Chevrolet

TrailBlazer

2004

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Product Information

2004 Chevrolet Trailblazer: Rugged, Yet Refined

The versatile Chevy TrailBlazer for 2004 can easily strike a balance between active everyday life and a desire to take advantage of all life has to offer. TrailBlazer and TrailBlazer EXT offer an unequaled combination of strength, power and high-tech precision, wrapped in a design that evokes patented Chevy Truck toughness and dependability.

TrailBlazer, in both 2WD and 4WD, has become a sales leader in the U.S. mid-size SUV segment. TrailBlazer EXT, with its spacious third-row seat, handles seating for seven people - with added cargo space behind the third seat. Rugged yet refined, The North Face Edition offers a lengthy list of useful features for outdoor enthusiasts.

All-new features on the 2004 TrailBlazer and TrailBlazer EXT include a last-door locking feature and new 17-inch bright aluminum wheels on TrailBlazer and TrailBlazer EXT. Both Continental and B.F. Goodrich tires will be utilized in 2004. Interior design changes include an attractive and durable monochromatic instrument panel, Light Cashmere cloth reclining bucket seats or premium two-tone leather seating surfaces. Infotainment additions for 2004 include XM Satellite (continental U.S. only) and Navigation radios.

Sure-footed and comfortable

TrailBlazer and TrailBlazer EXT don't sacrifice refined ride and handling, ample cargo and passenger space, or long-lasting dependability. The TrailBlazer EXT has room for more than 23 cubic feet (663L) of cargo space behind the third seat. The second and third rows can be folded flat to allow 107 cubic feet (3,030L) of cargo space.

TrailBlazer and TrailBlazer EXT combine authentic Chevy Truck toughness and unprecedented precision. Hydroformed steel frame side rails form a strong foundation for the truck's overall strength, optimum structural feel and ride quality. The frame's torsional stiffness helps the performance of suspension components.

TrailBlazer's five-link rear suspension combines with an independent, double-A-arm front suspension and hydraulic power-assist rack-and-pinion steering for superior responsiveness, quietness and performance, providing ride and handling more like that of a European sport sedan than a traditional truck.

Creature comforts abound

The heating/ventilation/air conditioning system (HVAC) in TrailBlazer and TrailBlazer EXT has been rated one of the best against "best-in-class" competitors, both car and truck. Its dual zones and high-airflow system warms up and cools down faster than virtually any other system in the segment or price range.

For the first time, TrailBlazer will offer optional brake and accelerator pedals that can be adjusted rearward in unison by nearly 3 inches (76.2 mm) for better positioning and comfort.

The TrailBlazer and TrailBlazer EXT driver information center has a 22-character message display, giving drivers feedback on dozens of vehicle systems and conditions. Some of the other available options on TrailBlazer and Trailblazer EXT include sun visors with lighted vanity mirrors, electrochromic inside rearview mirror with temperature gauge and compass, leather seating surfaces with eight-way power driver and passenger seats, and power lumbar, leather steering wheel and OnStar. The next-generation OnStar system provides hands-free calling, information services and many other features.

New available infotainment features include XM Satellite Radio and Navigation Radio. XM Satellite Radio (continental U.S. only) provides 100 coast-to-coast, digital-quality channels of original music, news, sports and talk. Consumers can subscribe to the basic service for $9.99 a month - less than the cost of a single CD. In addition, GM customers with GMAC financing can choose to include the XM subscription in their car payments. Navigation Radio incorporates a dash-mounted GPS system and display with the vehicle's sound system.

TrailBlazer and TrailBlazer EXT in LT trim include an overhead console with Universal Garage Transmitter and Travelnote. Universal Garage Transmitter allows vehicle owners to program up to three different signals for items such as the garage door opener, house lights or an electric gate. Travelnote can record brief reminders on a digital voice recorder.

Proven powertrains

TrailBlazer's standard Vortec 4200 4.2L I-6 engine combines advanced technology with the proven balance of an inline-six engine to offer power and smoothness, and excellent fuel efficiency. The naturally balanced configuration virtually eliminates shake and idle roll. The standard Vortec 4200 engine delivers the most horsepower in its segment - 275 hp (373 kw) with 275 lb.-ft. of torque (373 Nm) for strong trailer towing capacity. It meets or exceeds all sound requirements while providing outstanding 0-to-60-mph and 50-to-70-mph performance.

