEED 6 DRIVING EVENT

MAZDASPEED PERFORMANCE

CONTENTS

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Mazdaspeed6 Vehicle Walk Around

Exterior

1. Hood scoop for intercooler concealed inside hood
2. Grill
3. Front bumper with fog lights
4. Dark finish headlight housings
5. HID headlights (3-position leveling)
6. Side sills
7. Rear lip spoiler
8. Rear bumper and exhaust diffusers
9. Dark finish tail light housings
10. Silver painted calipers larger rotors front and rear
11. 18” X 7” alloy wheels with 215/45/18 summer radials

Interior

1. Stainless steel scuff plates
2. Alloy pedals
3. Front sport seats with longer seat bottom and enlarged side bolsters
4. Unique meter treatment
5. Unique center console finish
6. Rear seat headrests and rear seat does not fold due to structural cross bracing
7. Auto A/C
8. Power windows with one-touch up & down for all windows and anti-pinch
9. Keyless Entry (operates power windows)
10. Available Advanced Keyless Entry & Starting (operates power windows & trunk)
11. Immobilizer (iPATS)
12. BOSE Modular Audio (2-tweeters, 4-speakers and a trunk mounted sub-woofer
13. Available DVD NAVIgation System (no voice command), removable remote, DVD unit under passenger front seat
14. Illuminated steering wheel audio and cruise control buttons
15. Speed sensing windshield wipers

Under Hood

1. 2.3L (L3T) Direct Injected Turbo, VVT: 274 hp 280 ftlbsf torque
2. Turbo control similar to Mazdaspeed Miata
3. 1885 PSI DISI- Direct Injection Spark Ignition
4. 15.6 lbs boost 9.5:1 compression
5. DSC: ABS, EBD, BAC, TCS
6. 6-speed Manual transmission
7. All Wheel Drive
8. Water cooled transfer unit
9. Electronic coupling control engages AWD at the rear differential
10. Tochigi-Fuji LSD similar to RX-8

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Objectives

After completing this section, you will be able to:

- Explain DISI (Direct Injection Spark Ignition
- Explain turbocharger controls and operation

L3T: 2.3L DISI, VVT, Turbo

The engine block is the same Mazda L3 engine family used since 2001:

2001➔ B2300
2003➔ MAZDA6
2004➔ MAZDA3 (2.0L & 2.3L)
2005➔ Tribute
2006➔ MX-5 (2.0L)
2006➔ MAZDASPEED6

Increased power

274 hp*
280 ft-lb Torque*
*approximate with 93 Octane fuel

- 9.5:1 compression ratio (non-turbo engines are 9.7:1)
- DISI Direct Injection Spark Ignition
- 15.6 psi turbocharger boost
- VVT Variable Valve Timing

Engine Modifications To Handle The Increased Power

- New precision engine block and cylinder head casting process
- Forged steel crankshaft and connecting rods
- 4-layer metal head gasket
- Aluminum alloy dished pistons for heat dissipation and lower compression
- Large diameter full floating wrist pins
- Roller timing chain
- Oil jets added to lubricate and cool pistons
- Optimized piston skirts and connecting rods due to addition of oil jets
- Increased lubricant volume and pressure
- Water-cooled engine oil cooler
- Intake manifold and valve cover changed to aluminum for better heat and pressure characteristics

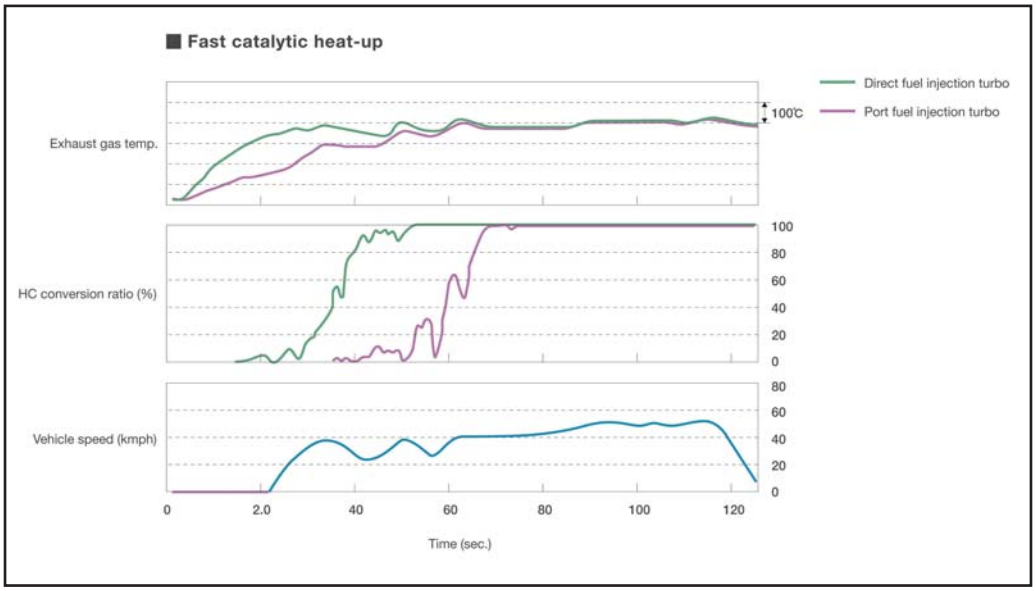
Direct Injection

Diesels were the first engines to use direct injection, but they use compression ignition rather than spark ignition. Direct injection works just like PFI Port Fuel Injection. The main differences are:

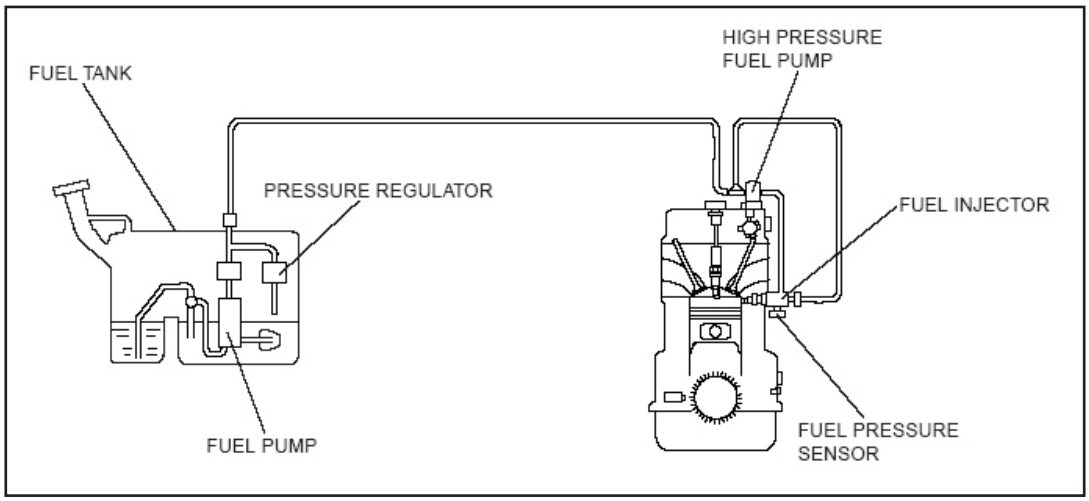
1. Fuel injectors are mounted inside the combustion chamber like spark plugs
2. Fuel is injected directly into the cylinders
3. Fuel pressure is much higher: 410 to 1885 psi
4. Fuel atomizes completely into a stratified charge

DISI

- 2 fuel pumps
  - ▶ In-tank electric pump 60-71 psi
  - ▶ Camshaft driven mechanical pump 410-1885 psi
- Direct injection allows complete atomization and the fuel vapor provides a cooling effect, improving the loading efficiency of the fuel mixture
- Allows a high compression ratio of 9.5:1, while resisting knock even with turbocharging
- Ignition timing is delayed without misfire, decreasing exhaust temperatures below NO_X production temperatures
- Catalyst lights off quicker: within 40-seconds of starting, the HC conversion of the catalyst is nearly 100%

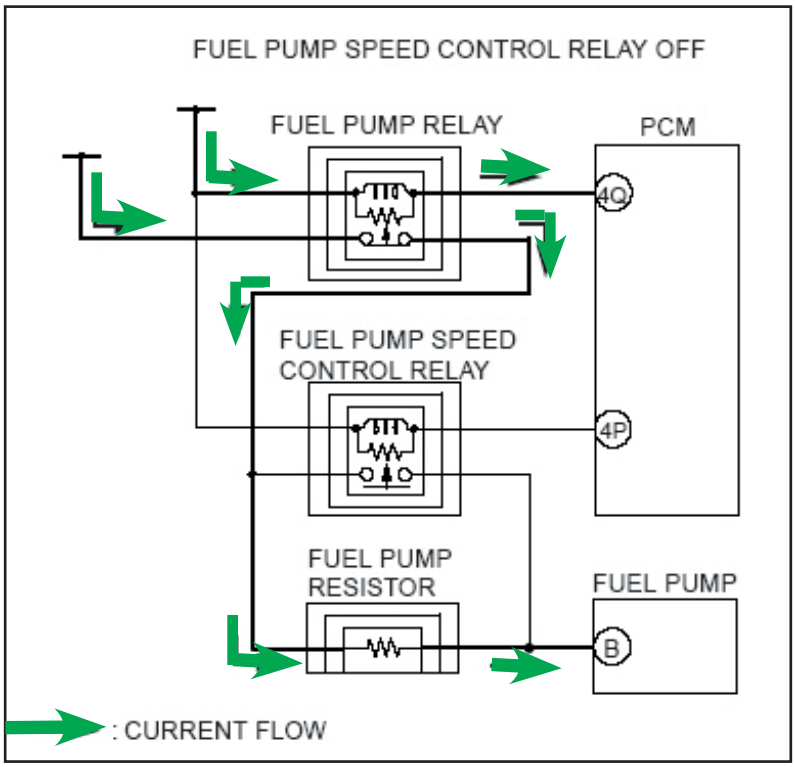


DISI Fuel System

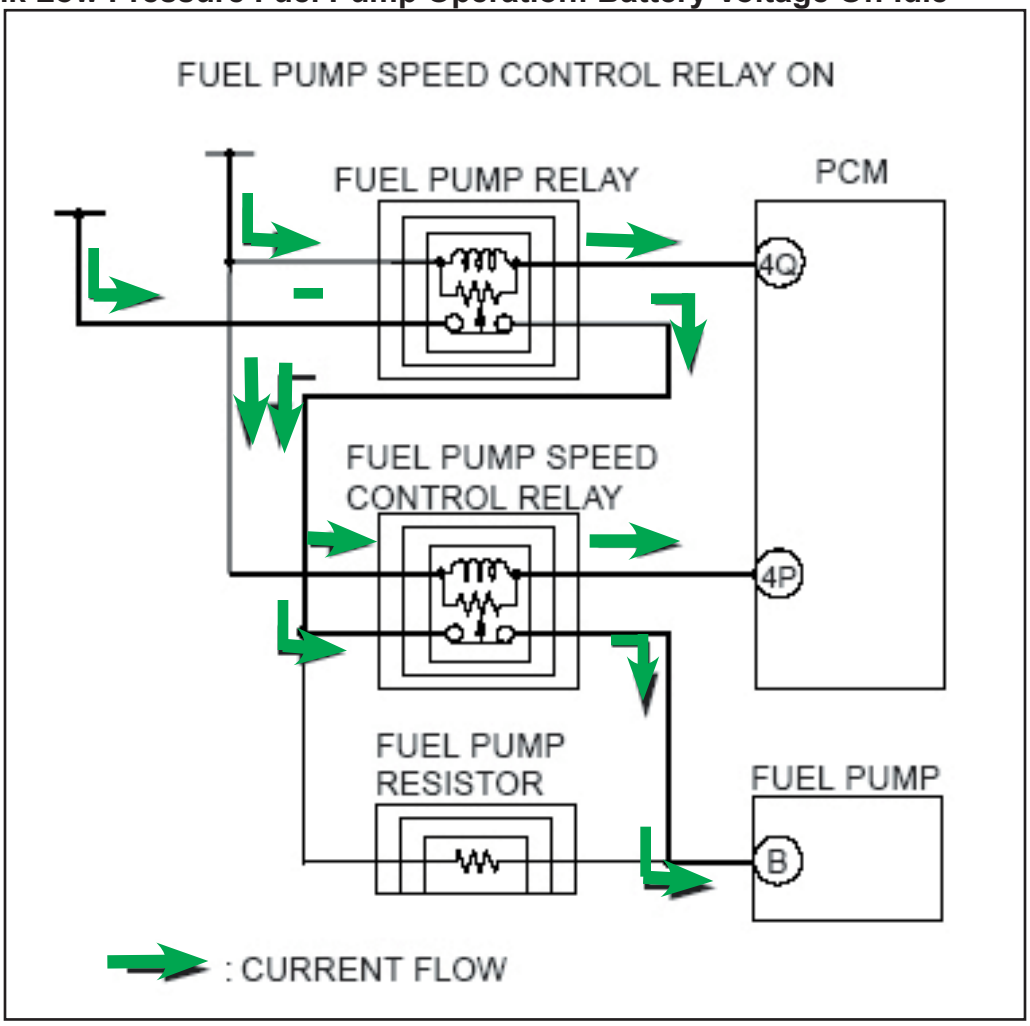


Fuel pressure from the in-tank pump is controlled at two voltages; low voltage for idle when less fuel volume is required and high voltage for high volume required during higher engine speeds. Voltage and volume change but pressure is constant.

In-Tank Low Pressure Fuel Pump Operation: Low voltage Idle operation

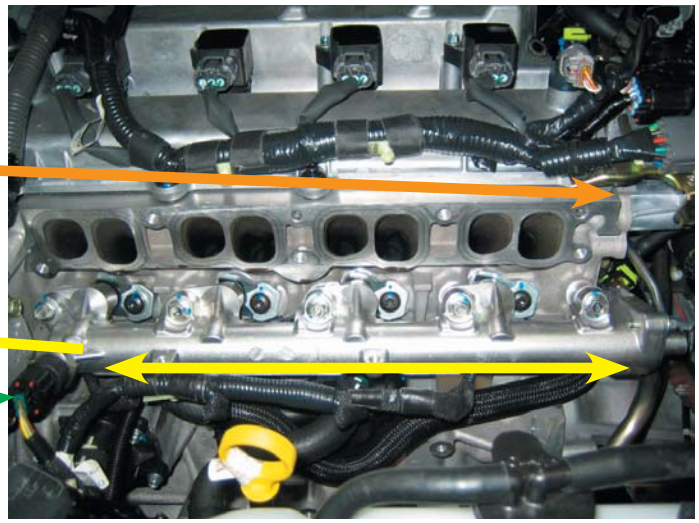


In-Tank Low Pressure Fuel Pump Operation: Battery Voltage Off Idle



Fuel pressure is inspected in the traditional manner in the engine compartment before the high pressure pump and should be approximately 65 psi. You can also use WDS to monitor the high pressure fuel rail pressure sensor before the engine is cranked. Key on engine off, the in-tank fuel pump pressure is displayed. The fuel pump resistor is located in front of the drivers side strut tower.

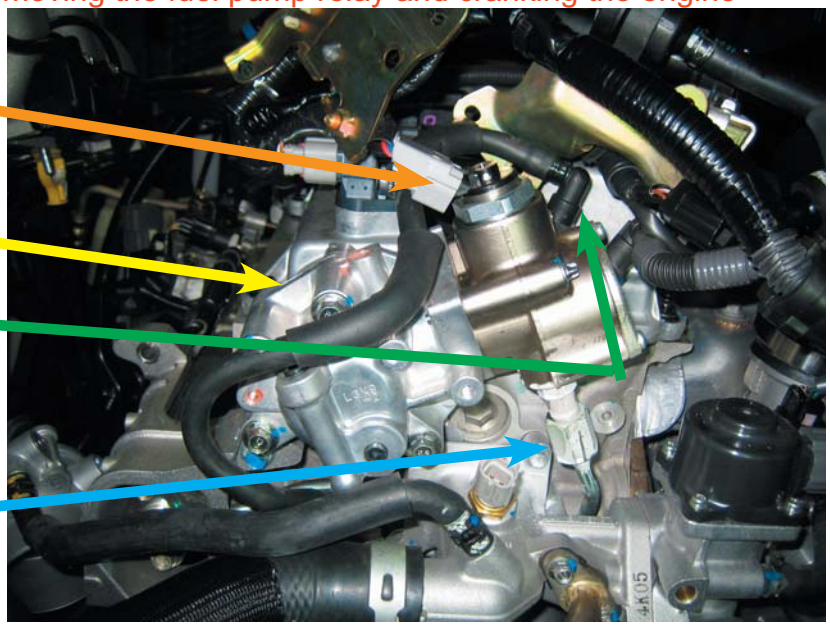
High Pressure Fuel Rail



High Pressure Fuel Pump

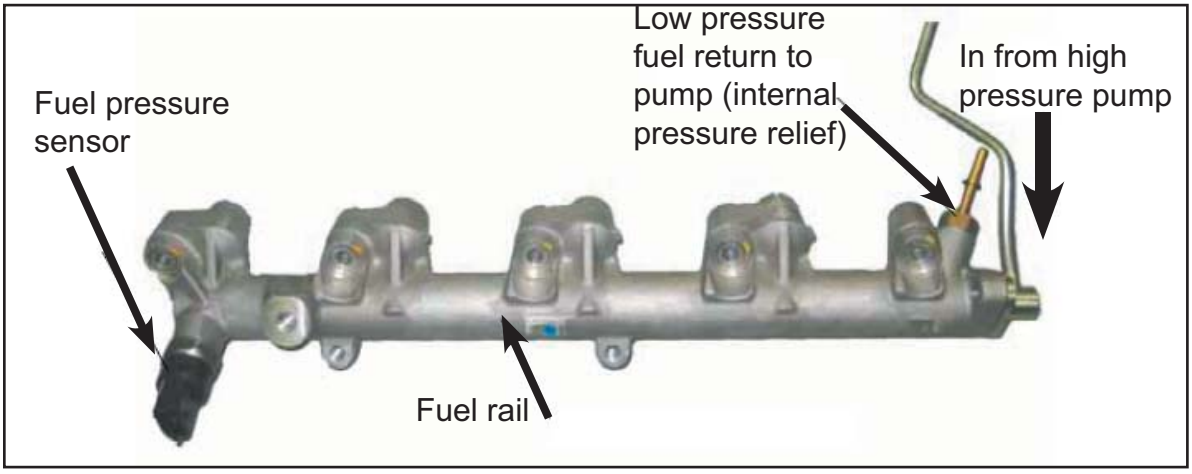
The PCM maintains pressure by monitoring the fuel rail pressure sensor

- Pressure is modified by opening the spill control solenoid
- Fuel pressure on the high pressure rail can only be inspected using WDS or equivalent to monitor the fuel rail pressure sensor
- The PCM energizes the spill control solenoid to control fuel pressure
- High pressure fuel is dangerous. Fuel pressure must be released prior to service by removing the fuel pump relay and cranking the engine



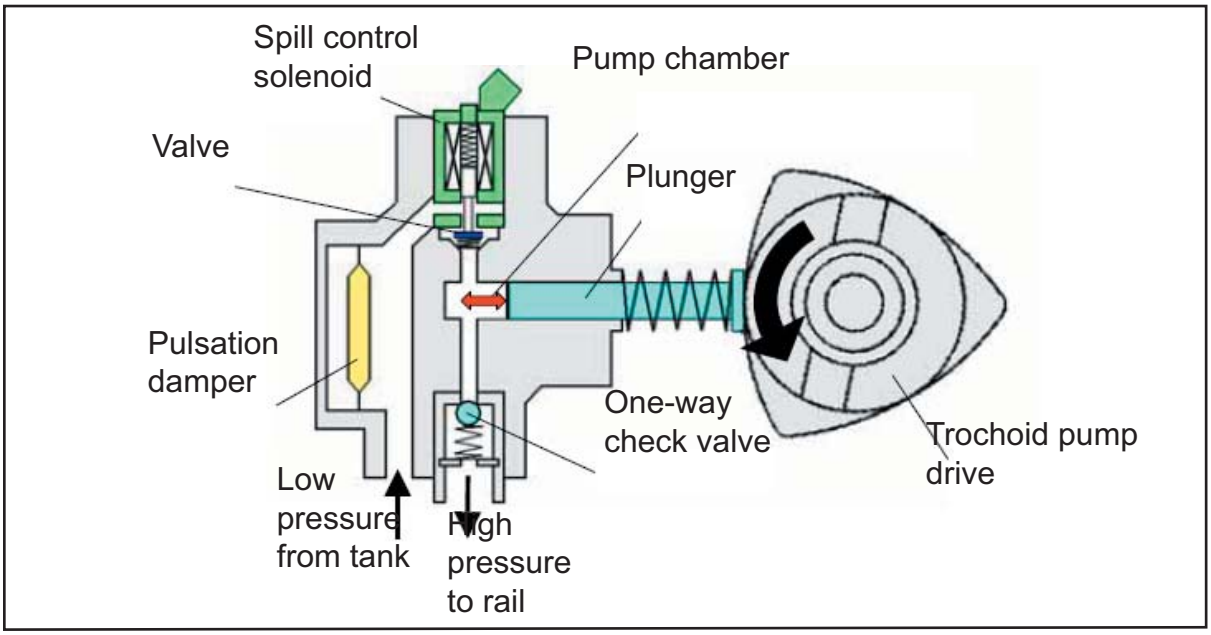
High Pressure Fuel Rail

The fuel rail supplies fuel to the injectors. The fuel rail pressure sensor supplies pressure information to the PCM. A pressure relief valve inside the low pressure return line allows pressure over 1885 psi to return to the low pressure side of the high pressure fuel pump.



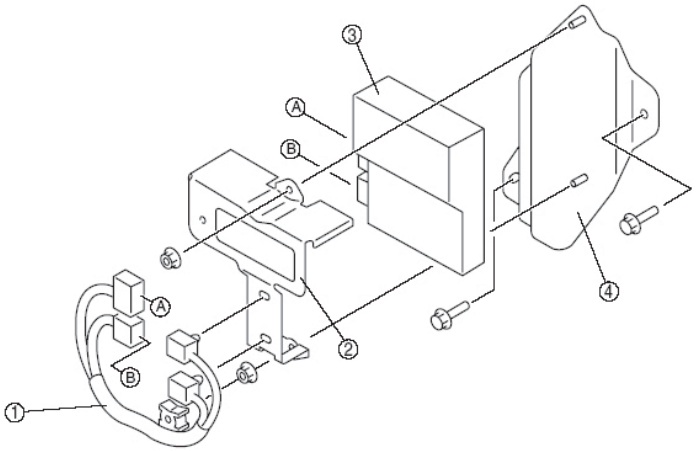
High Pressure Pump Internal Construction

A trochoid drive on the camshaft at the rear of the cylinder head drives the high pressure pump. When the PCM energizes the spill control solenoid fuel enters the pump chamber. When the spill solenoid is commanded off, the high pressure chamber is isolated and can build high pressure. The one way check valve assures high pressure can only go one direction, into the rail.



Injector Driver Module

The PCM fires the injectors with the injector driver module. Because the fuel system is running at up to 1885 PSI, it requires more energy to open the fuel injectors. The injector driver module turns the injectors on with +100 volts. The injector is then held open with +12 volts. The injector driver module then closes the injectors with -100 volts. The injector driver module is located at the rear of the drive strut tower.