TrailBlazer EXT offers some added power for pulling or payload with an optional Vortec 5300 5.3L V-8. This advanced design is the first Vortec V-8 featuring an aluminum block, and it delivers 290 hp (216 kw) and 325 lb.-ft. of torque (441 Nm). A properly equipped TrailBlazer EXT can tow up to 7,200 pounds (3,266 kg). The aluminum block provides reduced mass and superior thermal efficiency to enhance performance and fuel efficiency. The engine also is cleaner than its predecessors and meets federal and California Ultra Low Emissions Vehicle (ULEV) standards.

Both the Vortec 4200 I-6 and aluminum Vortec 5300 V-8 are mated to GM's proven Hydra-Matic 4L60-E four-speed automatic transmission.

Getting there safely

The TrailBlazer and TrailBlazer EXT offer excellent visibility and a commanding view of the road. The strong safety package includes standard four-wheel vented disc anti-lock brakes (ABS) as well as dual-stage air bags for front seating positions and three-point restraint systems for all seating positions (including the middle rear). Side-impact air bags for front seating positions are also available.

And to help provide a smoother, quieter ride, an advanced system of 12 specially tuned body mounts uses hydraulics and rubber pads to isolate road inputs and noise, limiting vibration and harshness dramatically on any kind of road or trail.

An Autotrac four-wheel-drive system is standard on 4x4 models. Traction control is available as an option for two-wheel-drive models.

The North Face Edition

The North Face Edition package, available in both two- and four-wheel-drive TrailBlazer and TrailBlazer EXT models, offers unique features that appeal to outdoor enthusiasts. The exterior features standard unique 17-inch sport aluminum wheels, lower accent-color body cladding, body-colored outside rearview mirrors, running lamps, headlamp washers and B-pillar badging.

The interior offers unique leather accents and The North Face badged seats, mesh map pockets, rain-sense wipers, liftgate lighting, an underfloor storage cargo liner, heavy-duty floor/cargo mats, an adjustable cargo shelf with a table (EXT model only) and The North Face duffel bags and blanket. Several other features are required in order to get The North Face Edition package, including blackwall tires, skid plates (4WD models), locking rear differential and heated seats.

Chevy Trailblazer And GM Accessories Offer Unequaled Style and Convenience

Whether customers are looking for style or convenience, GM Accessories and Chevy TrailBlazer are aimed at sport utility buyers looking to make a distinctive, personal statement. From the trailer-hitch receiver cover to the assist steps and other exterior enhancements, GM Accessories are engineered to provide the ideal fit, style and performance for the active lifestyles of TrailBlazer owners.

"With GM Accessories, owners can make the TrailBlazer suit their individual needs," said Bob Triulzi, general director of GM Accessories at GM Service and Parts Operations. "Since they're engineered specifically for the Chevy TrailBlazer, our accessories will provide the perfect fit, style and performance required."

Accessorize for style and convenience

The sleek, low-profile, molded hood protector is an attractive addition to personalize the vehicle. Crafted to work in tandem with the TrailBlazer, the molded hood protector will not create side-view mirror vibrations.

To assist TrailBlazer owners in and out of the vehicle, extruded aluminum assist steps have been purpose-designed for functionality and style. The assist steps feature extruded plastic step pads, injection-molded plastic end caps and a double tube step appearance. They come in black anodized and clear anodized aluminum.

To protect and cover the trailer-hitch opening, a receiver cover clips into the trailer hitch receiver and helps prevent corrosion by preventing dirt and water from entering the hitch receiver area. The addition of this cover completes the vehicle's rear bumper fascia look.

The grille guard gives a customized appearance while protecting the vehicle's front grille on busy city streets and brutal off-road terrain. The grille guard features gaskets at all contact points on the brush guard, eliminating metal-to-metal contact.

With a variety of innovative packages available to mix or match, the sky's the limit for customers looking to enhance the TrailBlazer's appearance.

Custom splash guards protect the vehicle from mud, dirt, snow, salt and gravel, while enhancing its look. Made of a long-lasting, high-grade material, the guards will not chip, crack or tear - even in extreme temperatures.

Maximum comfort is the goal with side-window weather deflectors. The weather deflectors let the fresh air in, but keep rain, sleet and snow out. Custom-designed to fit the vehicle exactly, this functional accessory also complements the distinctive contours and styling of the Chevy TrailBlazer.

Available at Chevrolet dealers

All GM Accessories can be purchased through Chevrolet dealerships.