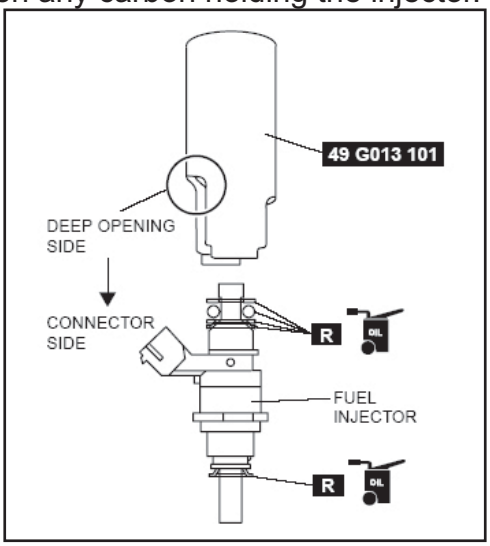


D6U140ZWC022

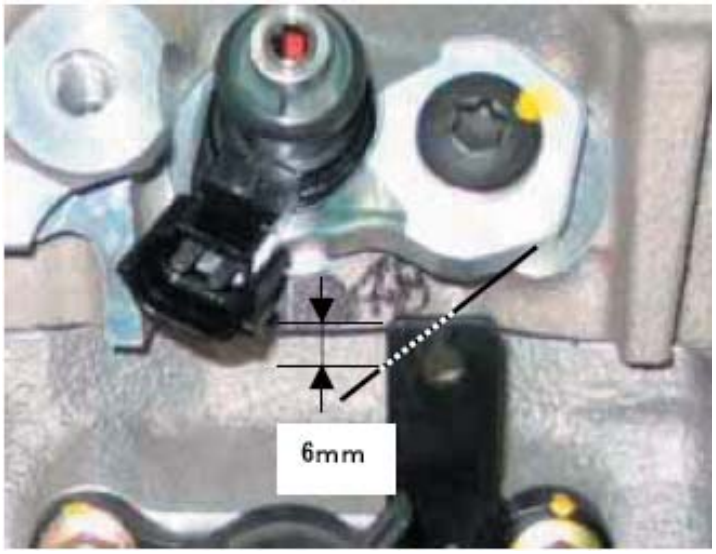
1	Wiring harness
2	Connector bracket
3	Injector driver module
4	Injector driver module bracket

High Pressure Fuel Injectors

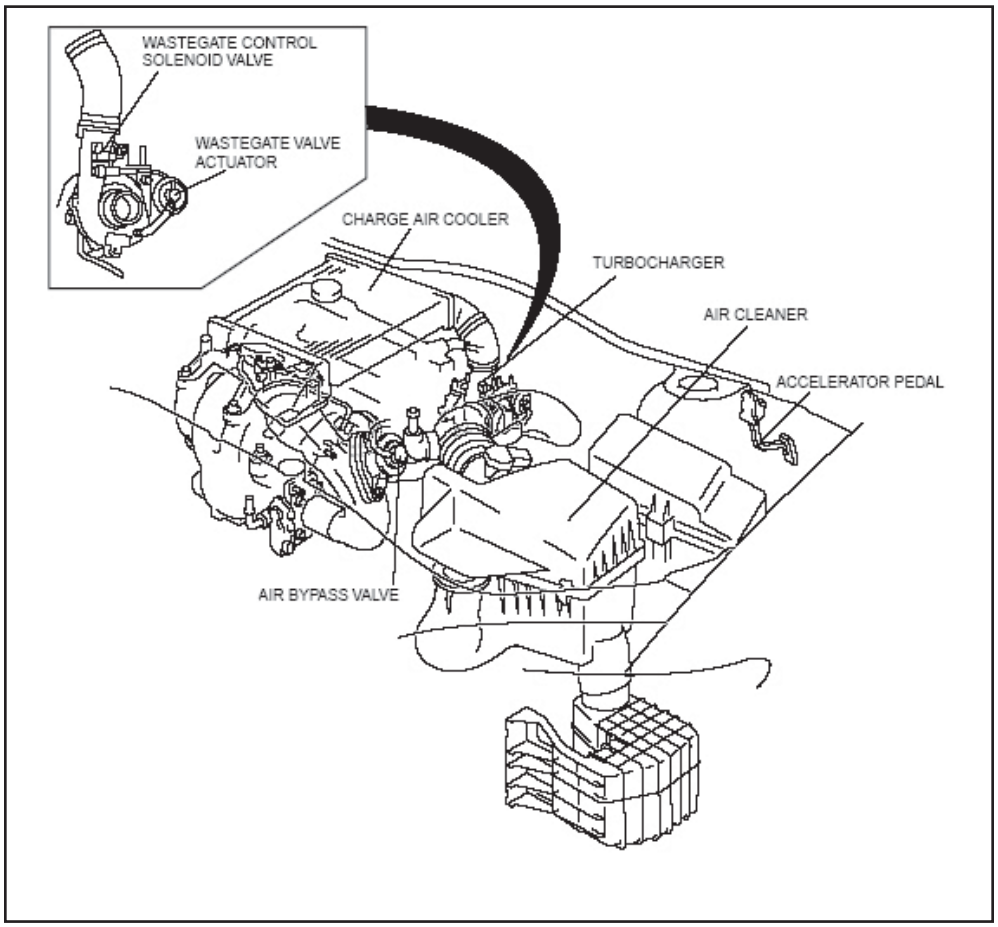
- Removal requires a special tool similar to O_2 sensor socket, fuel pressure must be released and intake manifold must be removed. The tool is rocked left to right to loosen any carbon holding the injector.



The #3 injector requires cutting the corner off of the PCV catch tank to allow more clearance.



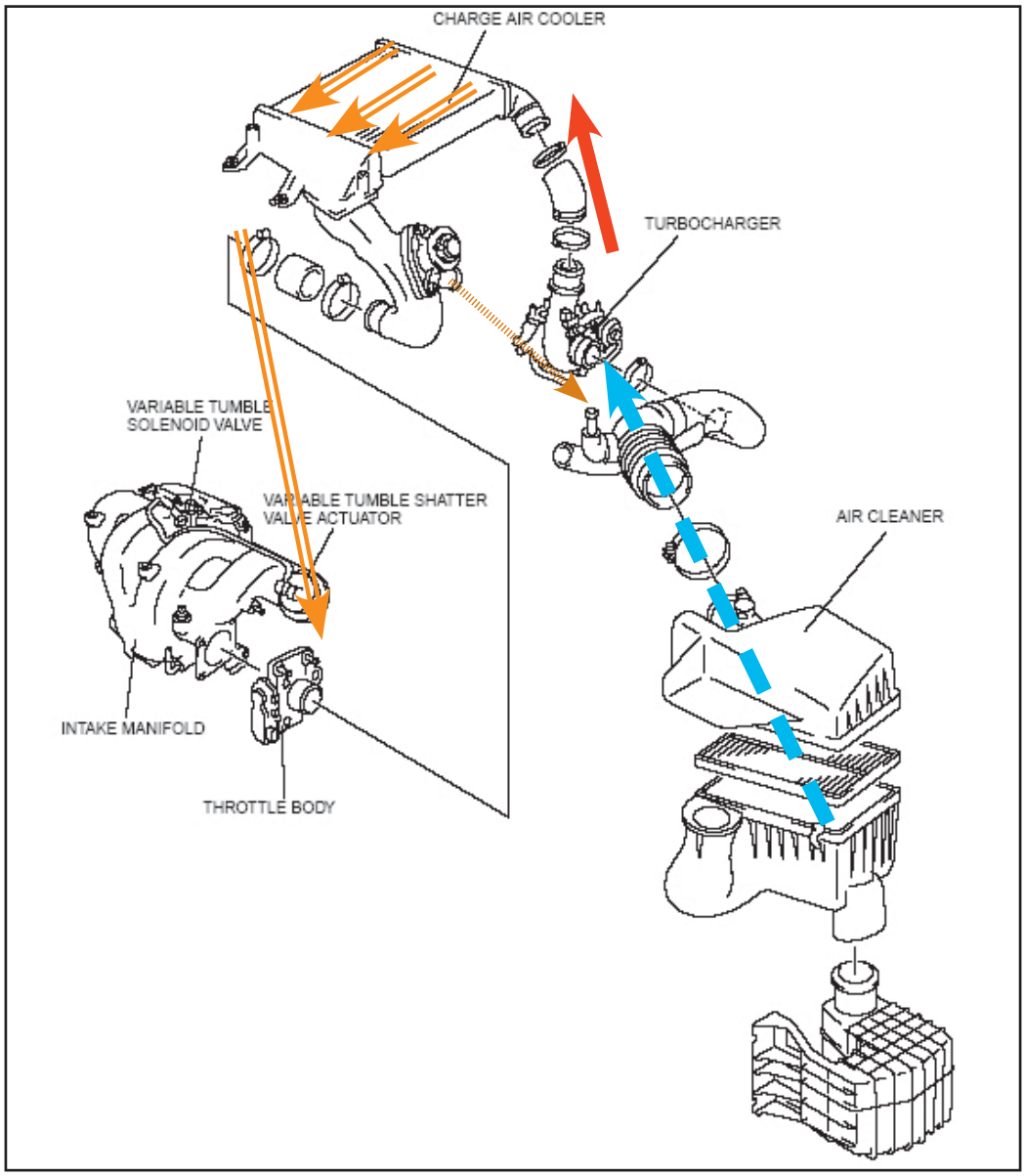
Turbocharger



The main components of the turbocharging system are:

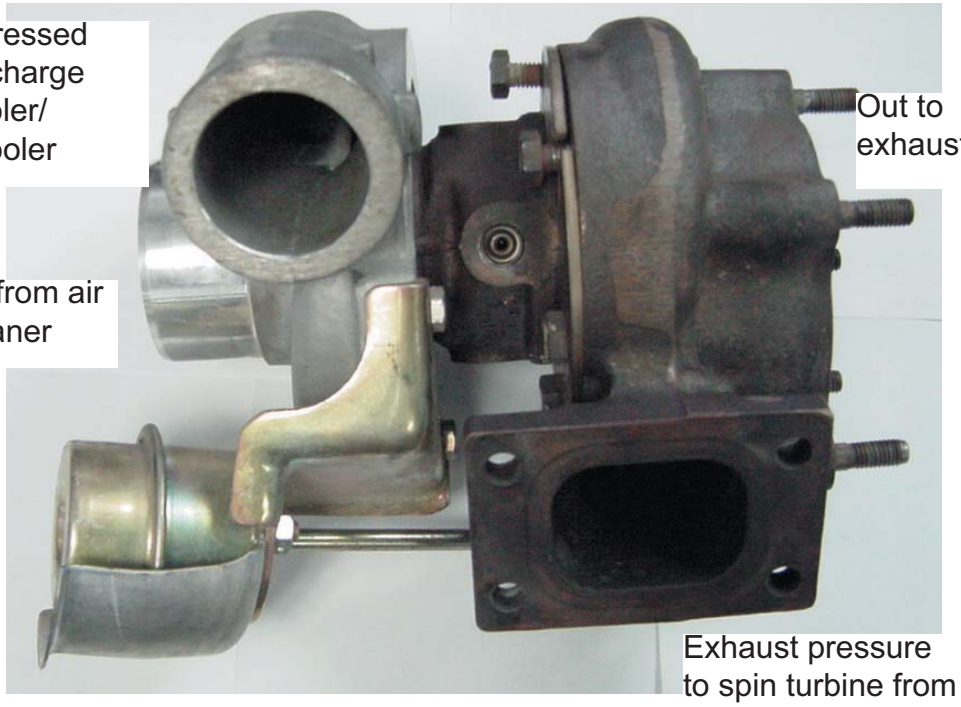
- Air ducts and charge air cooler (Intercooler)
- Turbocharger
  - Waste gate
  - Waste gate actuator
- Boost control:
  - Waste gate control solenoid
  - Air bypass valve

Air Ducts and Charge Air Cooler



	Air cleaner to turbo inlet (low pressure/low temperature)
	Turbo outlet to charge air cooler (high pressure/high temperature)
	Charge air cooler to throttle body/intake manifold (high pressure/low temperature)
	Air bypass valve to turbo inlet

Turbo



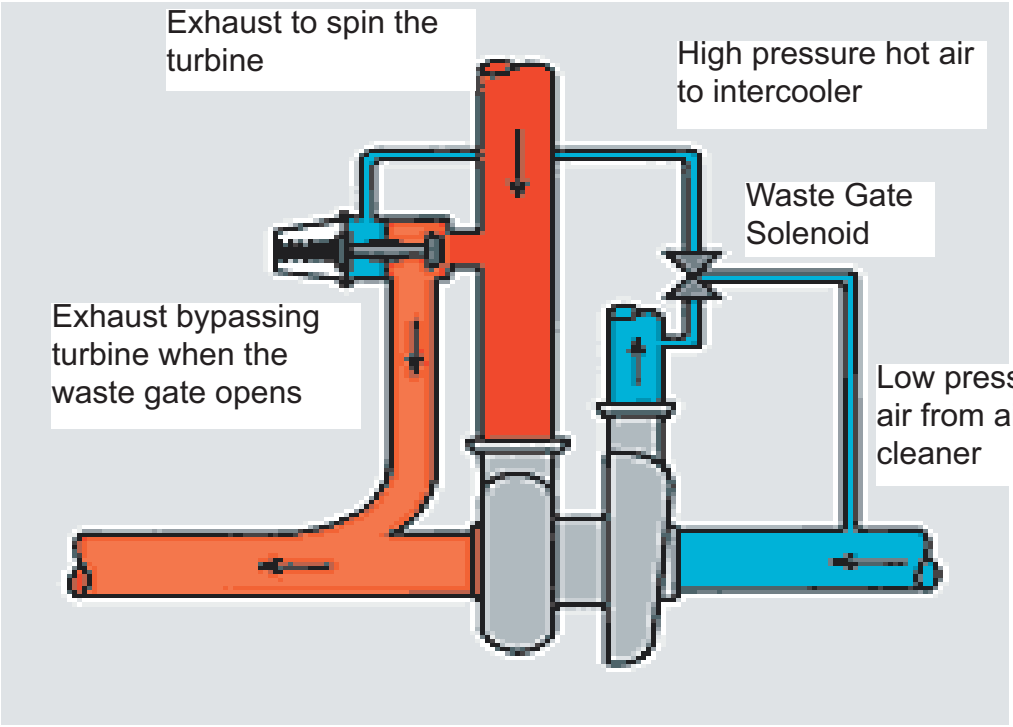
Turbochargers consist of a housing, a blade assembly, inlet ducts for low pressure air and outlet ducts for high pressure air, an intercooler, oil inlet and return, coolant inlet and return, and boost control circuits.

The turbine blade is on the exhaust side of the turbocharger and the compressor blade is on the intake side of the turbocharger. The turbine blade is spun by exhaust pressure.The compressor blade spins and pressurizes the intake air.

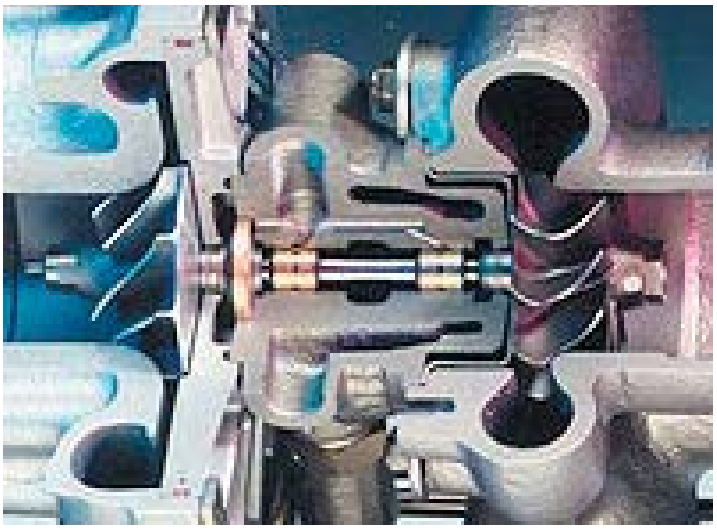
The hot/high pressure air coming out of the turbo is sent to the intercooler to cool it and make it denser.

The shaft between the turbocharger's blades rides on bearing surfaces and a thin film of oil. The turbo's center upper housing has an oil feed line that connects to the engines lubrication system to provide pressurized oil. On the bottom of the turbo housing is an oil drain line to return oil back to the engines crankcase.

Turbocharger Inlet and Outlet Pressures and Temperatures



Compressor blade



Turbine blade

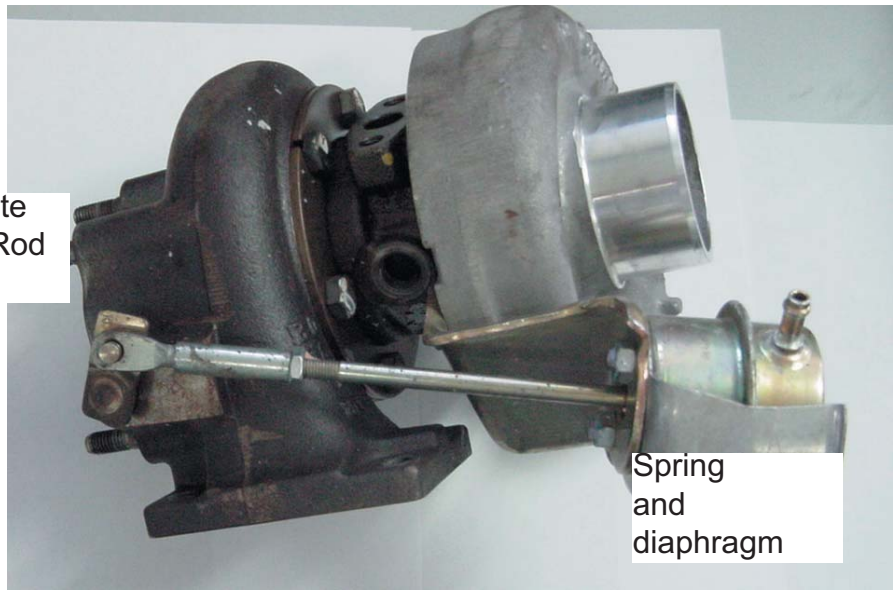
Waste Gate

The waste gate is a valve that allows exhaust pressure to bypass the turbocharger turbine and dump directly into the exhaust. The waste gate valve actuator controls the waste gate. When the waste gate opens, the turbine spins slower.

Waste gate valve open

Waste Gate Actuator

The waste gate actuator consists of a control rod connected to the waste gate valve and a spring and diaphragm that hold the waste gate valve closed. The actuator pops open to allow the exhaust to bypass the turbocharger turbine and dump directly into the exhaust.



Waste Gate Actuator Rod

Spring and diaphragm

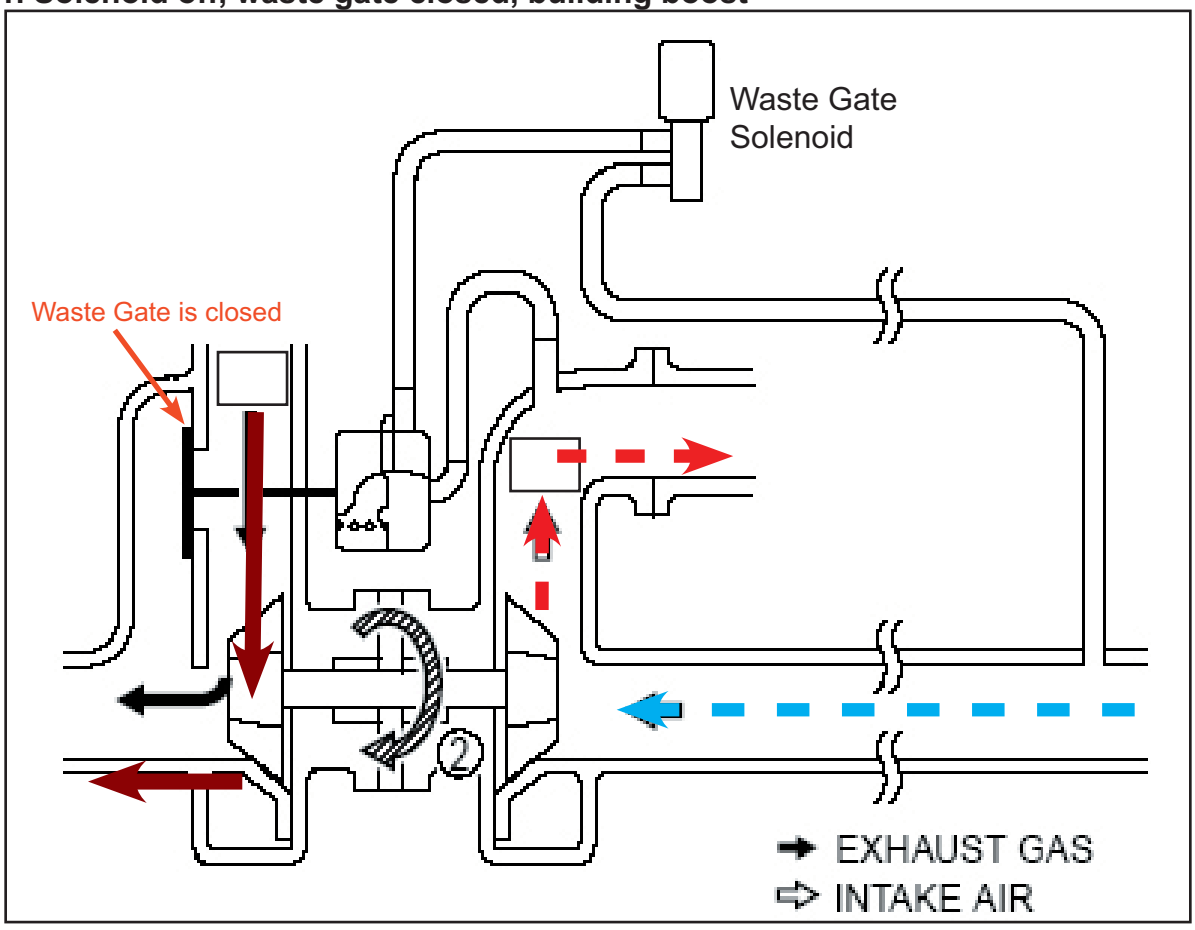
Waste Gate Regulator Solenoid

An intake manifold connection to the waste gate actuator opens the waste gate. The waste gate regulator solenoid regulates boost pressure from the intake to bleed off pressure, preventing the waste gate from opening too early when maximum boost is needed.