GM Accessories permanently installed on a new GM vehicle at the time of delivery will be covered under the GM New Vehicle Limited Bumper-to-Bumper Warranty. GM Parts and Accessories permanently installed by a GM dealer after vehicle purchase will be covered for the balance of the New Vehicle Warranty, but in any event no less than 12 months or 12,000 miles.

Please visit www.gmaccessorieszone.com or call toll-free 866-901-9001 to speak to one of SPO's knowledgeable agents.

SPO, headquartered in Grand Blanc, Mich., markets automotive replacement parts and accessories worldwide under the GM Parts and ACDelco brand names. For more information, visit the GM Goodwrench Web site at http://www.gmgoodwrench.com.

New For 2004

- Optional electrical adjustable brake and accelerator pedals
- Monochromatic instrument panel
- Last-door locking feature
- Front stabilizer bar size change
- New unique 17-inch sport aluminum wheel standard on The North Face Edition models
- New 17-inch bright aluminum wheel standard on TrailBlazer, optional on TrailBlazer EXT
- Both Continental and B.F. Goodrich tires will be utilized
- New series of radios that incorporate XM Satellite Radio (continental U.S. only) and Navigation Radio
- New exterior colors include: Medium Red Metallic, Sandstone Metallic (replaces Sandalwood) and Silverstone Metallic (replaces Pewter)
- New Light Cashmere cloth reclining bucket seats
- New Light Cashmere premium two-tone leather seating surfaces

Model Lineup

	Engines		Transmission
	Vortec 4200 4.2L I-6	**Vortec 5300 5.3L V-8**	**4-spd auto (Hydra-Matic 4L60-E)**
TrailBlazer			
LS	s	-	s
LT	s	-	s
TrailBlazer EXT			
LS	s	o	s
LT	s	o	s

Standard s
Not available –
Optional o

Specifications

Overview		
Models:	Chevrolet TrailBlazer and Chevrolet TrailBlazer EXT	
Body style / driveline:	4-door, 5- and 7-passenger, front-engine, 2- and 4-wheel-drive mid-size utilities	
Construction:	body on frame	
EPA vehicle class:	mid-size sport utility	
Manufacturing location:	TrailBlazer: Moraine, Ohio, and Oklahoma City, Oklahoma TrailBlazer EXT: Oklahoma City, Oklahoma	
Key competitors:	Ford Explorer, Jeep Grand Cherokee, Dodge Durango, Toyota 4-Runner	
Engines	**Vortec 4200 4.2L I-6 (LL8)**	**Vortec 5300 5.3L V-8 (LM4)**
Application:	standard on TrailBlazer and TrailBlazer EXT	optional on TrailBlazer EXT
Type:	4.2L inline six cylinder	5.3L V-8
Displacement (cu in / cc):	256 / 4195	325 / 5328
Bore & stroke (in / mm):	3.66 x 4.01 / 93 x 102	3.78 x 3.27 / 96 x 92
Block material:	cast aluminum	cast aluminum
Cylinder head material:	cast aluminum	cast aluminum
Valvetrain:	dual overhead camshafts, variable cam phasing - exhaust cams, 4 valves per cylinder	overhead valves, camshaft in block, 2 valves per cylinder
Ignition system:	coil-on-plug, platinum-tipped spark plugs	coil near plug
Fuel delivery:	sequential fuel injection	sequential fuel injection
Compression ratio:	10.1:1	9.5:1
Horsepower (hp / kw @ rpm):	275 / 205 @ 6000	290 / 216 @ 5200
Torque (lb-ft / Nm @ rpm):	275 / 373 @ 3600	325 / 441 @ 4000
Recommended fuel:	unleaded regular	unleaded regular
Maximum engine speed (rpm):	6300	5900
Emissions controls:	catalytic converter; NLEV	evaporative system, catalytic converter, exhaust gas recirculation, positive crankcase ventilation; NLEV
Estimated fuel economy (mpg city / hwy / combined):	2003 EPA (2004 N/A) TrailBlazer 2WD: 16 / 22 / 19 TrailBlazer 4WD: 15 / 21 / 18 TrailBlazer EXT 2WD: 15 / 20 / 17 TrailBlazer EXT 4WD: 15 /20 / 17	2WD: 15 / 19 / 17 4WD: 14 / 18 / 16
Transmission	**Hydra-Matic 4L60-E**	
Type:	4-speed automatic transmission, rear-wheel drive, electronically controlled automatic overdrive with torque converter clutch	
Gear ratios (:1):		
First:	3.059	
Second:	1.625	
Third:	1.000	
Fourth:	0.696	
Reverse:	2.294	
Final drive ratio:	3.42:1; 3.73:1 and 4.10:1* are optional (*not optional on V-8)	

Chassis/Suspension		
Front:	independent, double A-arm, 46-mm shocks, 34-mm stabilizer	
Rear:	5-link solid axle, 36-mm shocks, 34-mm stabilizer bar on 2WD, 24-mm stabilizer bar on 4WD	
Transfer case system:	Autotrac (standard on 4WD)	
Steering type:	rack-and-pinion (hydraulically assisted)	
Steering ratio:	TrailBlazer: 20.4:1; TrailBlazer EXT: 18.5:1	
Steering wheel turns, lock-to-lock:	TrailBlazer: 3.82; TrailerBlazer EXT: 3.48	
Turning circle, curb-to-curb (ft / m):	TrailBlazer: 36.4 / 11; TrailBlazer EXT: 39.6 / 12	
Brakes	**TrailBlazer**	**TrailBlazer EXT**
Type:	4-wheel vented disc with front aluminum dual piston calipers, standard	4-wheel ABS; drum-in-hat parking brake 4-wheel vented disc with front aluminum dual piston calipers, standard 4-wheel ABS; drum-in-hat parking brake
Rotor diameter x thickness (in / mm):	front: 12 x 1.14 / 305 x 29; rear: 12.8 x 0.78 / 325 x 20	front: 12.8 x 1.14 / 325 x 29; rear: 12.8 x 0.78 / 325 x 20
Total swept area (sq in / sq cm):	front: 210 / 1353; rear: 217 / 1397	front: 228 / 1469; rear: 217 / 1397
Wheels/Tires	**TrailBlazer**	**TrailBlazer EXT**
Wheel size & type:	std: 16-inch cast aluminum; opt: 17-inch bright aluminum; North Face: 17-inch sport aluminum	std: 17-inch bright aluminum; North Face: 17-inch sport aluminum
Tires:	std: P245/70R16; opt: P245/65R17 North Face: P245/65R17	P245/65R17 North Face: P245/65R17

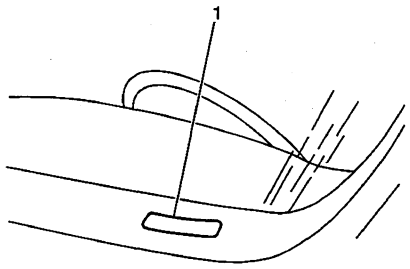
Dimensions

Exterior	TrailBlazer	TrailBlazer EXT
Wheelbase (in / mm):	113 / 2870	129 / 3277
Overall length (in / mm):	191.8 / 4872	207.8 / 5279
Overall width (in / mm):	74.6 / 1895	74.7 / 1897
Overall height, with side rails (in / mm):	74.5 / 1892	77.1 / 1957
Track (in / mm):	front: 63.1 / 1603; rear: 62.1 / 576	front: 63.1 / 1603; rear: 62.1 / 1576
Minimum ground clearance (in / mm):	8 / 203	8 / 203
Ground to top of load floor (in / mm):	32.1 / 817	31.9 / 810
Step-in height, 2WD (in / mm):	19.7 / 500	18.9 / 480
Approach angle:	29°	2WD: 34.6° 4WD: 34.1°
Departure angle:	23°	2WD: 23.1° 4WD: 23.6°
Curb weight (lb / kg):	2WD: 4425 / 2007 4WD: 4612 / 2092	2WD w/Vortec 4200: 4773 / 2165 4WD w/Vortec 4200: 4954 / 2247 2WD w/Vortec 5300: 4822 / 2187 4WD w/Vortec 5300: 5077 / 2303
Weight distribution (% front / rear):	2WD: 53 / 47 4WD: 54 / 46	2WD w/Vortec 4200: 52 / 48 4WD w/Vortec 4200: 53 / 47 2WD w/Vortec 5300: 52 / 48 4WD w/Vortec 5300: 53 / 47
Interior	**TrailBlazer**	**TrailBlazer EXT**
Seating capacity:	1st row: 2; 2nd row: 3 (total 5)	1st row: 2; 2nd row: 3 3rd row: 2 (total 7)
Head room (in / mm):	1st row: 40.2 / 1021 2nd row: 39.6 / 1006	1st row: 40.2 / 1021 2nd row: 39.6 / 1006 3rd row: 38.5 / 978
Leg room (in / mm):	1st row: 42.9 / 1090 2nd row: 37 / 940	1st row: 42.9 / 1090 2nd row: 37 / 940 3rd row: 31.2 / 792
Shoulder room (in / mm):	1st row: 58.5 / 1486 2nd row: 58.5 / 1486	1st row: 58.5 / 1486 2nd row: 58.5 / 1486 3rd row: 58.3 / 1481
Hip room (in / mm):	1st row: 56 / 1422 2nd row: 58.2 / 1478	1st row: 56 / 1422 2nd row: 58.1 / 1476 3rd row: 45.9 / 1167
Cargo length floor (in / mm):	70 / 1778	85.5 / 2180
Cargo volume (cu ft / L):	2nd row seat up: 43.7 / 1237 behind 1st row seat: 80.1 / 2268	3rd row seat up: 23.4 / 663 2nd row seat up: 66.5 / 1883 behind 1st row seat: 107 / 3030