There are three operating modes for the Waste Gate Actuator solenoid:

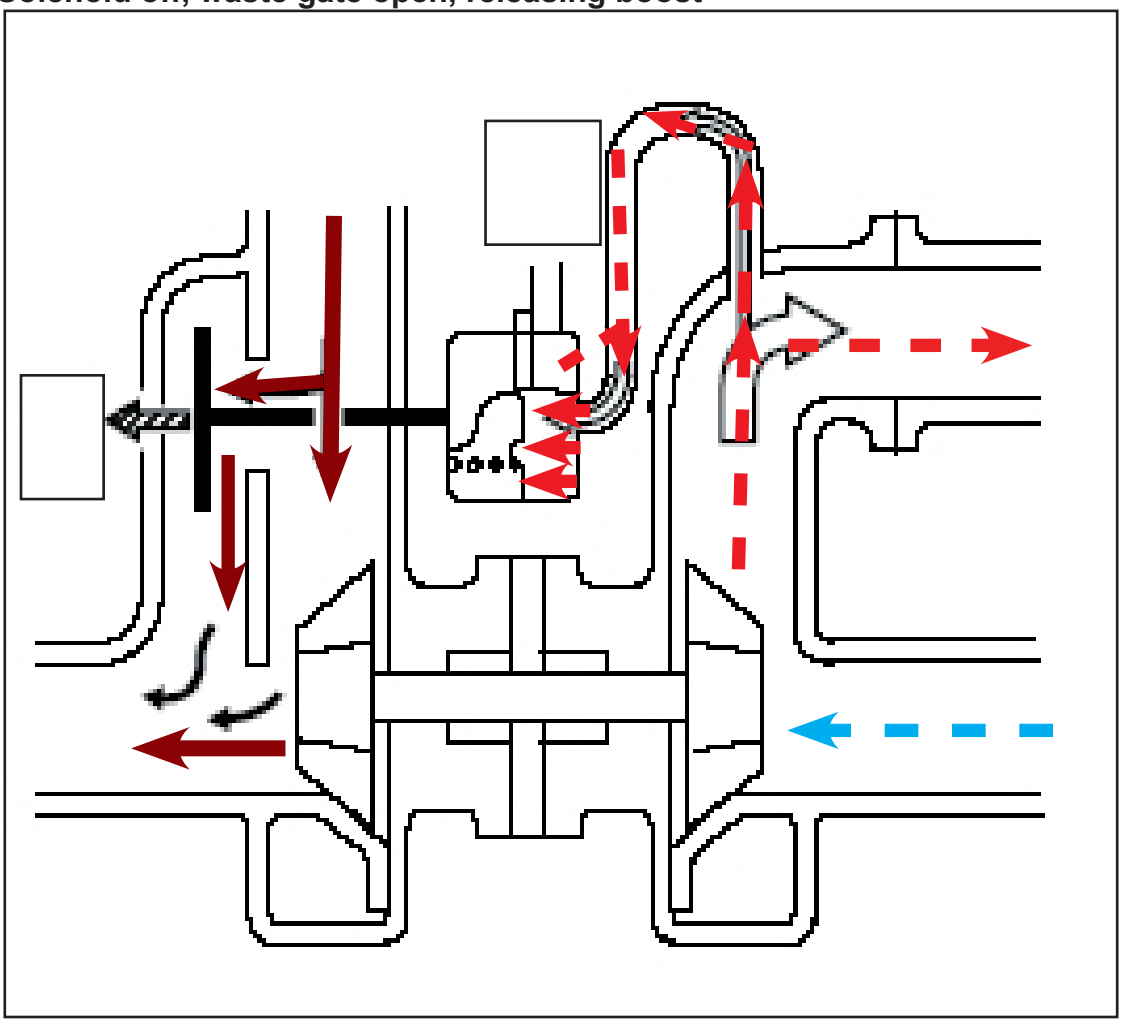
1. Solenoid off, waste gate closed, building boost
2. Solenoid off, waste gate open, releasing boost
3. Solenoid on, waste gate closed, building maximum boost

1. Solenoid off, waste gate closed, building boost



	Cool Fresh Air
	High Pressure Hot Air
	Exhaust Gasses

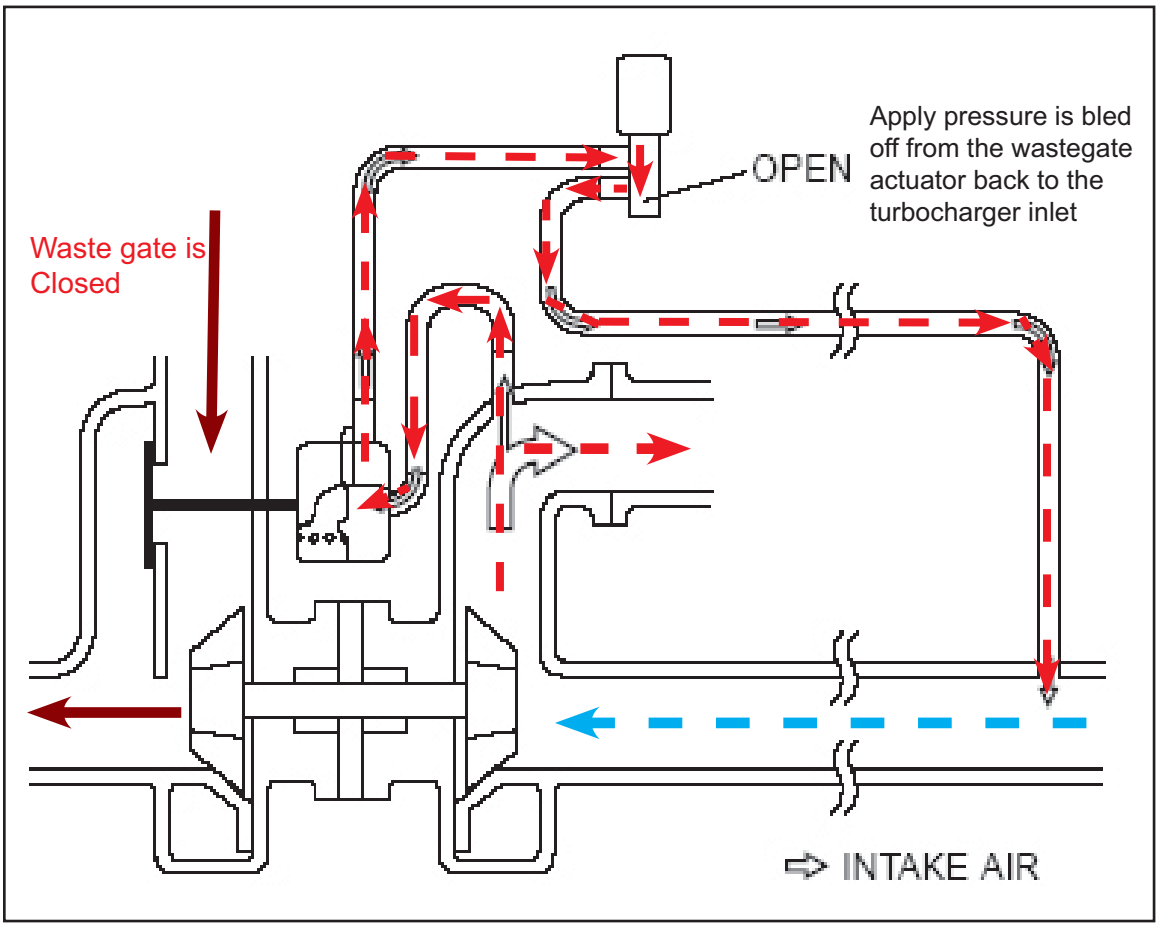
2. Solenoid off, waste gate open, releasing boost



When boost pressure is high in the intake, the boost pressure from the intake manifold acts on the waste gate actuator to open the waste gate, slow down the turbine, and prevent an over-boost condition.

	Cool Fresh Air
	High Pressure Hot Air
	Exhaust Gasses

3. Solenoid on, waste gate closed, building maximum boost



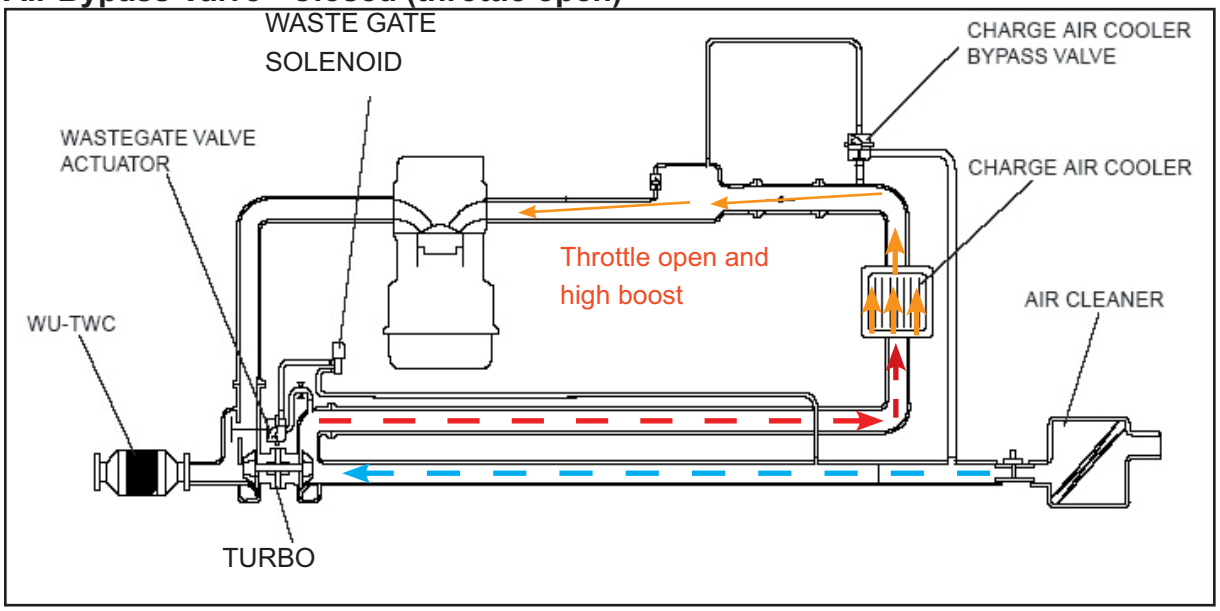
The waste gate regulator solenoid tunes the opening rate of the waste gate to help build maximum boost when needed. The solenoid controls the line from the intake manifold to the waste gate actuator. When the solenoid is energized, it bleeds off pressure routed from the intake manifold to the waste gate actuator. The solenoid bleeds this pressure back into the turbocharger inlet.

	Cool Fresh Air
	High Pressure Hot Air
	Exhaust Gasses

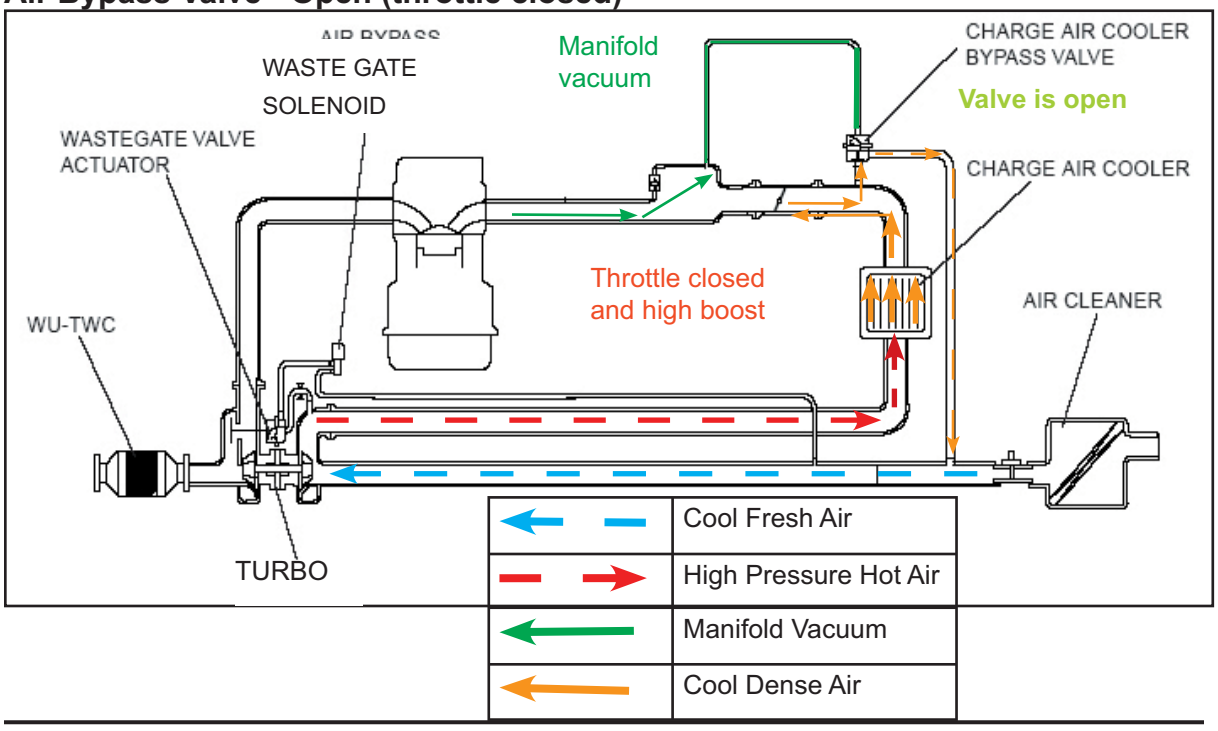
Air Bypass Valve

The air bypass valve protects the intake manifold air ducts, passages, and sealing gaskets from damage due to over-boost. Over-boost can occur when accelerating the vehicle and closing the throttle suddenly. When the throttle closes suddenly and boost pressure is present in the intake manifold, this valve pops open and vents the pressure back to the inlet side of the turbocharger.

Air Bypass Valve - Closed (throttle open)



Air Bypass Valve - Open (throttle closed)



Turbocharger Diagnosis

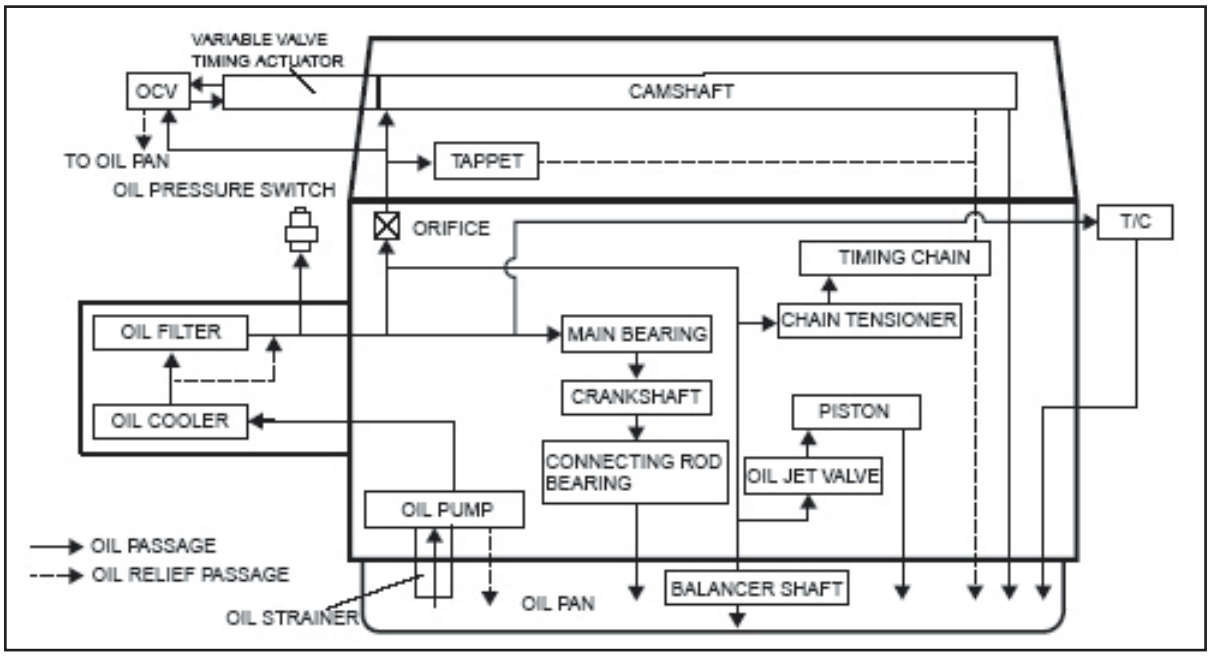
Black Smoke Dirty air filter system Suction and pressure line distorted or leaking Excessive flow resistance in exhaust system/leakage upstream of turbine Fuel system/injection feed system defective or incorrectly adjusted Valve guide, piston rings, engine or cylinder liners worn/ increased blow by Dirty compressor or charge air cooler Boost pressure control swing valve/poppet valve does not close Turbocharger bearing damage Foreign body damage on compressor or turbine Engine air collector cracked/missing or loose gaskets Turbine housing/flap damaged Insufficient oil supply of turbocharger	**Lack of Power/Boost Pressure Low** Dirty air filter system Suction and pressure line distorted or leaking Excessive flow resistance in exhaust system/ leakage upstream of turbine Fuel system/injection feed system defective or incorrectly adjusted Valve guide, piston rings, engine or cylinder liners worn/ increased blow by Dirty compressor or charge air cooler Boost pressure control swing valve/poppet valve does not close Pipe assy. to swing valve/poppet valve defective Turbocharger bearing damage Foreign body damage on compressor or turbine Engine air collector cracked/missing or loose gaskets Turbine housing/flap damaged Insufficient oil supply of turbocharger
Boost Pressure Too High Fuel system/injection feed system defective or incorrectly adjusted Boost pressure control swing valve/poppet valve does not open Pipe assy. to swing valve/poppet valve defective	**Compressor/Turbine Wheel Failure** Turbocharger bearing damage Foreign body damage on compressor or turbine Turbine housing/flap damaged Insufficient oil supply of turbocharger
High Oil Consumption Dirty air filter system Excessive flow resistance in exhaust system/ leakage upstream of turbine Oil feed and drain lines clogged, leaking or distorted Crankcase ventilation clogged and distorted Coke and sludge in turbocharger center housing Valve guide, piston rings, engine or cylinder liners worn/ increased blow by Dirty compressor or charge air cooler Piston ring sealing defective Turbocharger bearing damage	**Blue Smoke** Dirty air filter system Excessive flow resistance in exhaust system/ leakage upstream of turbine Oil feed and drain lines clogged, leaking or distorted Crankcase ventilation clogged and distorted Coke and sludge in turbocharger center housing Valve guide, piston rings, engine or cylinder liners worn/ increased blow by Dirty compressor or charge air cooler Piston ring sealing defective Turbocharger bearing damage
Black and Blue Smoke Dirty air filter system Excessive flow resistance in exhaust system/ leakage upstream of turbine Valve guide, piston rings, engine or cylinder liners worn/ increased blow by Dirty compressor or charge air cooler Turbocharger bearing damage	**Oil Leakage at Turbine** Oil feed and drain lines clogged, leaking or distorted Crankcase ventilation clogged and distorted Coke and sludge in turbocharger center housing Valve guide, piston rings, engine or cylinder liners worn/ increased blow by Piston ring sealing defective Turbocharger bearing damage
Turbocharger noise Suction and pressure line distorted or leaking Excessive flow resistance in exhaust system/ leakage upstream of turbine Dirty compressor or charge air cooler Turbocharger bearing damage Foreign body damage on compressor or turbine Exhaust gas leakage between turbine outlet and exhaust pipe Engine air collector cracked/missing or loose gaskets Turbine housing/flap damaged Insufficient oil supply of turbocharger	**Oil Leakage at Compressor** Dirty air filter system Excessive flow resistance in exhaust system/ leakage upstream of turbine Oil feed and drain lines clogged, leaking or distorted Crankcase ventilation clogged and distorted Coke and sludge in turbocharger center housing Valve guide, piston rings, engine or cylinder liners worn/ increased blow by Dirty compressor or charge air cooler Piston ring sealing defective Turbocharger bearing damage

Black **Blue Smoke** **Compressor/Turbine Wheel Failure** Turbocharger bearing damage	**Black** **Blue Smoke** **High Oil Consumption** **Compressor/Turbine Wheel Failure** Turbocharger bearing damage
Black **Blue Smoke** **High Oil Consumption** Dirty air filter system Excessive flow resistance in exhaust system/ leakage upstream of turbine Valve guide, piston rings, engine or cylinder liners worn/ increased blow by Dirty compressor or charge air cooler Turbocharger bearing damage	**Black** **Blue Smoke** **Insufficient power** Dirty air filter system Excessive flow resistance in exhaust system/ leakage upstream of turbine Valve guide, piston rings, engine or cylinder liners worn/ increased blow by Dirty compressor or charge air cooler Turbocharger bearing damage
Black **Blue Smoke** **Oil Leak at Compressor** Dirty air filter system Excessive flow resistance in exhaust system/ leakage upstream of turbine Valve guide, piston rings, engine or cylinder liners worn/ increased blow by Dirty compressor or charge air cooler Turbocharger bearing damage	**Black** **Blue Smoke** **Oil Leak at Turbine** Valve guide, piston rings, engine or cylinder liners worn/ increased blow by Turbocharger bearing damage
Black **Blue Smoke** **Noisy Turbocharger** Excessive flow resistance in exhaust system/ leakage upstream of turbine Dirty compressor or charge air cooler Turbocharger bearing damage	**Black** **Blue Smoke** **High Oil Consumption** **Compressor/Turbine Wheel Failure** **Insufficient Power** Turbocharger bearing damage
Black **Blue Smoke** **High Oil Consumption** **Compressor/Turbine Wheel Failure** **Insufficient Power** **Oil Leak at Compressor** Turbocharger bearing damage	**Black** **Blue Smoke** **High Oil Consumption** **Compressor/Turbine Wheel Failure** **Insufficient Power** **Oil Leak at Compressor** **Oil Leak at Turbine** Turbocharger bearing damage
Black **Blue Smoke** **High Oil Consumption** **Compressor/Turbine Wheel Failure** **Insufficient Power** **Oil Leak at Compressor** **Oil Leak at Turbine** **Turbocharger generates noise** Turbocharger bearing damage	

Turbocharger Diagnosis by Symptom

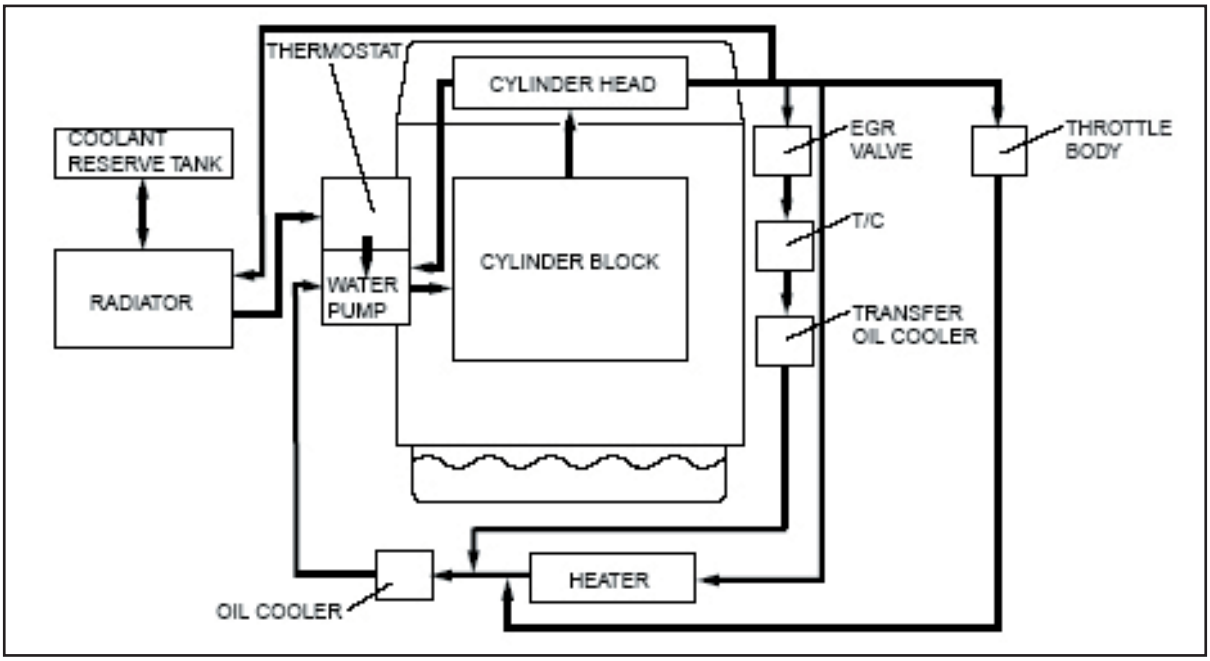
	Symptoms								
Possible Cause	Black smoke	Blue smoke	High Boost Pressure	Compressor/ turbine wheel damage	High oil consumption	Low power/low boost pressure	Oil leak into compressor	Oil leak into turbine	Turbocharger noisy
Dirty air filter	×	×			×	×	×		
Inlet duct distorted or leaking	×	×			×	×	×		
Outlet duct distorted or leaking						×			×
Overfilled crankcase		×					×		
PCV plugged or lines distorted		×			×		×	×	
Turbo oil inlet line plugged or distorted						×			×
Turbo oil inlet line leaking					×				
Turbo oil drain line plugged or distorted		×			×		×	×	
Turbo oil drain line leaking					×				
Low engine compression: valve guides, piston rings, cylinders worn/ increased blow by	×	×			×	×	×	×	
Excessive flow resistance/ backpressure in exhaust system or leakage upstream of turbine	×				×	×			×
Fuel system problem	×		×			×			
Dirty compressor or charge air cooler	×				×	×	×		×
Waste gate control valve does not close	×		×			×			
Turbocharger bearing damage	×	×		×	×	×	×	×	×
Foreign body damage to compressor or turbine				×		×			×
Engine air collector cracked or loose gaskets	×					×			×
Turbine housing/flap damaged	×			×		×			×
Insufficient oil supply to turbocharger	×			×		×			×
Coke and sludge in turbocharger center housing		×			×		×	×	
Waste gate control valve defective			×			×			
Exhaust gas leakage between turbine outlet and exhaust pipe									×

Lubrication Routing Diagram



Coolant Routing Diagram

The coolant lines run from the cylinder head to the EGR valve and turbocharger.



Fuel Octane

The MZR 2.3L L3T engine has a high compression ratio for a turbocharged vehicle of 9.5:1. Typically turbocharged engine compression ratios are in the range of 7.5:1 to 8.5:1. This engine also has high boost pressure from the turbocharger 15.6 psi. Typical turbochargers boost from 5 to 12 psi . When you combine a high compression ratio and high boost, the result is a higher compression engine, somewhere in the range of 11:1. Higher compression engines require higher octane fuel.

Using lower than 91 octane fuel is not recommended. Lower octane fuel must be injected and ignited earlier. Less timing advance results in lower power and more heat. This engine should be run with 91 to 93 octane, 93 is ideal for its compression ratio. There are several disadvantages to lower octane fuels, less power, more heat, lower fuel economy, more carbon deposits. 89 octane should only be used in an emergency if 91 octane is not available.

The engine management system is able to seemlessly modify the ignition timing and fuel delivery for the entire range of fuel octane from 89 to 93 without detonation. It is also designed to protect the engine from damage due to lower octane fuel. When low octane fuel is used, the fuel delivery and ignition timing are retarded and power output is reduced. Continued operation with low octane fuel can result in increased engine intake air temperatures, when temperatures exceed safe levels, the PCM commands the turbochargers waste gate regulator solenoid off at 4200 rpm. With the wastegate regulator solenoid off, the wastegate opens earlier to reduce heat. A customer using low octane fuel in hot climates may describe this as a loss of power over 4000 rpm.

Suspension Modifications

- 18” X 7” Alloy wheels with 215/45/18
- Vehicle overall height reduced 0.4”
- Shock dampers tuned
- Spring rates increased:

  Front- 25%

  Rear- 37%
- Stabilizer bar thickness increased:

  Front- 23 to 24mm

  Rear- 21 to 23mm

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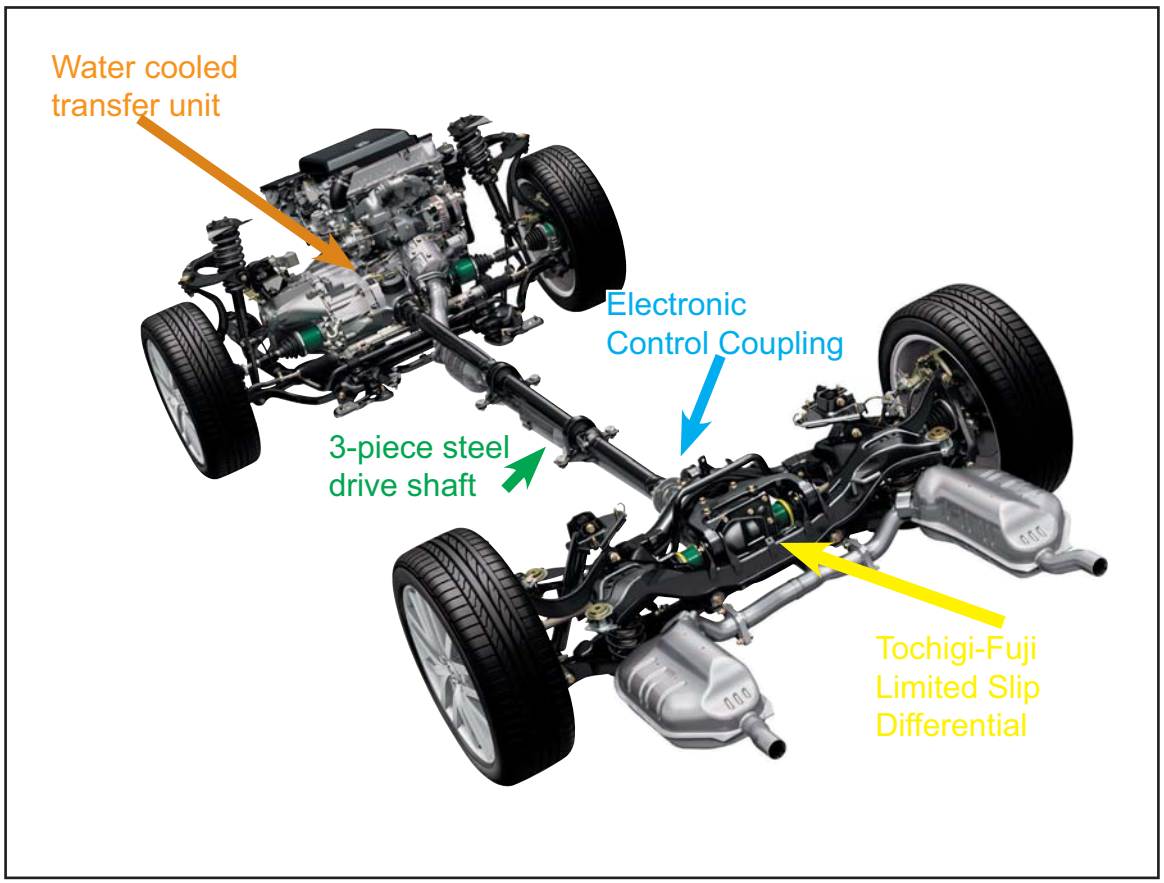
Objectives

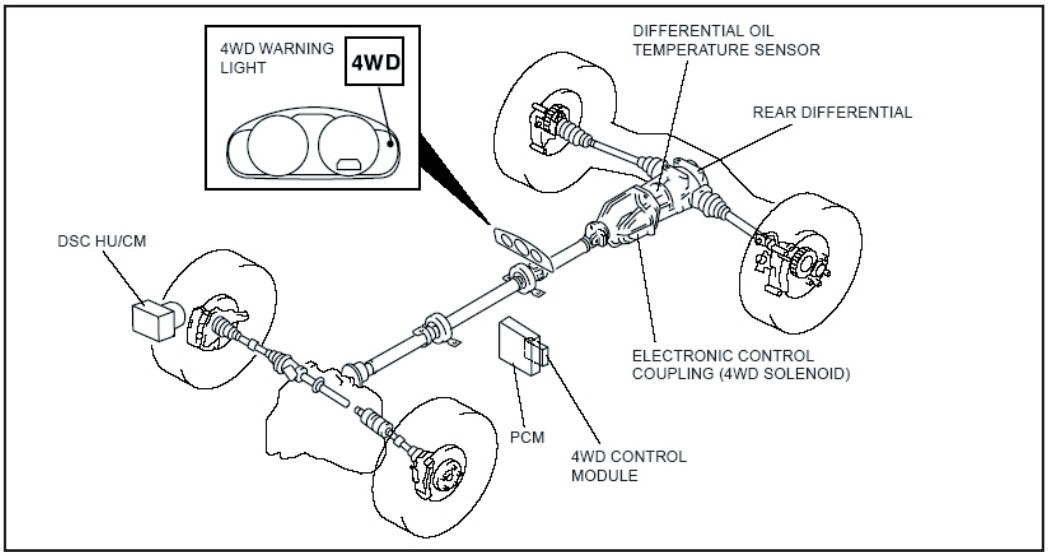
After completing this section, you will be able to:

- Explain Active Torque Control AWD

All Wheel Drive (AWD)

- Front/rear wheel torque varies between 100/0 and 50/50 through an electronic torque coupling mounted in front of the rear differential
- 100/0 is only used when the hand brake is applied or at low speeds during tight turns (parking lot maneuvers)
- Many AWD systems in FWD cars require front wheel slip (viscous couplings) before power is transferred to the rear, *MAZDASPEED6* has a strong rear wheel bias in most driving conditions
- Almost constant torque to the rear requires a water cooled transfer unit

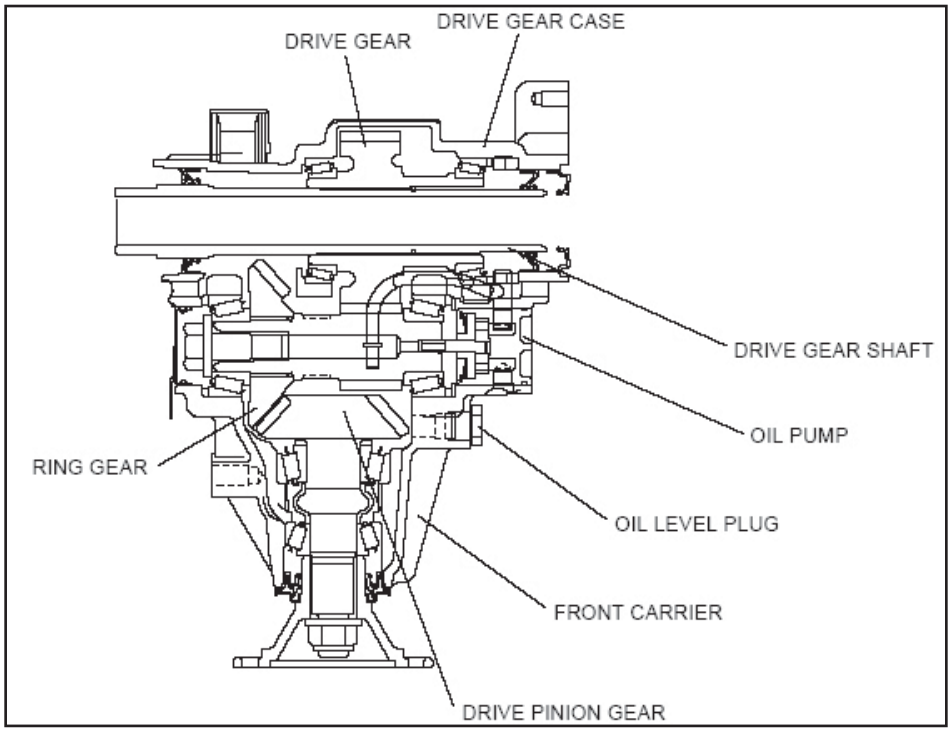




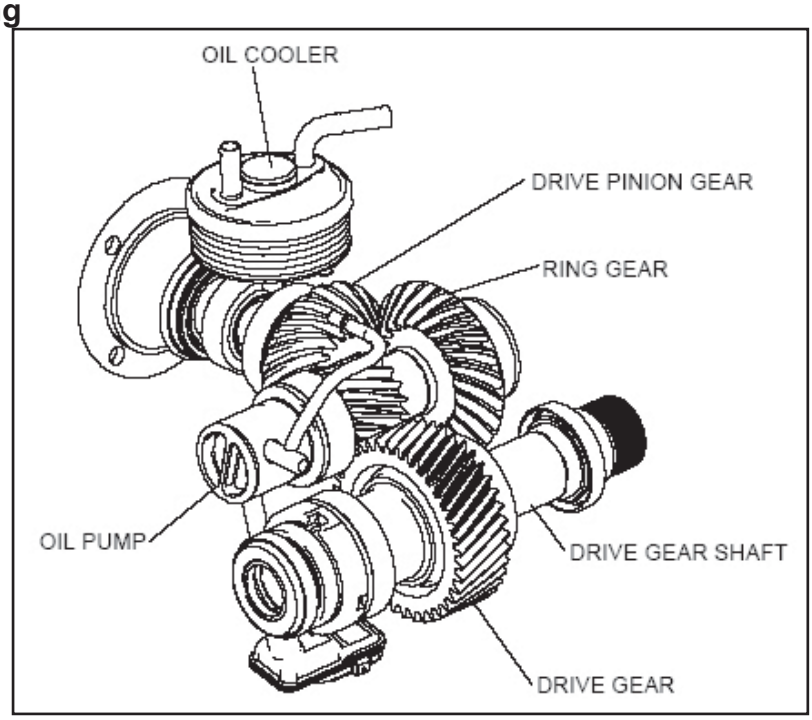
The 4WD ECU uses real-time data to manage torque.

- **PCM:** VSS, RPM, TP angle, neutral switch, brake pedal position, selector lever position
- **DSC:** 4-wheel speed sensors, parking brake switch, ABS activated, steering wheel angle, brake fluid pressure, back-up light, coupling torque request, yaw rate, and lateral G-force
- **Rear Differential:** oil temperature

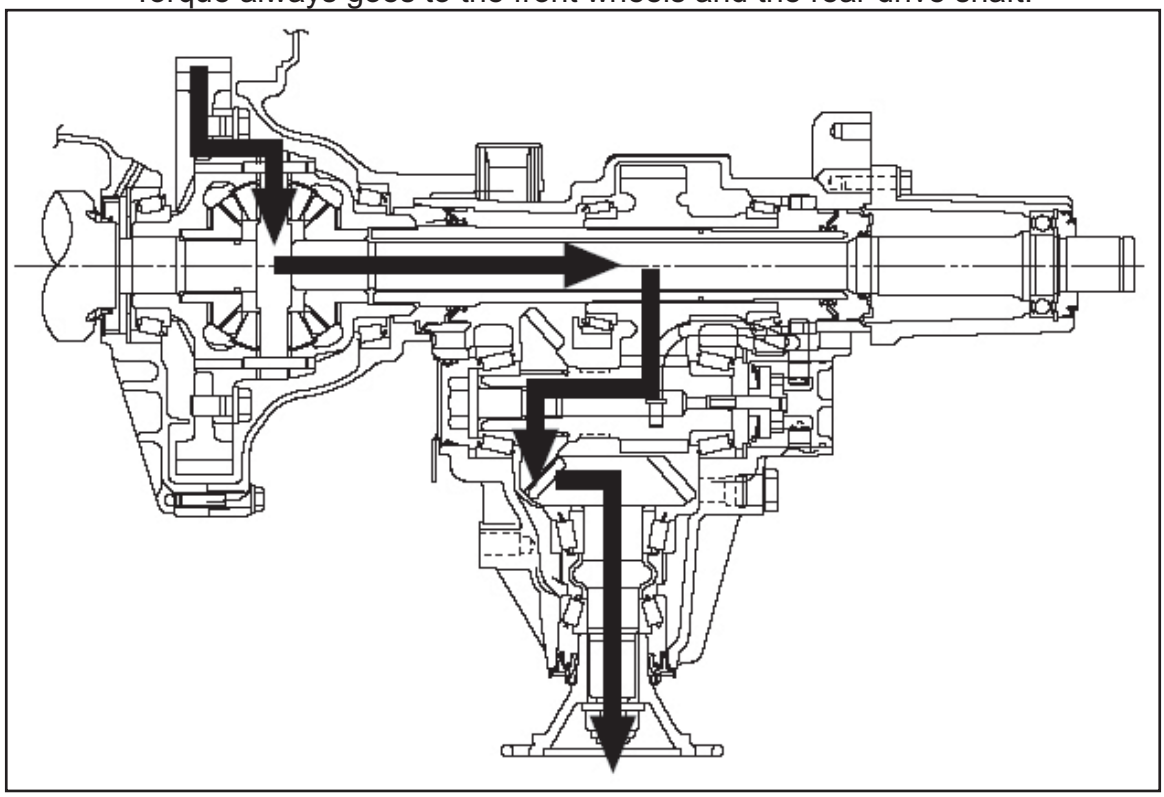
Transfer Unit



Water Cooling

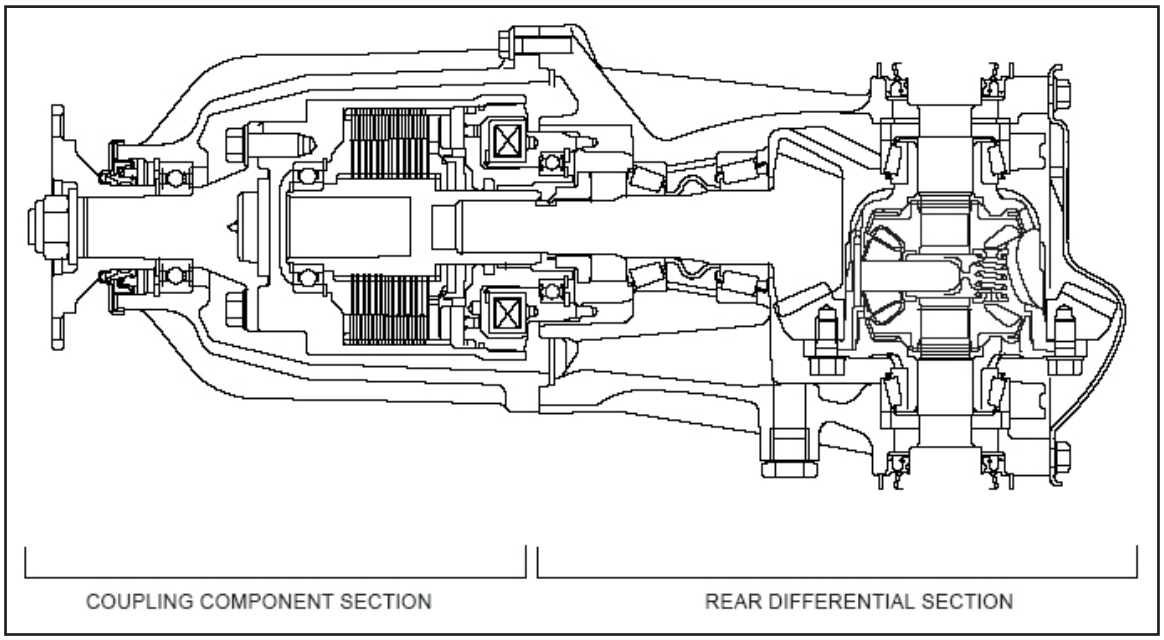


Torque always goes to the front wheels and the rear drive shaft.

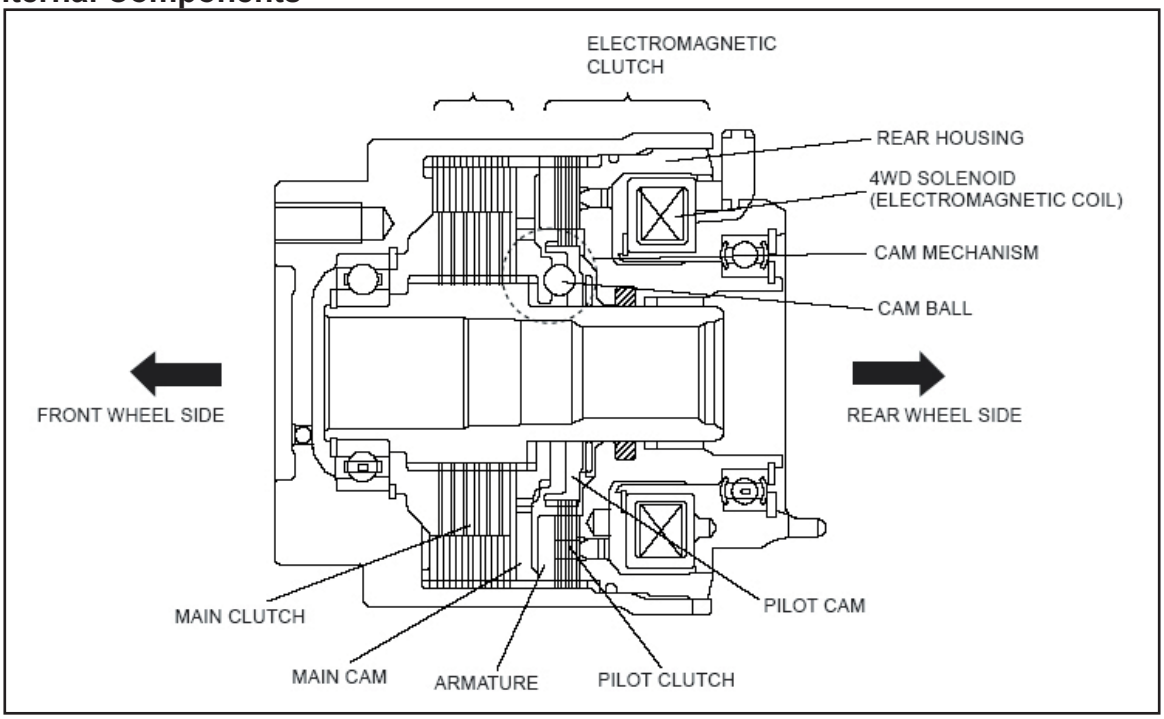


Electronic Control Coupling

The electronic control coupling switches power to the rear wheels the rear differential.

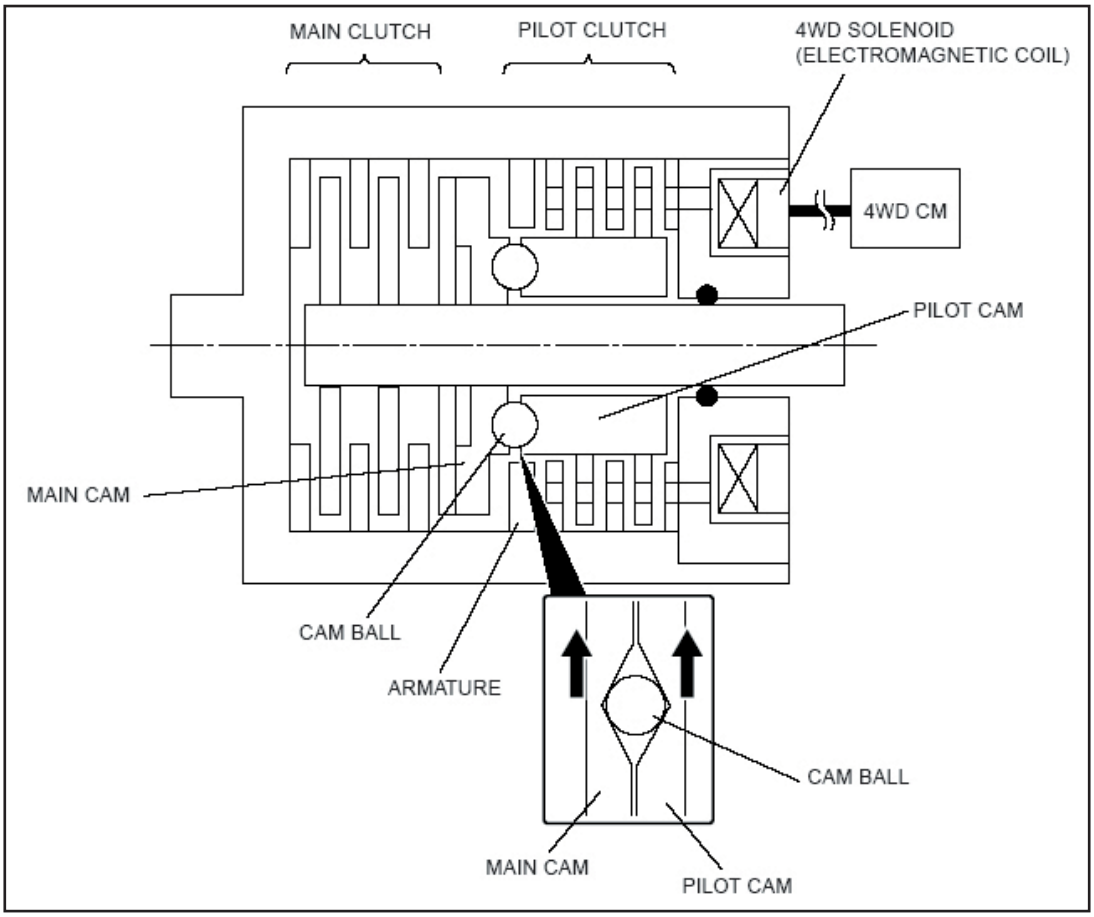


Internal Components



Electromagnetic Clutch OFF

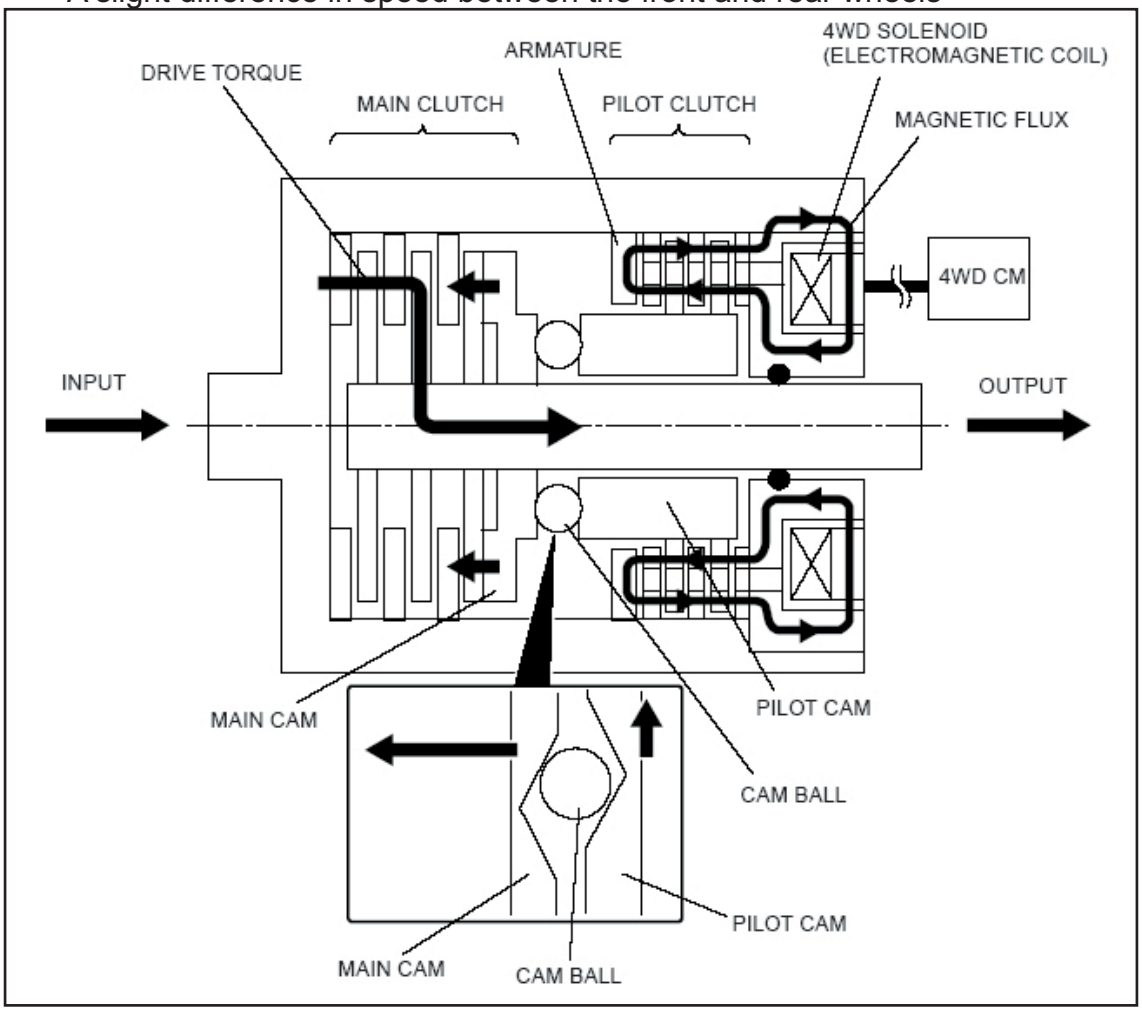
- Electromagnetic solenoid off, pilot clutch released
- No power to rear differential and the rear wheels are turning at same rate as front



The ball is centered in the pilot cam so no pressure is exerted on the main clutch and no torque is transmitted to the rear differential.

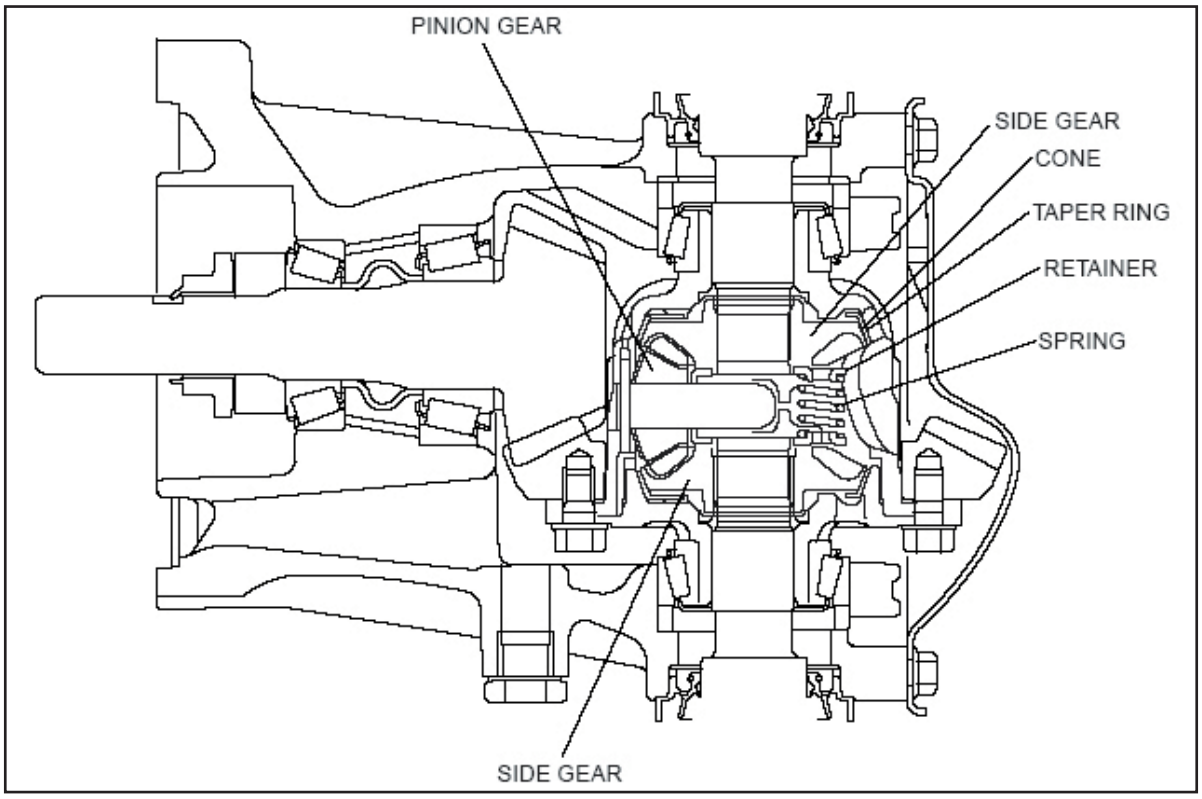
Power to Electromagnetic Clutch

- Electromagnetic solenoid energized, pilot clutch applied
- A slight difference in speed between the front and rear wheels

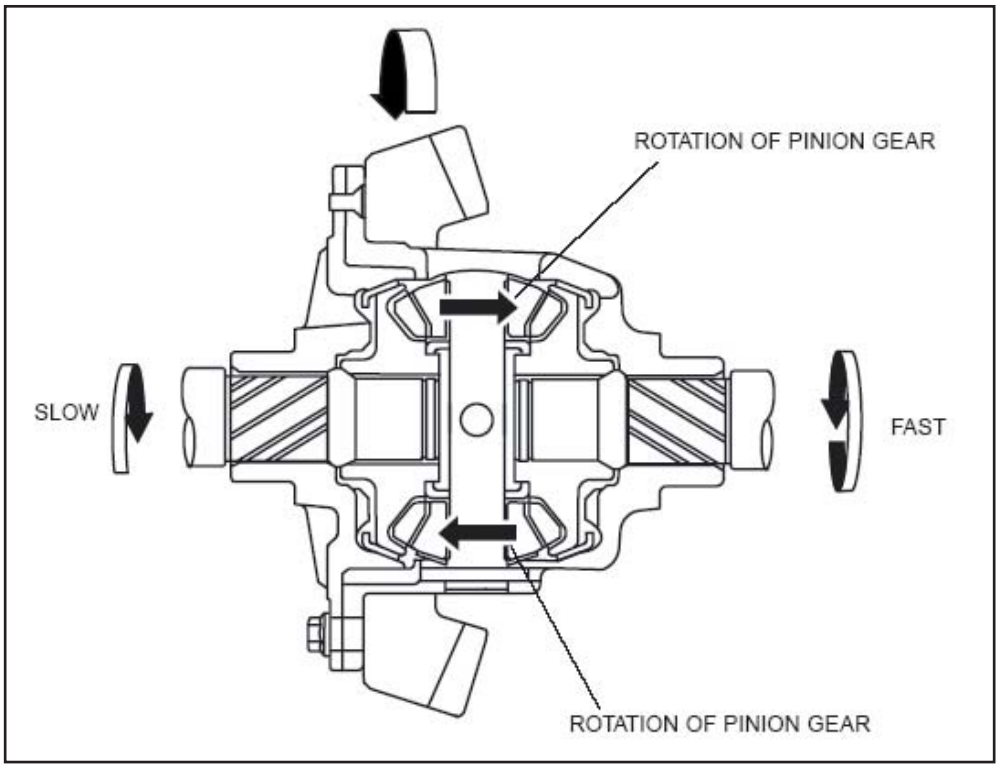


When the electromagnetic coil is energized and the front wheels rotate at a different rate than the rear wheels, the ball separates the main cam and the pilot cam. This exerts force on the main clutch and torque is transmitted from the driveshaft to the rear differential.

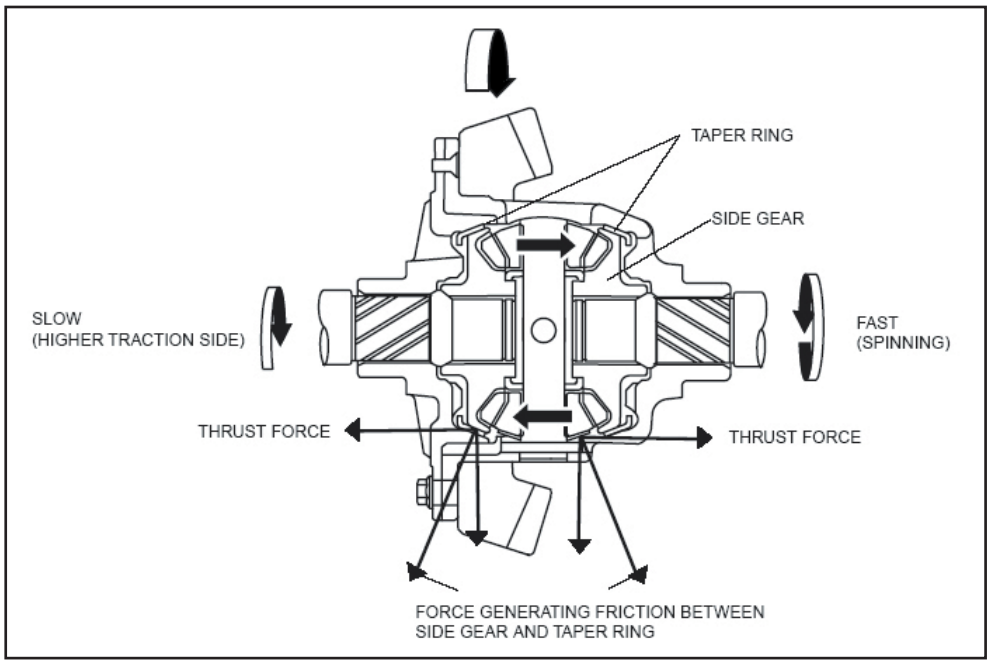
Tochigi-Fuji Limited Slip Differential (LSD)



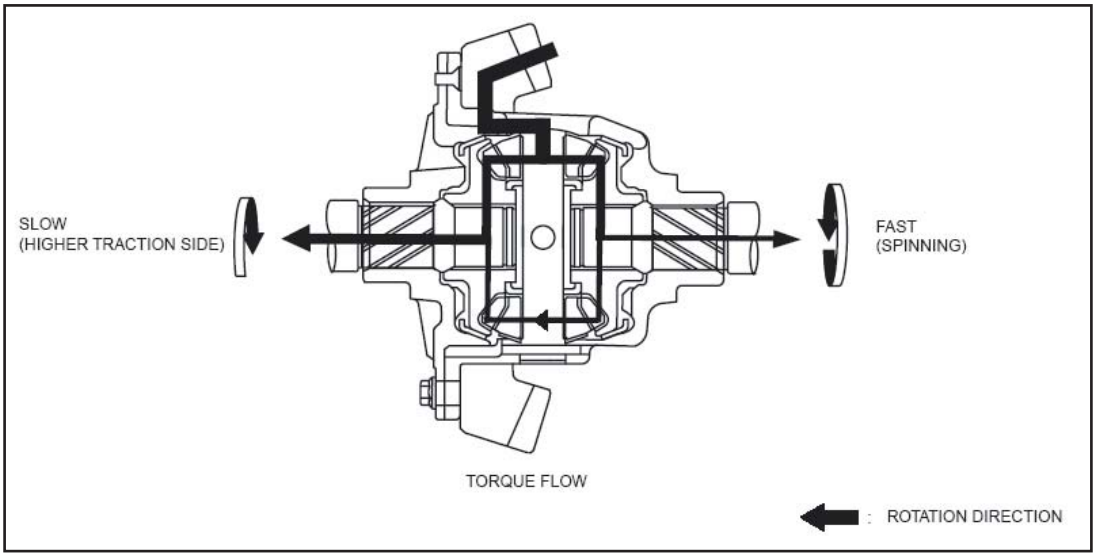
Differential Effect



LSD Effect



LSD Torque Transfer



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Objectives

After completing this section, you will be able to:

- Explain Brake Assist Control
- Explain Oversteer and Understeer
- Explain Dynamic Stability Control
- Explain Traction Control.

Braking System Modifications

- Larger brakes:
  Front- 12.6” (vs 11.8”) ventilated discs
  Rear-12.4” (vs 10”) solid discs

ABS	Anti-lock Braking System	Maintains steering control by preventing wheels from locking during braking
EBD	Electronic Brake Force Distribution	Prevents rear wheel lockup by maintaining optimal distribution of braking force front to rear
BAC	Brake Assist Control	Monitors build of brake pressure with a pressure sensor inside the HU/CM. During hard braking it assists braking by building additional pressure using the ABS pump
DSC	Dynamic Stability Control	Monitors vehicle speed, steering angle, G-force and Yaw and adjust braking on individual wheels to help maintain the vehicle on the correct line through turns
TCS	Traction Control System	Detects drive wheel spin and maintains traction by cutting engine torque or applying braking to the slipping wheel

ABS and EBD have been around and BAC is simple to understand. However, DSC and TCS are relatively new so we will cover these functions in detail.

With DSC and TCS, the HU/CM determines the direction the vehicle is headed and reduces engine torque and applies the brakes individually to keep the vehicle moving in the correct direction.

DSC

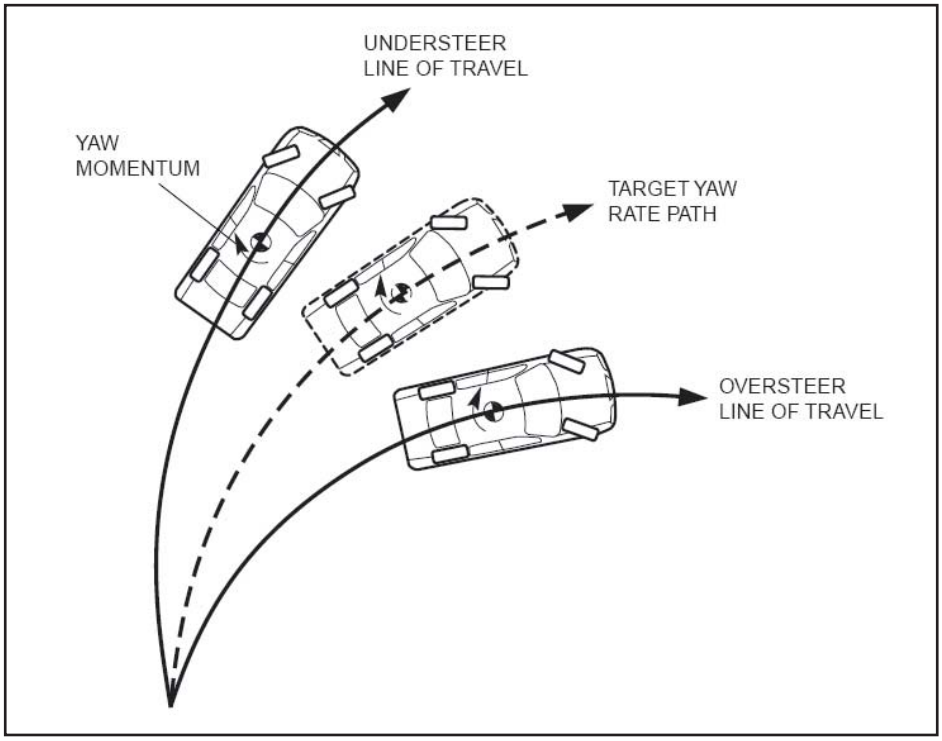
DSC is designed to help correct understeer and oversteer.

Understeer

Is described by drivers as plowing or pushing. Understeer occurs when the vehicle moves further to the outside of a turn than the driver intended and the driver must slow the vehicle and increase the steering angle to correct the vehicle direction.

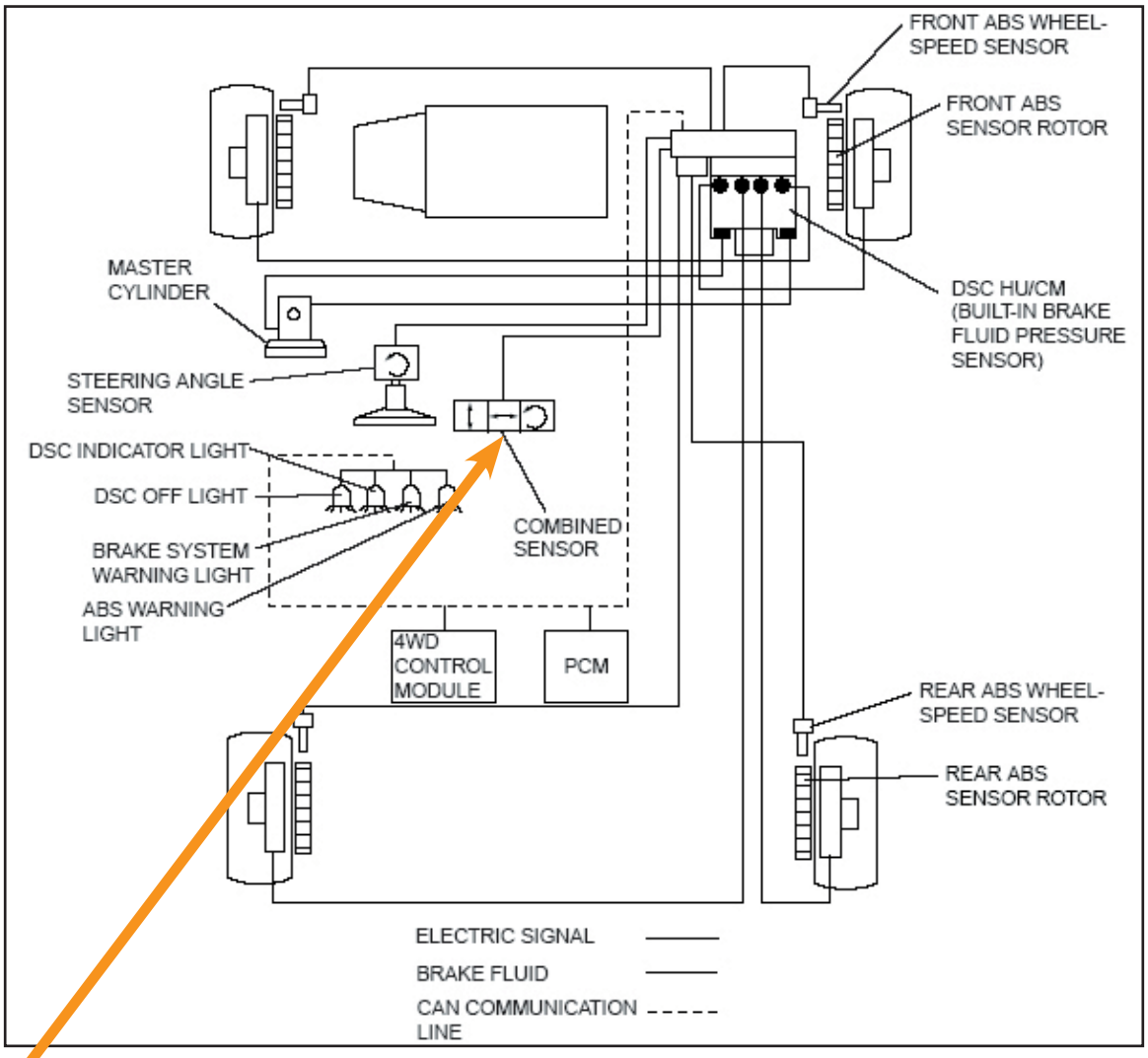
Oversteer

Is described by drivers as fishtailing or spinning out. Oversteer occurs when the vehicle moves further to the inside of a turn than the driver intended and the driver must slow the vehicle and decrease the steering angle to correct the vehicle direction.

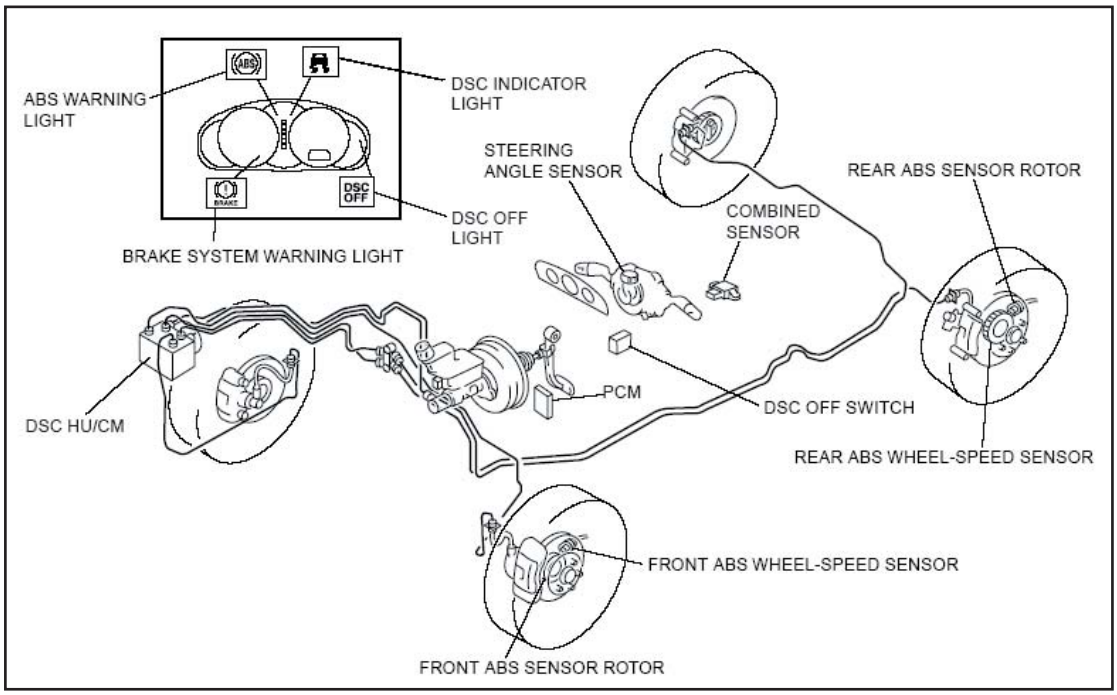


Direction of travel is determined by inputs from the steering angle sensor and the combined sensor. The combined sensor measures yaw angle, and forward and lateral G-forces.

- Yaw Angle = the angle of a vehicle's travel compared to its heading angle.
- Heading Angle = angle by which the longitudinal axis of a moving vehicle deviates from its true direction of travel.

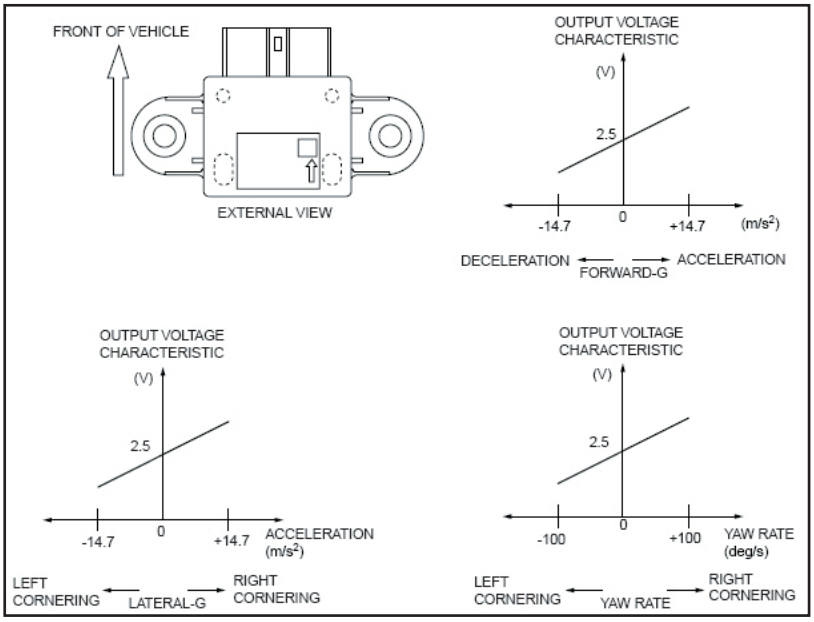


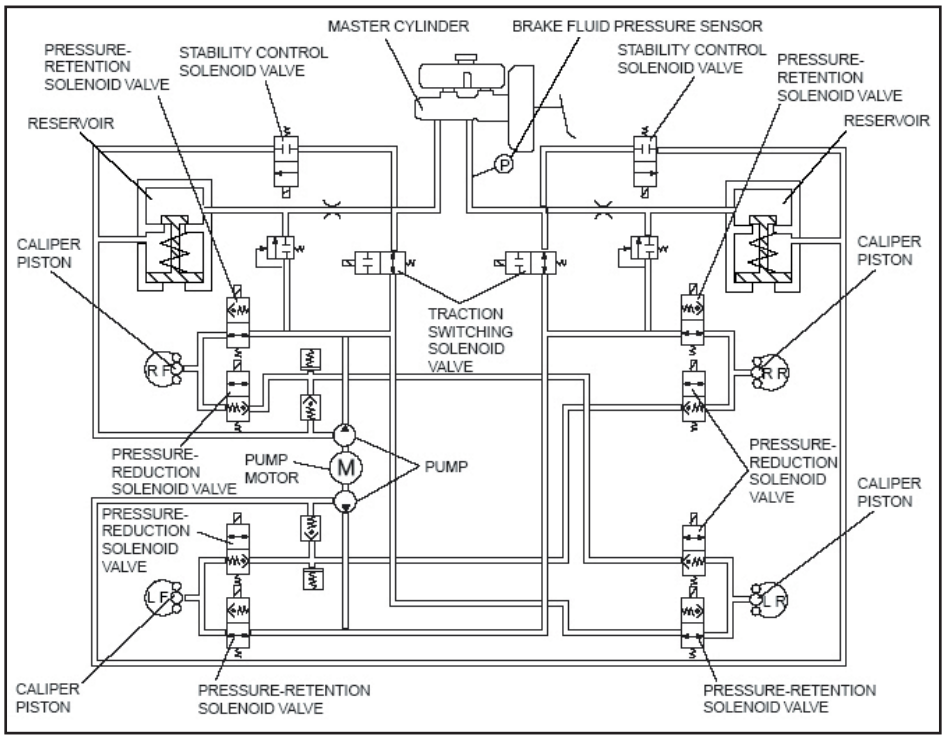
↕	Forward G-force
↔	Lateral G-force
⮌	Yaw Angle



Combined Sensor

All combined sensor readings (yaw, forward and lateral G-force) read 2.5 volts while the vehicle is at rest. The voltage of each sensor in the combined sensor will increase or decrease as the direction of vehicle travel changes.





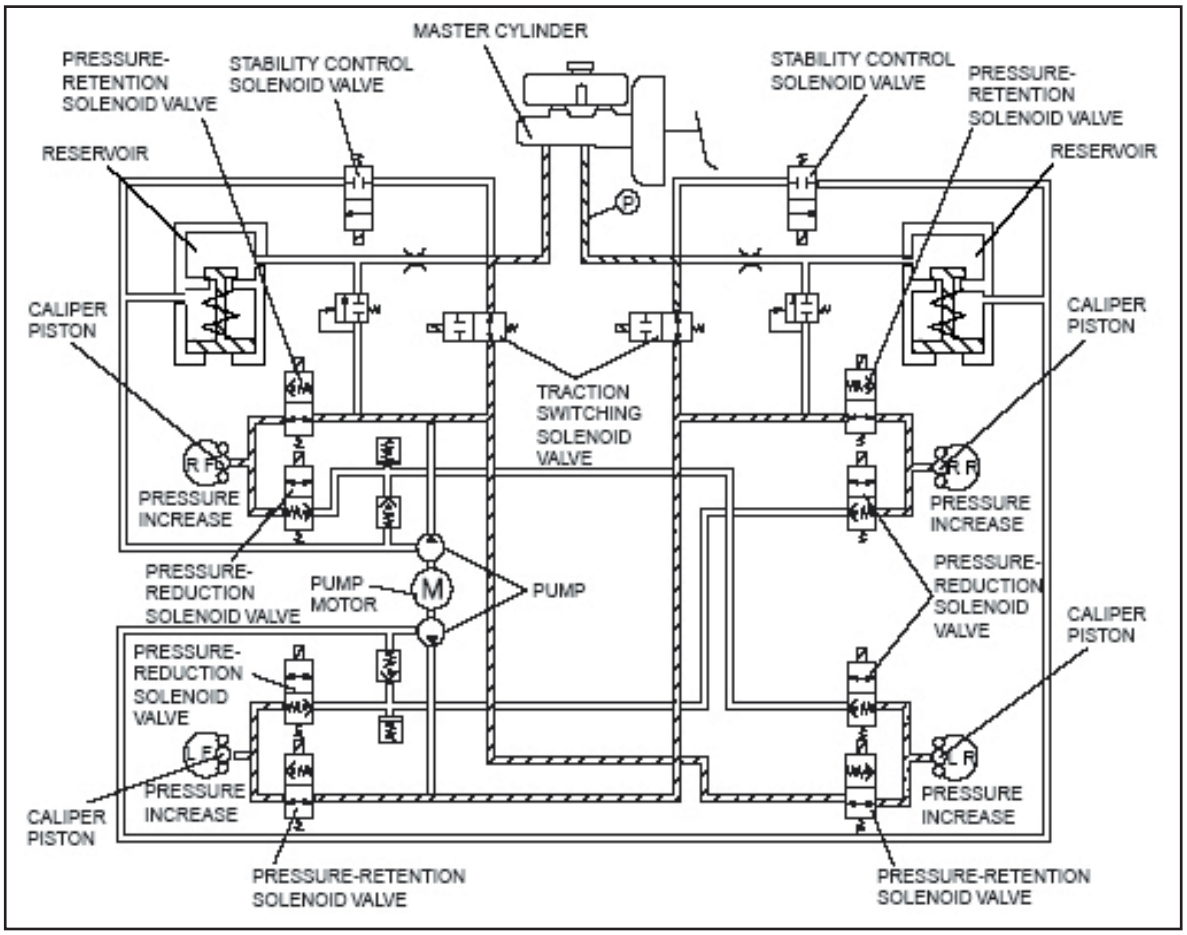
Part name	Function	Normal Position
Pressure-retention solenoid valve	Adjusts the fluid pressure in each brake system according to DSC HU/CM signals.	OFF = Open
Stability control solenoid valve	Switches the brake hydraulic circuits during and according to normal braking, ABS and EBD control, TCS control and DSC control.	OFF = Closed
Brake fluid pressure sensor	Monitors brake fluid pressure build up to determine hard braking to use ABS pump for assist	Not applicable
Reservoir	Temporarily stores brake fluid from the caliper piston to ensure smooth pressure reduction during ABS and EBD control, TCS control and DSC control.	Not applicable
Pressure-reduction solenoid valve	Adjusts the fluid pressure in each brake system according to DSC HU/CM signals.	OFF = Closed
Traction switching solenoid valve	Switches the brake hydraulic circuits during and according to normal braking, ABS and EBD control, TCS control and DSC control.	OFF = Open
Pump motor	Operates the pump according to DSC HU/CM signals.	Stopped
Pump	Returns the brake fluid stored in the reservoir to the master cylinder during ABS and DSC control. Increases brake fluid pressure and sends brake fluid to each caliper piston during TCS control and DSC control.	Not applicable

Normal Braking

Fluid pressure passes from the master cylinder through all HU/CM solenoids directly to the front and rear brake calipers.

The following happens at the same time:

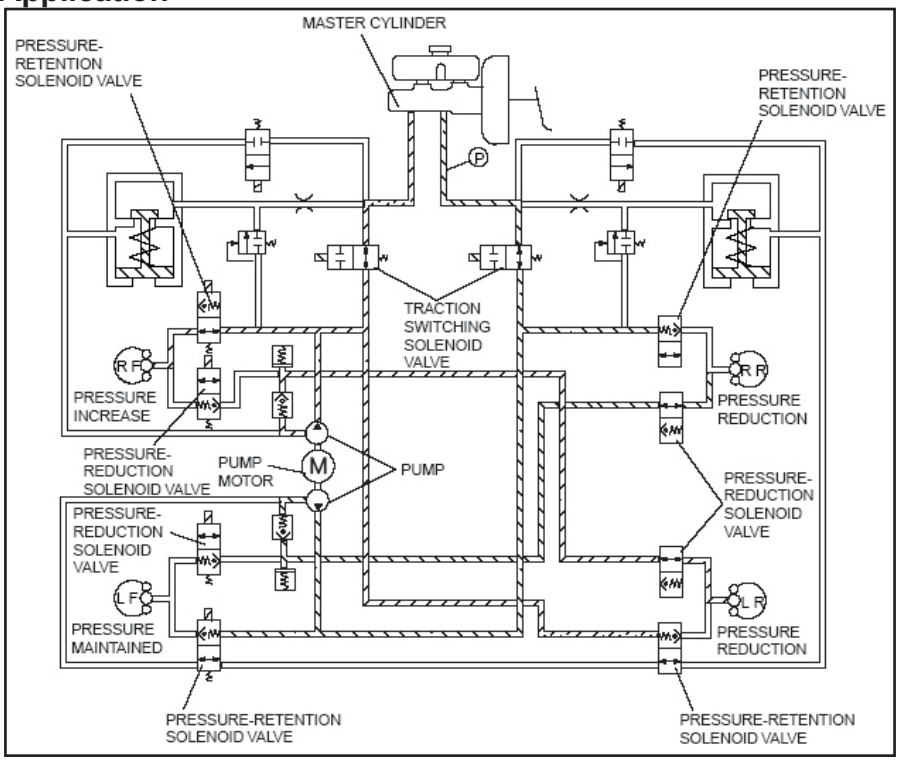
- **Right Front Brake Applies**
- **Left Rear Brake Applies**
- **Right Rear Brake Applies**
- **Left Front Brake Applies**



Solenoid Valve Operation Table

Traction switching solenoid valve		Stability control solenoid valve		Pressure-retention solenoid valve				Pressure-reduction solenoid valve				Pump motor
LF - RR	RF-LR	LF - RR	RF-LR	LF	RF	LR	RR	LF	RF	LR	RR	
OFF (Open)		OFF (Closed)		OFF (Open)				OFF (Closed)				Stopped

ABS/EBD Application

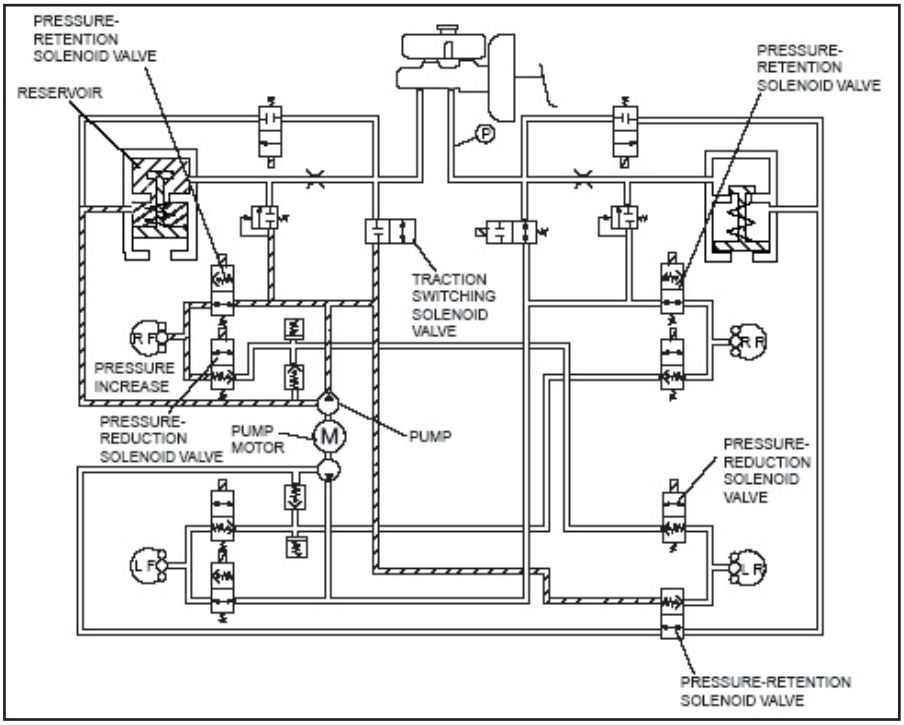


- **Right Front Pressure Increases**
- **Left Front Pressure Maintains**
- **Both Rear Wheels Pressure Decreases. During pressure reduction, bled-off pressure is stored in the accumulators**
- **After pressure reduction, the pump returns unused pressure from the accumulators back to the brake master cylinder**

	Traction switching solenoid	Stability control solenoid	Pressure-retention solenoid	Pressure-reduction solenoid	Pump motor
	LF - RR RF-LR	LF - RR RF-LR	LF-RF-LR-RR	LF-RF-LR-RR	
Pressure Increase	OFF (Open)	OFF (Closed)	ON (Closed)	OFF (Closed)	Stopped
Pressure Maintain	OFF (Open)	OFF (Closed)	ON (Closed)	OFF (Closed)	Stopped
Pressure Reduction	OFF (Open)	OFF (Closed)	ON (Closed)	ON (Open)	Operating

DSC: Oversteer Correction

- Left turn, the right front wheel is slipping, resulting in oversteer
- The pump, traction switching and stability control solenoids are energized
- Brake pressure is applied to the slipping outer front wheel or slipping drive wheel
- The inlet solenoid of the inner rear wheel is energized, closing its hydraulic circuit
- The right front wheel is slowed to correct oversteer
- Additional pressure charges the accumulator/reservoir

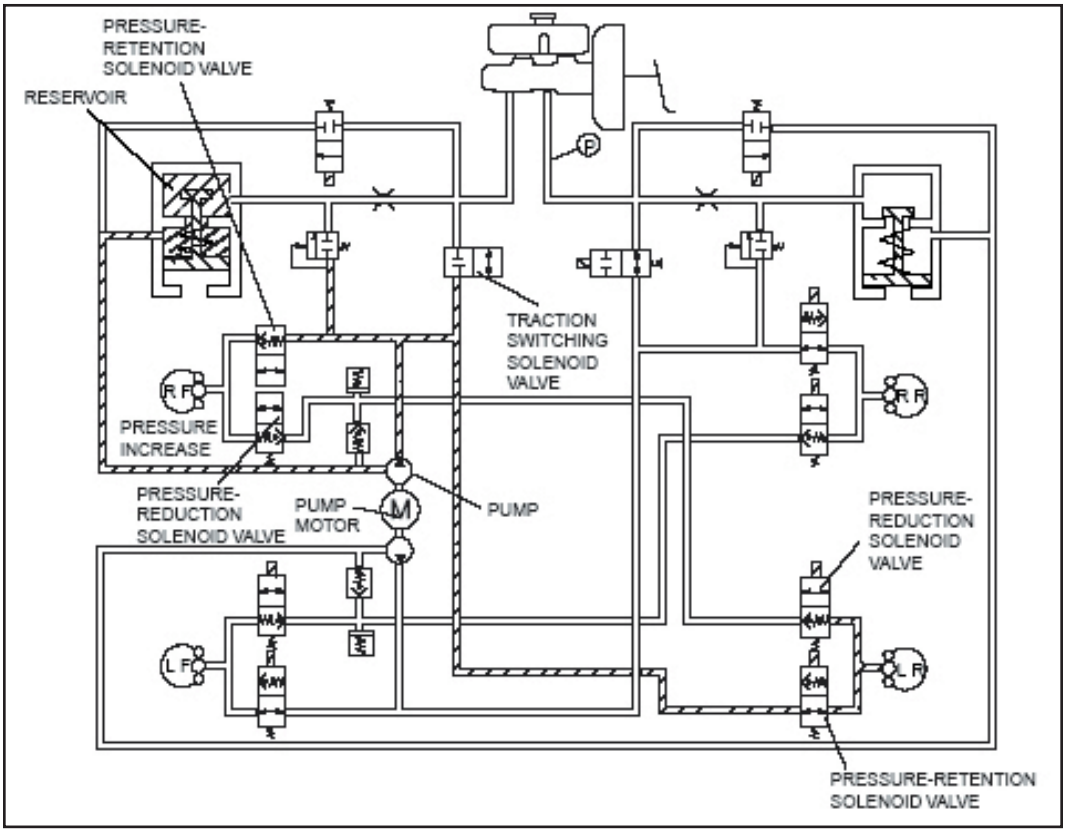


Solenoid operation during a left turn to control right front wheel spin

	Traction switching solenoid		Stability control solenoid		Pressure-retention solenoid				Pressure-reduction solenoid				Pump motor
	LF - RR	RF-LR	LF - RR	RF-LR	LF	RF	LR	RR	LF	RF	LR	RR	
Pressure Increase	OFF (Open)	ON (Closed)	OFF (Closed)		OFF (Closed)		On (Closed)	OFF (Open)	OFF (Closed)				Operating
Pressure Maintain	OFF (Open)	ON (Closed)	OFF (Closed)		OFF (Open)	On (Closed)		OFF (Open)	OFF (Closed)				Stopped
Pressure Reduction	OFF (Open)	ON (Closed)	OFF (Closed)		OFF (Open)	On (Closed)		OFF (Open)	OFF (Closed)	On (Open)	OFF (Closed)		Operating

DSC: Understeer Correction

- Left turn
- Understeer is detected
- DSC applies ABS pump, traction switching and stability control solenoids to slow the left rear wheel to correct
- The ABS pump also charges the accumulator
- Left rear wheel is slowed



Solenoid operation during a left turn to obtain target wheel speed

	Traction switching solenoid		Stability control solenoid		Pressure-retention solenoid valve				Pressure-reduction solenoid				Pump motor
	LF - RR	RF-LR	LF-RR	RF-LR	LF	RF	LR	RR	LF	RF	LR	RR	
Pressure Increase	OFF (Open)	ON (Closed)	OFF (Closed)		OFF (Open)	On (Closed)	OFF (Open)		OFF (Closed)				Operating
Pressure Maintain	OFF (Open)	ON (Closed)	OFF (Closed)		OFF (Open)	On (Closed)		OFF(Open)	OFF (Closed)				Stopped
Pressure Reduction	OFF (Open)	ON (Closed)	OFF (Closed)		OFF (Open)	On (Closed)		OFF (Open)	OFF (Closed)		ON (Open)	OFF (Closed)	Operating

TCS

TCS will back off the electronic throttle to brake engine torque and prevent wheel slip, which is a uniform correction to all wheels simultaneously.

TCS can also command the HU/CM to apply the brakes of individual wheels to make localized corrections to one or more slipping wheels.

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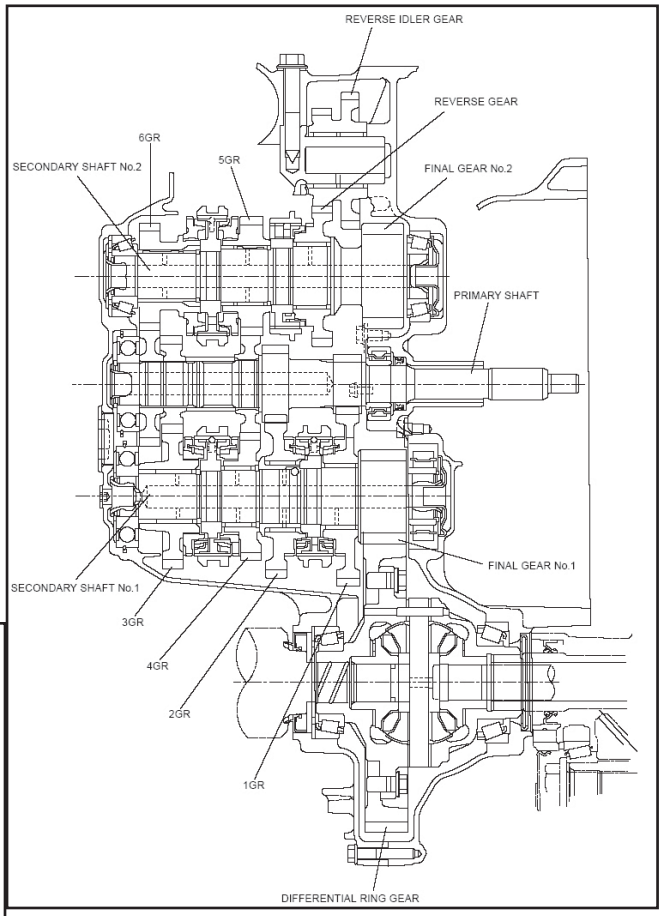
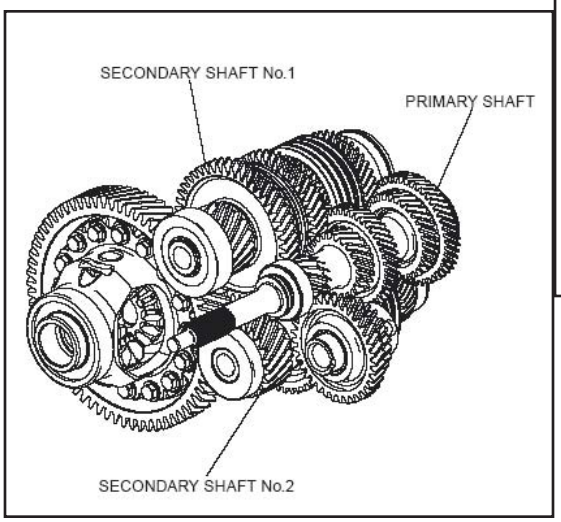
Manual Transaxle Changes

- A26 MX-R
- 6-Speed Manual Transmission
- Compact 3-shaft design keeps overall length the same as the 5-speed manual transmission
- Triple-cone synchronizers for 1st, 2nd, 3rd and 4th gears
- Double-cone synchronizers for 5th, 6th and Reverse
- Wide gear ratios to exploit the engine's power band

1st = 3.53
2nd = 2.23
3rd = 1.53
4th = 1.17
5th = 1.08
6th = 0.85
Rev = 3.83





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Steering System Changes

The steering rack stroke has been increased from 135.4 to 141.6mm to accommodate the 18 inch wheels. This also increase the distance form lock to lock from 2.54 to 2.65 turns.

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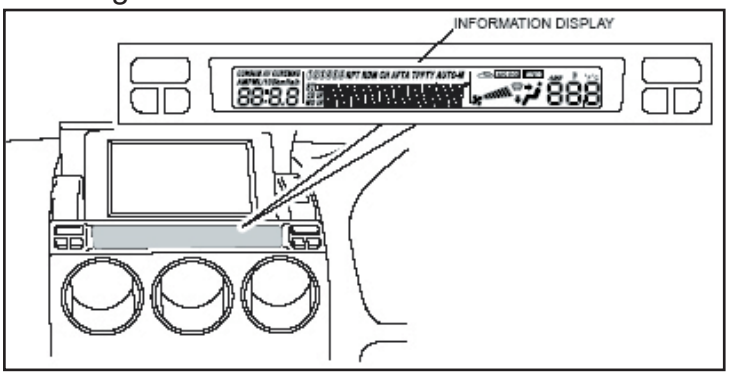
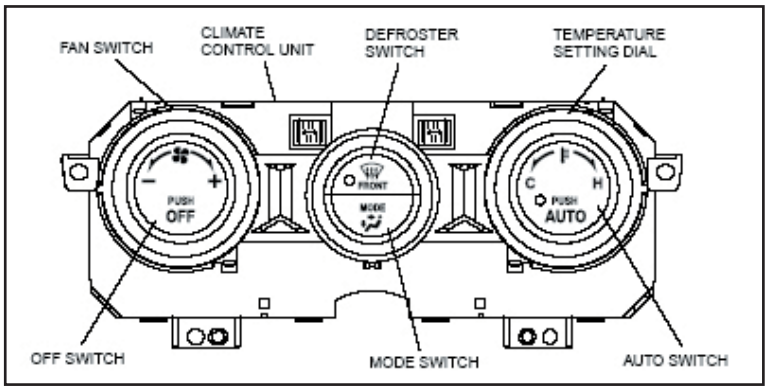
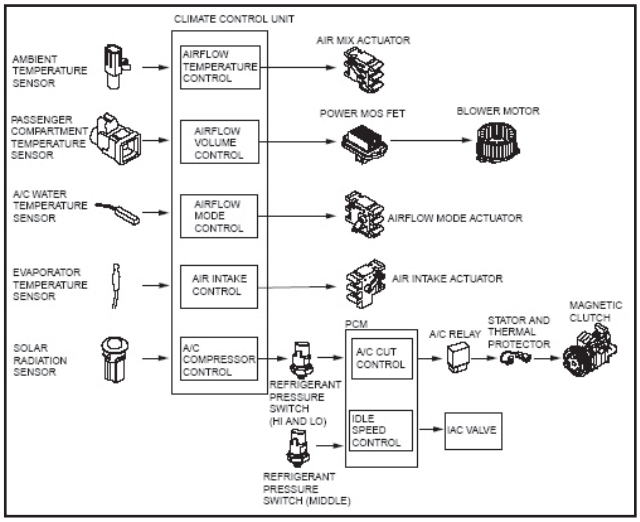
HVAC Changes

Auto AC

This has been available on MAZDA6 since 2003. Changes include combining the condenser and receiver drier together. In defrost mode, the air mode door is automatically switched to fresh air and the AC is switched on. Weight was reduced by integrating the cooling and heater units.







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Restraint System Changes

This system is the same as MAZDA6 and MAZDASPEED6 both receive the following DTCs:

DTC	Flash Code	Malfunction Location
B1317	None	SAS control module power supply voltage increases (16.1 V or more)
B1318	None	SAS control module power supply voltage decreases (less than 9 V)
B1884	18	Passenger air bag deactivation (PAD) indicator open or short to body ground
B1890	18	Passenger air bag deactivation (PAD) indicator circuit short to power supply
B2477	54	Configuration error

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Objectives

After completing this section, you will be able to:

Explain the following body and electrical changes:

- Power Windows
- Advanced Keyless Entry
- High Intensity Discharge Headlights (HID)
- Windshield Wipers
- Audio System
- NAVI
- Chassis
- Exterior
- Interior

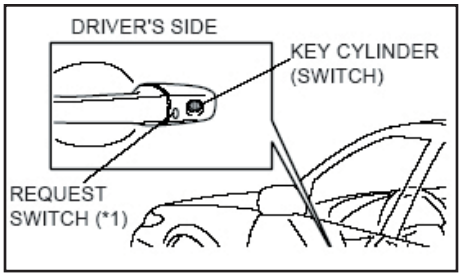
Power Windows

One touch operation

All power windows have one touch up and down capability from the master switch and the sub-switches.

Anti-pinch

To protect hands from injury during power window closing, all power windows will automatically stop and reverse direction when an object is caught between the window and upper door frame. Internal circuitry senses the amperage draw of the motor and engages auto reverse when necessary.



Automatic opening and closing functions:

	Opening	Closing
Transmitter	Hold unlock for more than 1.5-seconds all windows automatically open, (press the button a second time to stop the windows)	No applicable
Advanced keyless request switch	Not applicable	Hold drivers door advanced keyless request switch for more than 1.5 seconds until all windows close (windows will halt closing when the button is released)
Driver door key cylinder	Hold the driver key cylinder in the unlock position until all windows open	Hold driver Key cylinder in lock until all windows close completely (windows will halt the close function when the key is released)

Power window initialize procedure

Any time battery power to the power window circuit is lost several power window automatic features will not function.

- passsenger power windows will not function from the driver switch
- one-touch up and one touch down will not operate
- anti-pinch stops functioning,
- power window functions are disabled from the remote, the key in the driver door lock cylinder and the advanced keyless request switch.

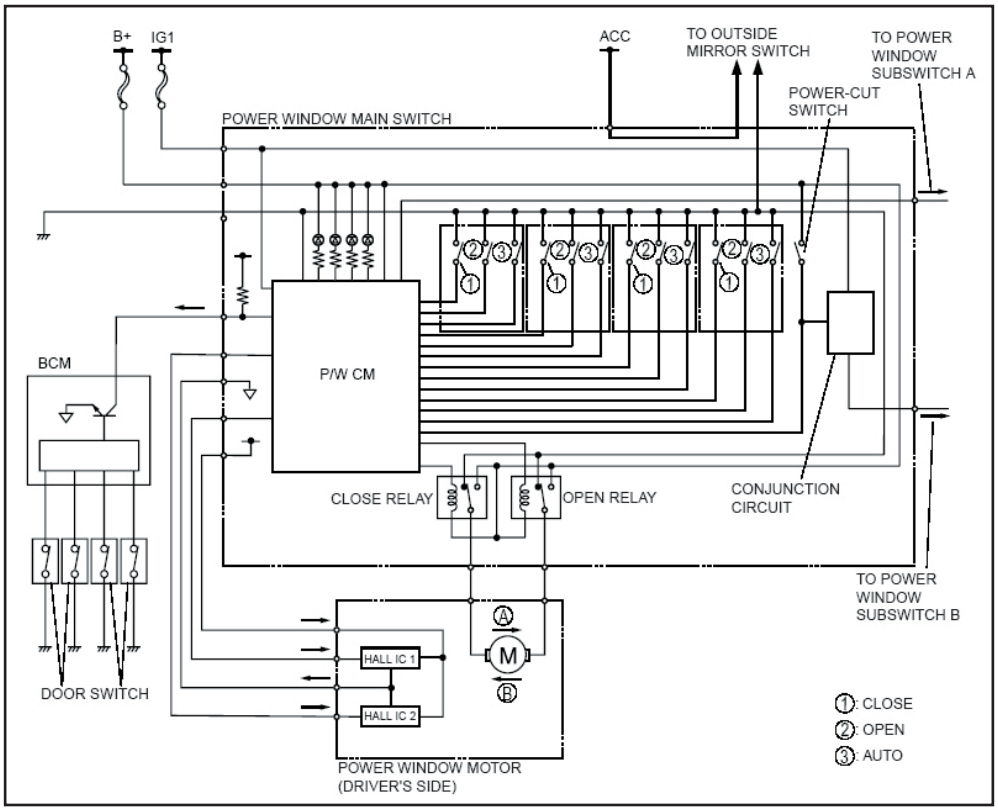
If battery power is lost to any of the passenger door switches, then just the affected door will loose the functions listed above.

If only one window is affected, perform this procedure on the affected window. If all windows are affected perform this procedure on all windows:

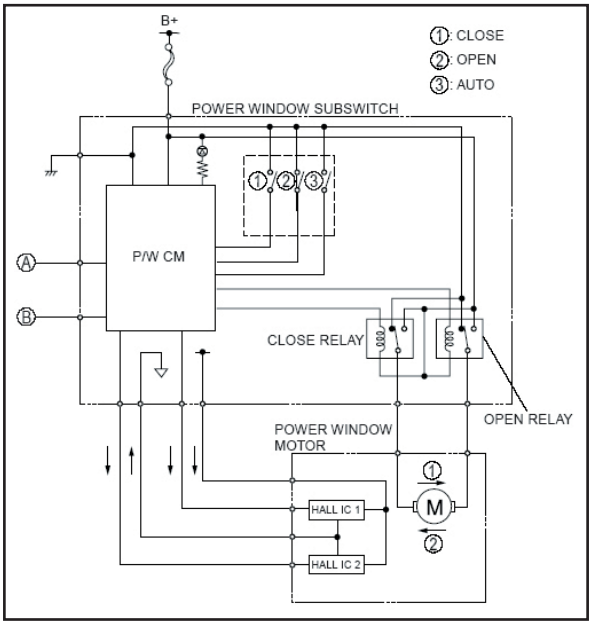
1. Roll the drivers window down
2. Roll the drivers window up
3. Hold the power window switch in the up position for more than 2-seconds
4. Repeat step 1 thru 3 at the power window sub-switch of each door
5. Verify all power window functions operate properly

I

Power Window Main Switch

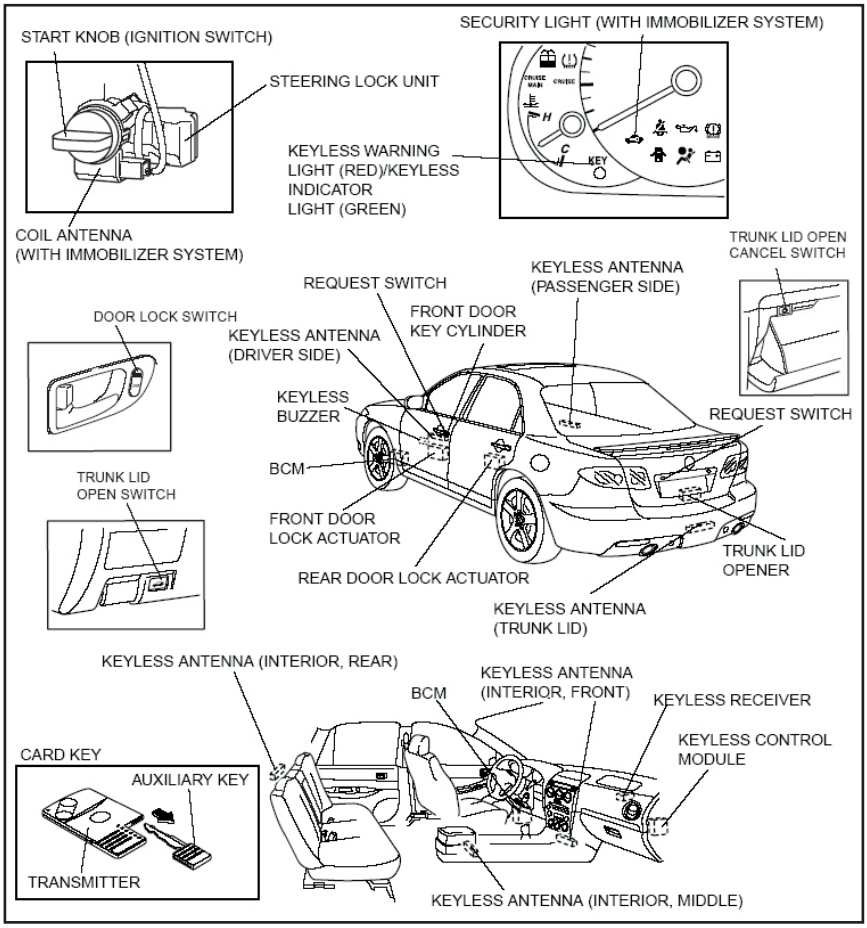


Power Window Sub Switches



Advanced Keyless System

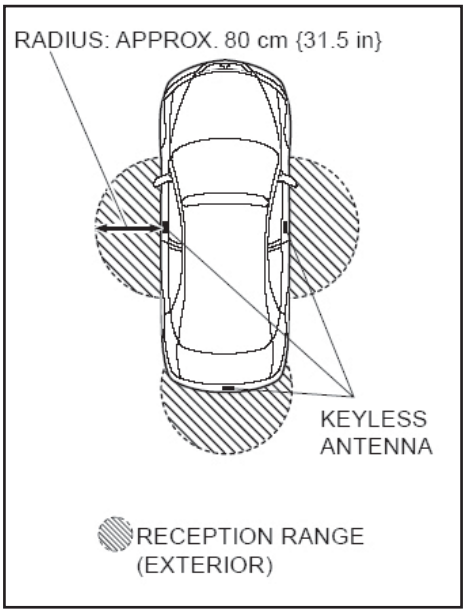
This system allows a customer to enter and start the vehicle without using a transmitter button or key.



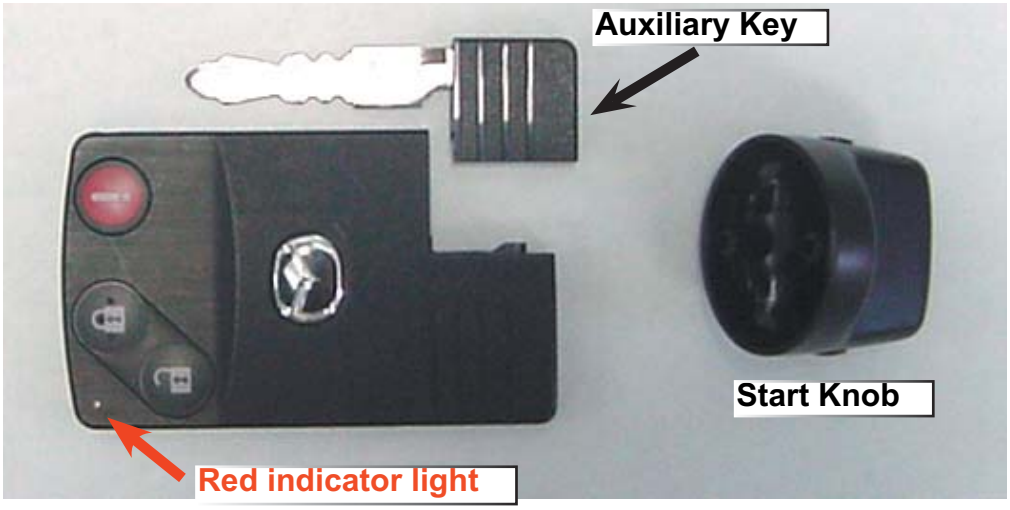
System components:

- Advanced keyless control module
- 6-antennas (driver, passenger, interior front, interior middle, interior rear, trunk)
- Keyless receiver
- 3-request switches (driver, passenger, trunk)
- 2-indicator lights (red and green) in the Instrument Cluster (IC)
- Keyless buzzer (in driver door)
- Start knob push button switch
- Up to 6 transmitters

Reception Range



Transmitter



Advanced Keyless Back-up

If the transmitter battery fails, the advanced keyless system fails or the battery dies, you can still access the vehicle and start the vehicle. There is an auxiliary key hidden inside the advanced keyless transmitter. This key will unlock the mechanical key cylinders/locks on the driver door, trunk, and glove box. This vehicle is also equipped with an auxiliary ignition cylinder. Remove the start knob by pressing the release buttons on each side of the start knob while pulling. Insert the key and turn.

Advanced Keyless System Operation

Driver Request Switch (person must have the transmitter)

Entering the vehicle	Exiting the vehicle
• Press once to unlock just the driver door* • Press twice to unlock all doors • Press a third time to lock all doors	• Press once to lock all doors • If you continue to hold the button in, all windows roll up

Passenger Request Switch (person must have the transmitter)

Entering the vehicle	Exiting the vehicle
• Press once to unlock just the passenger door* • Press twice to unlock all doors • Press a third time to lock all doors	• Press once to lock all doors (hold the button in to roll all windows up)
*Each time a request switch is pressed, a programed remotes indicator light will flash	

Trunk Request Switch (person must have the transmitter)

• Press once to unlock the trunk and all doors • Press a second time to lock the trunk and all doors Or • Press and hold until the trunk lock actuates to lock or unlock the trunk

Advanced Keyless System Buzzer and Warning Lights

Transmitter recognized	When the start knob is pressed and held, **the green "KEY" light illuminates for up to 2.5 seconds** Note: if the **green "KEY"** light flashes, replace the remote batteries. After the door is opened and when the transmitter is inside the vehicle **a red light** on the upper corner of the transmitter will flash approximately every 3 seconds
Transmitter not recognized	When the start knob is pressed, **the red "KEY" light flashes**
Advanced Keyless transmitter left inside vehicle	The power door locks will not lock
Ignition left on (Advanced Keyless transmitter removed from vehicle)	The buzzer inside the driver door sounds 3-times and **the red security light flashes**

Automatic Relocking
If the keyless transmitter moves outside the reception zone, all doors will automatically re-lock after 2-seconds. If no doors are opened (even if the transmitter is in the reception zone), the doors will re-lock after 30-seconds. This functions are turned off when the vehicle arrives and must be switched on using WDS.

Advanced Keyless Diagnosis, Transmitter & Key Programming
All diagnosis and programming of up to six-transmitters for the advanced keyless system is done with WDS or M-MDS and ESI or the new Mazda Service Support System (MS3), the replacement for ESI, for In-Codes . You can program keys and remotes separately.

- Answer Back Buzzer (RKE): during lock/unlock (factory default is ON)
- Automatic Locks (RKE): If the doors are unlocked and a door is not opened within 30 seconds, all doors relock. If the doors are unlocked and the transmitter leaves the 2.5 foot reception zone, the doors will relock after 3-seconds (factory default is OFF)
- Card Key Battery Low Warning: Green Key Light Flashes if the remote battery is weak (factory default is ON)

To change these features:

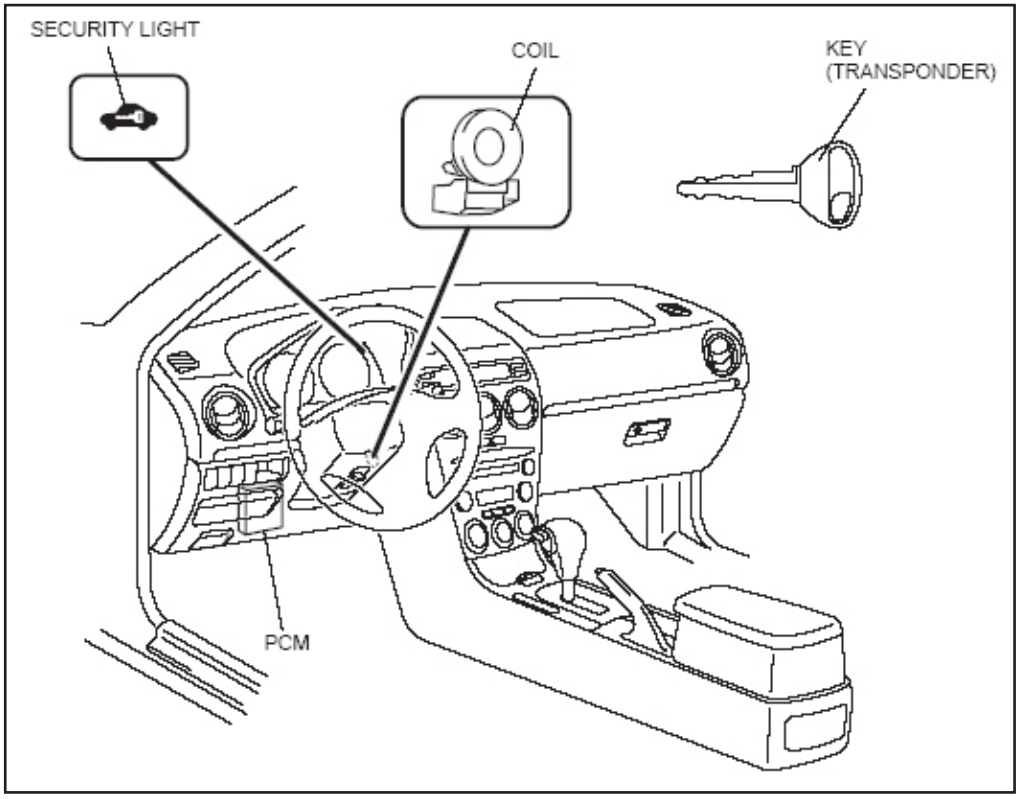
1. ID the vehicle
2. Select: Toolbox
3. Select: Module Programming
4. Select: Programmable Parameters
5. Select: RKE
6. Select the function and change it to ON or OFF as desired

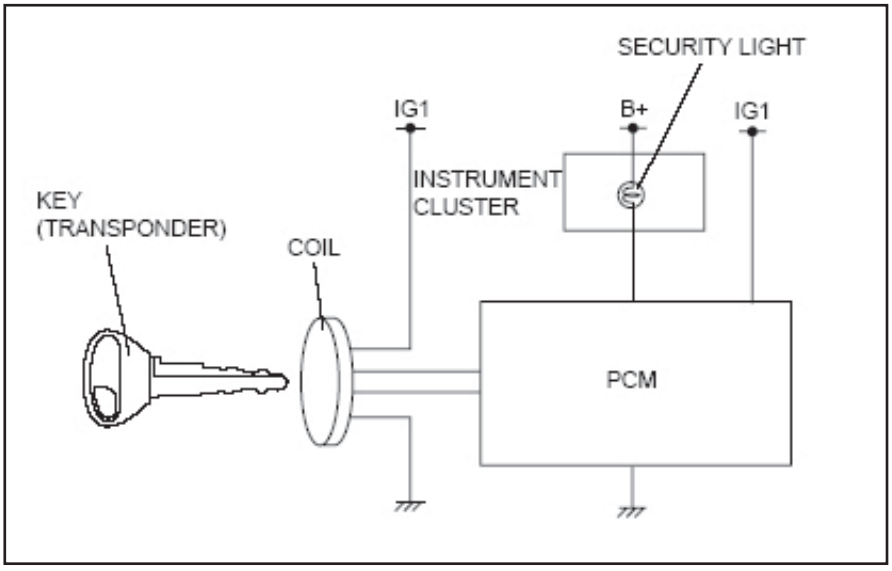
Perimeter Alarm
Standard perimeter alarm sounds the horn and flashes parking lights if any access points are opened after locking (doors, hood and trunk). An accessory shock kit is available as a dealer installed option.

Trunk Valet Function
All vehicles with advanced keyless come with tfive keys; two advanced keyless remotes, two full access keys (one hidden inside each advanced keyless remote), and 1 valet key with (grey plastic head). Pressing and holding the the trunk request switch for 5 seconds allows you to enter and exit the valet mode. Valet mode causes the trunk to stop locking and unlocking with the doors.

Immobilizer (iPATS)

The PCM, ignition coil, and keys are the main components. When a key or transmitter is recognized the engine will start. When a key or transmitter is not recognized, the engine will not start. This system requires WDS or M-MDS for diagnosis and key programming functions as well as access to ESI for In-Codes.

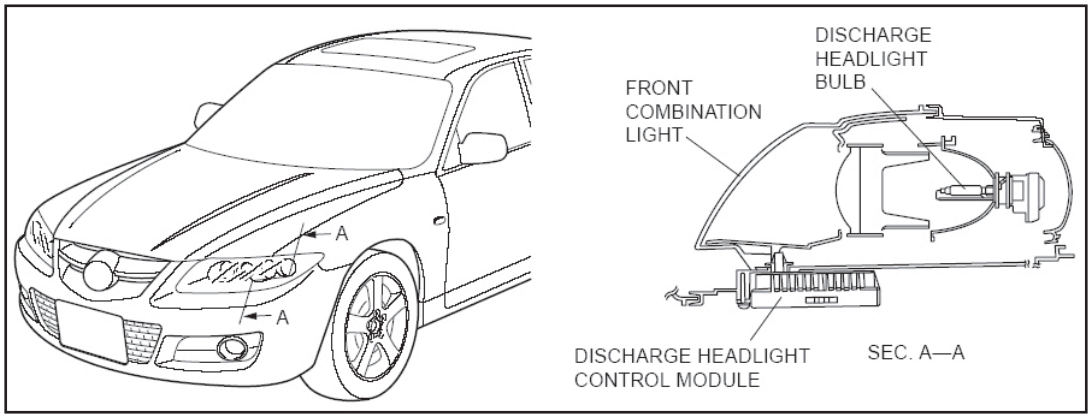




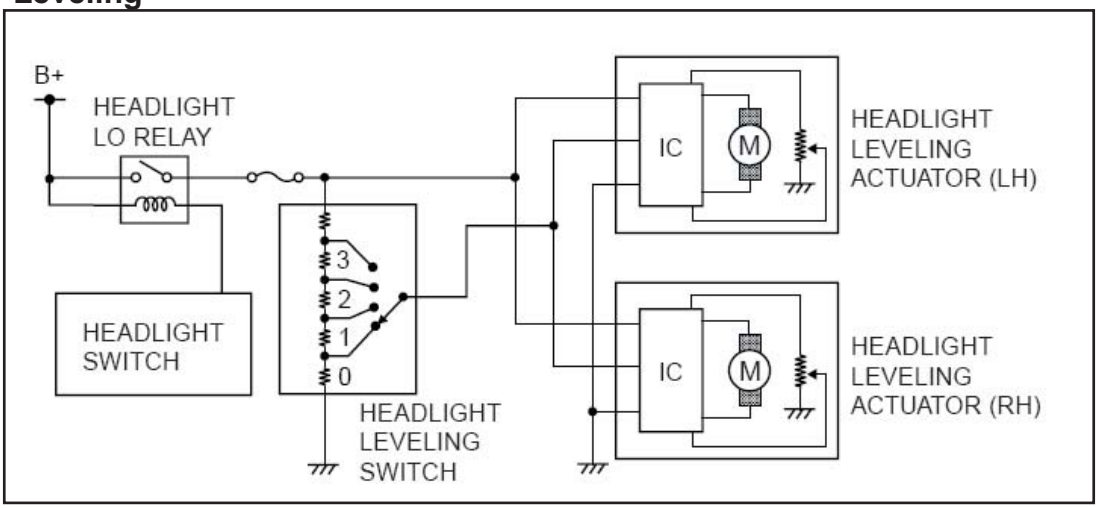
High Intensity Discharge (HID) Headlights

The high intensity discharge headlights are Xenon gas charged with 25,000 volts. The driver can adjust the height of the headlights using a 4-position leveling switch. Headlights will automatically shut off.

HID

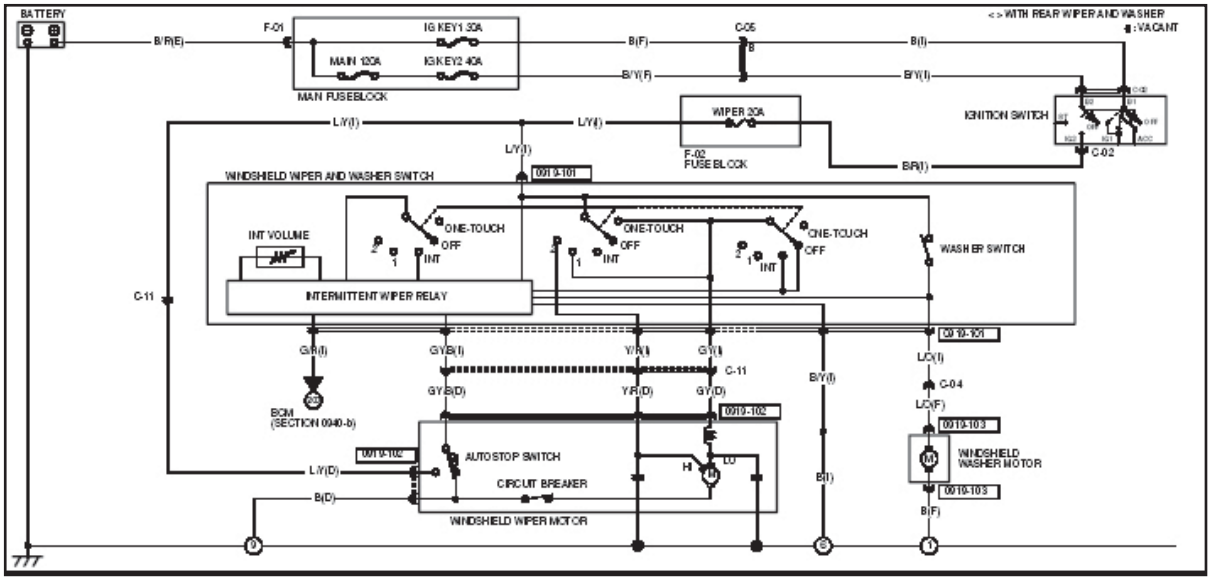


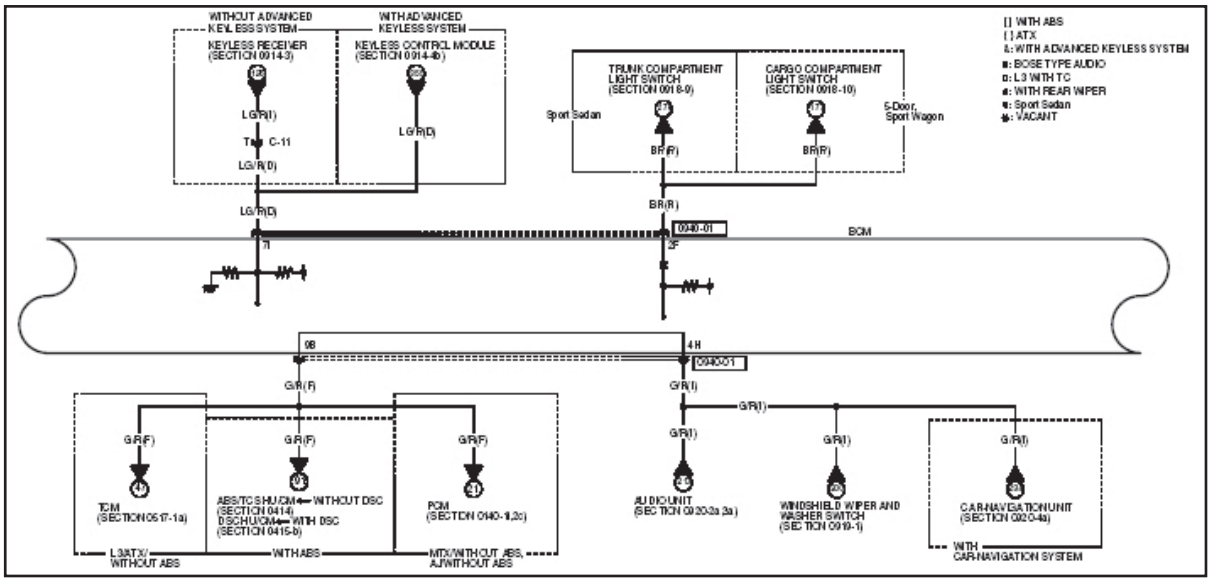
HID Leveling



Wiper Washer: Speed Sensing Wipers

In the intermittent position, the windshield wiper motor changes frequency of wipes based on vehicle speed. The wiper motor receives wiper speed control from the Body Control Module (BCM). The BCM receives vehicle speed information from the DSC HU/CM.





Audio

Standard BOSE® modular audio with:

- In-dash 6-CD changer
- 2-tweeters
- 4-speakers
- Trunk mounted subwoofer
- Sirius® satellite radio compatible
- Illuminated steering wheel audio and cruise controls

The in-dash 6-Disc CD changer can be swapped for an accessory option single CD player capable of playing MP3 files.

Audio System Removal

1. Remove the glove box damper clip and bend the stoppers inward.

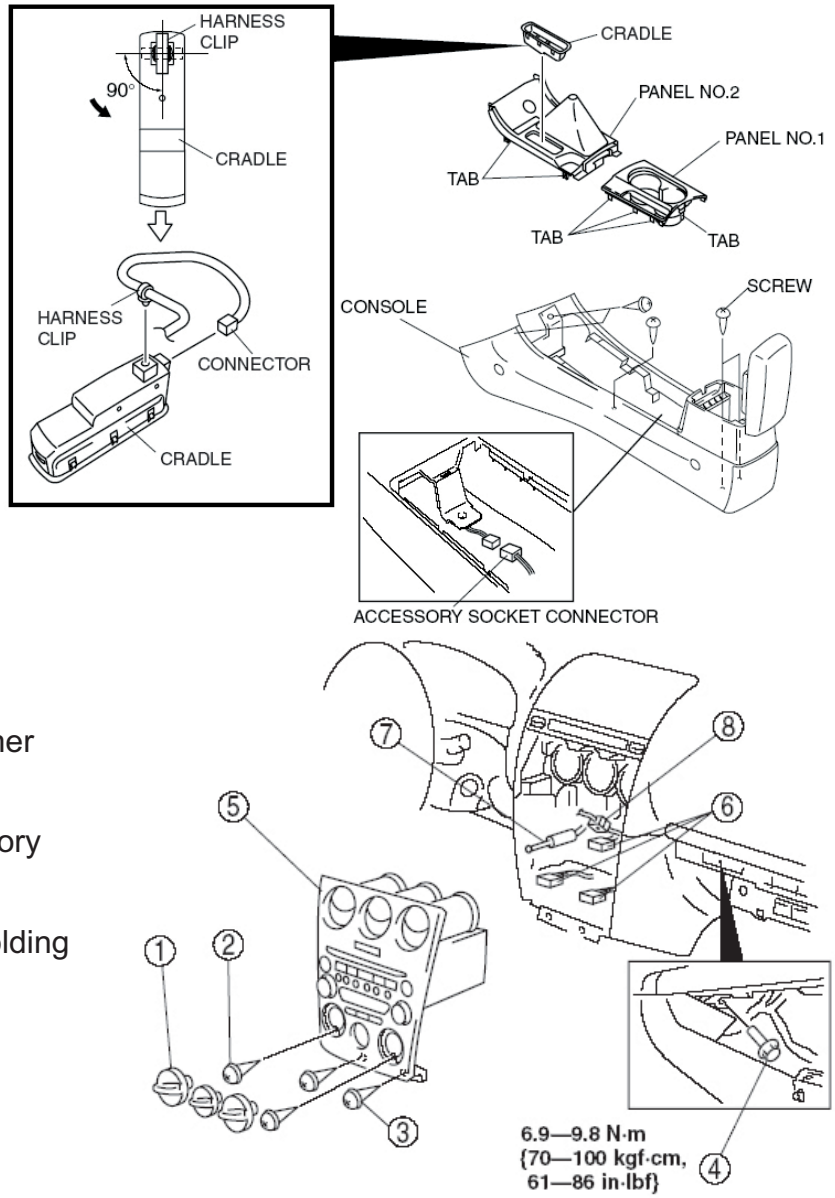
2. Remove the center console.

3. Disconnect the cigarette lighter, illumination from the ashtray and the NAVI cradle connector.

4. Remove the seat warmer switch.

5. Disconnect the accessory socket connector.

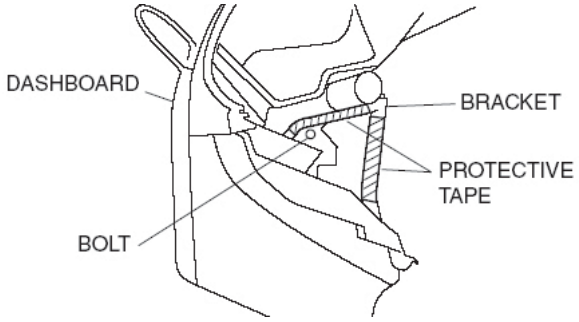
6. Remove the screws holding the finisher.



7. Remove bolt hidden behind the driver side of the dash (use protective tape to prevent cuts from sharp metal edges).

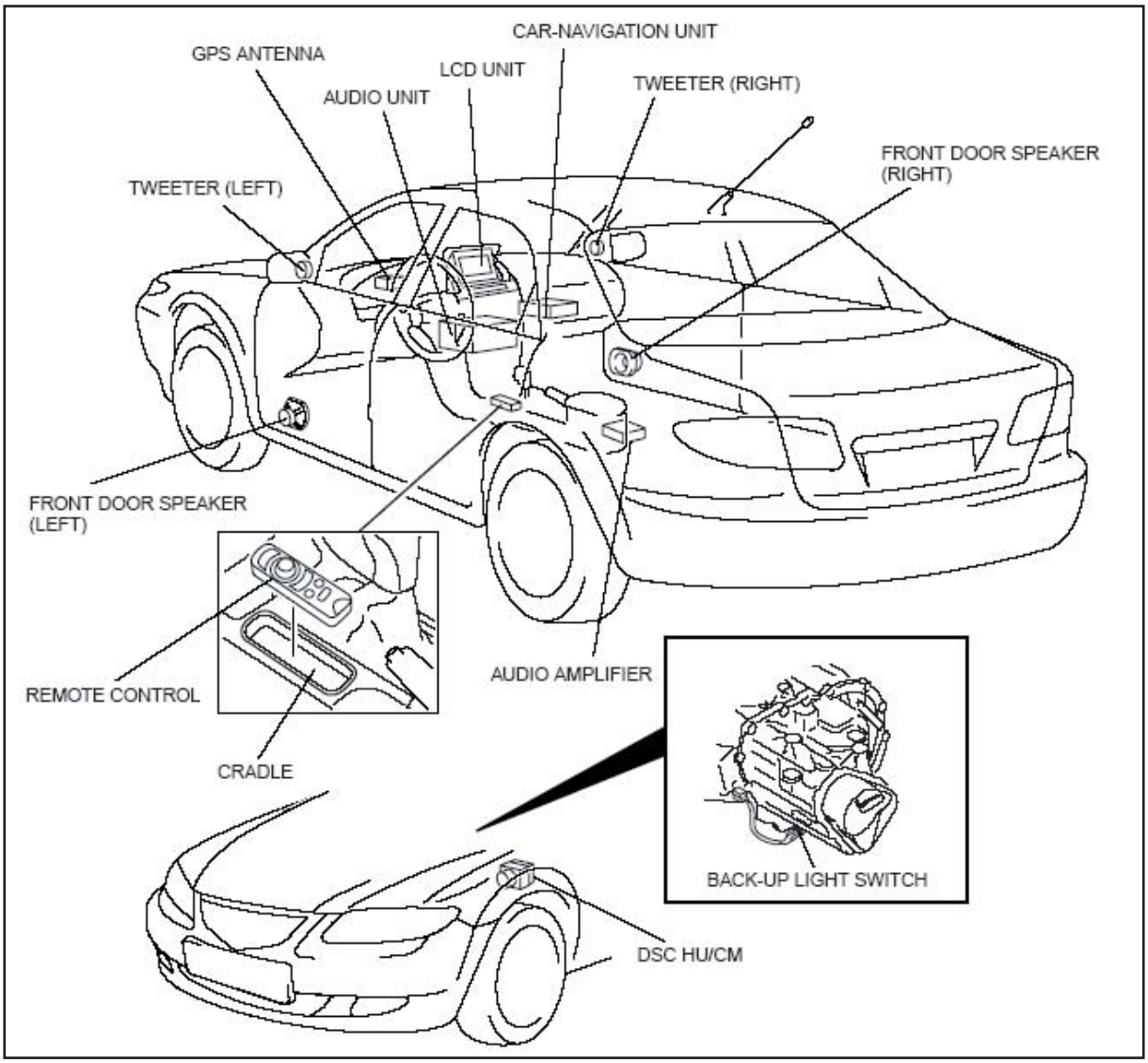
8. Remove the center panel #5.

9. Disconnect the electrical connectors.



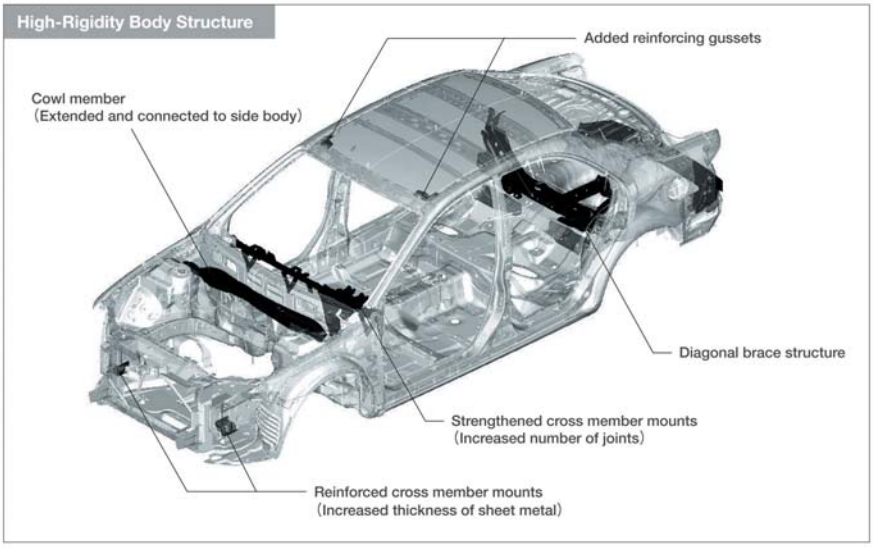
NAVI (DVD Satellite Navigation System)

- Similar to MAZDA3 and RX-8 (does not support voice commands)
- The remote control can be removed from the cradle for use by a passenger
- Maps have 3-dimensional characteristics which help show road contour
- The DVD-ROM drive which stores map data is under the front passenger seat
- There are new searching options for customers such as searching by phone number



MAZDASPEED PERFORMANCE

Chassis Stiffening to Improve Body Rigidity



- Torsional rigidity has been improved by approximately 50% over MAZDA6
- Local reinforcement on sub-assemblies to limit weight ,increase rigidity
- Advantages include overall rigid feel, improved grip of rear suspension, and steering response
- Four angled diagonal brace members added behind the rear seats (eliminating the fold down function)
- The cross members atop the floor join the left and right sides of the cabin to support the damper mounts
- The strength of the suspension mounts at the rear of the body was increased to support the greater damping force of the new rear dampers
- Increased size of the reinforcements for the inside of the bumper section strengthens the joint to the body
- The cowl has been lengthened on both ends and connected directly to stiffeners on the front damper mounts
- The numbers of joints between the instrument panel members and body were increased to create a stronger, more rigid assembly
- The body mounts for the perimeter frame to which the front suspension and engine are mounted were strengthened
- Reinforcing gussets were added to strengthen the left and right roof rails and header sections of the upper body

Body Exterior

- Hood
- Grille
- Side sills
- Rear lip spoiler
- Rear bumper with exhaust diffusers
- Front fenders
- Front bumper with fog lights
- Dark finish headlight housings
- Dark finish tail lights
- Silver painted brake calipers

Body Interior

• Stainless steel scuff plates	
• Alloy pedals	
• Front sport seats with longer seat bottom and enlarged side bolsters	
• Unique meter treatment • Unique center console finish	
• Rear seat headrests