Capacities	TrailBlazer	TrailBlazer EXT (Vortec 4200)	TrailBlazer EXT (Vortec 5300)
GVWR, standard (lb / kg):	2WD: 5550 / 2494 4WD: 5750 / 2608	2WD: 6200 / 2812 4WD: 6400 / 2903	2WD: 6200 / 2812 4WD: 6400 / 2903
Payload, base (lb / kg):	2WD: 1125 / 510 4WD: 1138 / 516	2WD: 1147 / 520 4WD: 1446 / 656	2WD: 1378 / 625 4WD: 1393 / 632
Trailer towing maximum (lb / kg):	2WD: 6300 / 2858 4WD: 6100 / 2766	2WD: 6000 / 2721 4WD: 5800 / 2630	2WD: 7100 / 3220 4WD: 6700 / 3039
Maximum tongue weight (lb / kg):	400 / 181 (without sway control)	400 / 181 (without sway control)	400 / 181 (without sway control)
Fuel tank (gal / L):	22 / 83.3	25 / 94.6	25 / 94.6
Engine oil (qt / L):	7 / 6.6	7 / 6.6	6 / 5.7
Cooling system (qt / L):	13.9 / 13.1	15.2 / 14.3	17.9 / 16.9

Vehicle Identification

Vehicle Identification Number (VIN)



The vehicle identification number (VIN) plate is the legal identifier of the vehicle. The VIN plate is located on the upper LH corner of the Instrument Panel and can be seen through the windshield from the outside of the vehicle:

Position	Definition	Character	Description
1	Country of Origin	1,4	U.S. Built
2	Manufacturer	G	General Motors
3	Make	C H K N T	Chevrolet Truck Oldsmobile MPV GMC MPV Chevrolet MPV GMC Truck
4	GVWR/Brake System	D E	5001-6000/Hydraulic 6001-7000/Hydraulic
5	Truck Line/Chassis Type	S T	Sm Conventional Cab--4x2 Sm Conventional Cab--4x4
6	Series	1	½ Ton Nominal
7	Body Type	3 6	GMT 360 GMT 370
8	Engine Type	S P	GM 4.2L L6 MFI (LL8) GM 5.3L V8 SFI (LM4)
9	Check Digit	--	Check Digit
10	Model Year	4	2004
11	Plant Location	K 2 X 6	Linden, NJ Moraine E.E.M.S Oklahoma City
12-17	Plant Sequence Number	--	Plant Sequence Number

VIN Derivative

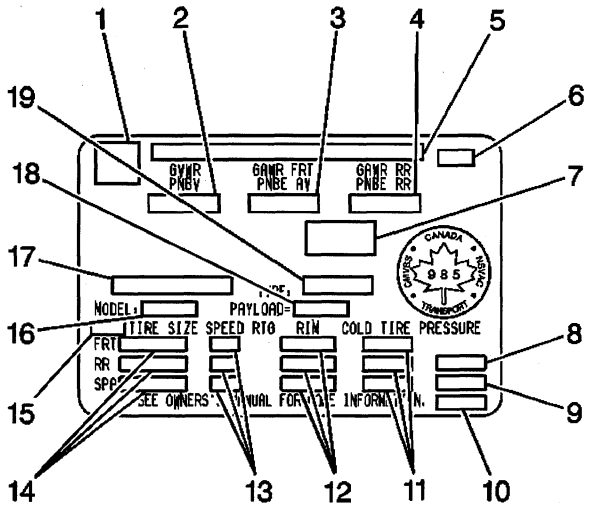
All engines and transmissions are stamped or laser etched with a partial vehicle identification number (VIN), which was derived from the complete VIN. A VIN derivative contains the following nine positions:

Position	Definition	Character	Description
1	GM Division Identifier	C H K N T	Chevrolet Truck Oldsmobile MPV GMC MPV Chevrolet MPV GMC Truck
2	Model Year	4	2004
3	Assembly Plant	K 2 X 6	Linden, NJ Moraine E.E.M.S Oklahoma City
4-9	Plant Sequence Number	--	Plant Sequence Number

A VIN derivative can be used to determine if a vehicle contains the original engine or transmission, by matching the VIN derivative positions to their accompanying positions in the complete VIN:

VIN Derivative Position	Equivalent VIN Position
1	3
2	10
3	11
4-9	12-17

Label Certification with RPO Z49



(1) Logo
(2) Gross Vehicle Weight Rating
(3) Gross Axle Weight Rating - Front
(4) Gross Axle Weight Rating - Rear
(5) Name of Manufacturer
(6) Final Manufacturer's Date
(7) RFI Statement - Canada Only
(8) DUAL - When Equipped
(9) Front Axle Reserve - When Equipped
(10) Total Capacity - When Required
(11) Tire Pressure
(12) Rim Size
(13) Speed Rating - When Required
(14) Tire Size
(15) GVW Rating Code
(16) Engineering Model
(17) Vehicle Identification Number
(18) Payload
(19) Model Designation

The vehicle certification label displays the following assessments:

- The Gross Vehicle Weight Rating (GVWR)
- The Gross Axle Weight Rating (GAWR) -- Front and Rear
- The vehicle's payload rating
- The original equipment tire sizes and the recommended tire pressures

Gross vehicle weight (GVW) is the weight of the vehicle and everything it carries. Include the following items when figuring the GVW:

- The base vehicle weight factory weight
- The weight of all vehicle accessories, like the winches or the plows
- The weight of the driver and the passengers
- The weight of the cargo

The gross vehicle weight must not exceed the Gross Vehicle Weight Rating.

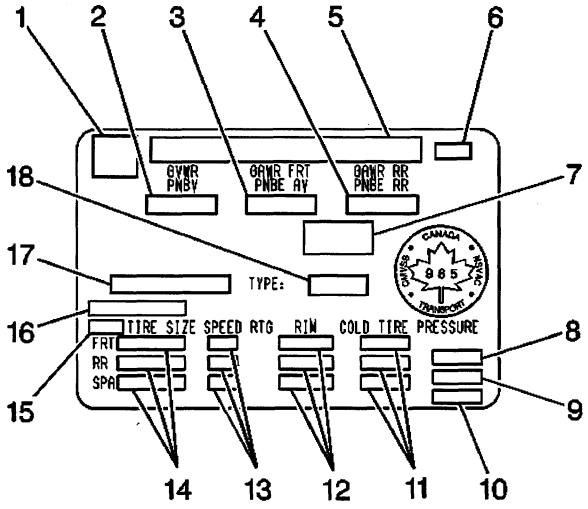
The front gross axle weight rating (GAWR FRT) is the weight exerted on the front axle. The rear gross axle weight rating (GAW RR) is the weight exerted on the rear axle. The front and rear gross axle weights must not exceed the front and rear gross axle weight ratings.

The payload rating defines the vehicle's maximum allowable cargo load. The cargo load includes the driver and the passengers. The payload rating is based on the vehicle's factory installed equipment. Deduct from the payload rating the weight of accessories added to the vehicle after the final date of manufacture .

The vehicle may have a Gross Combination Weight Rating (GCWR). The Gross Combination Weight Rating refers to the total maximum weight of the loaded tow vehicle including driver and passengers and a loaded trailer.

The vehicle tires must be the proper size and properly inflated for the load the vehicle is carrying.

Label Certification with RPO Z49 – Incomplete Vehicle



(1) Logo
(2) Gross Vehicle Weight Rating
(3) Gross Axle Weight Rating - Front
(4) Gross Axle Weight Rating - Rear
(5) Name Of Manufacturer
(6) Manufacturer's Date
(7) RFI Statement - Canada Only
(8) DUAL - When Equipped
(9) Front Axle Reserve - When Required
(10) Total Capacity - When Required
(11) Tire Pressure - Spare Optional
(12) Rim Size - Spare Optional
(13) Speed Rating - When Required - Spare Optional
(14) Tire Size - Spare Optional
(15) GVW Rating Code
(16) Engineering Model
(17) Vehicle Identification Number
(18) Model Designation

The vehicle certification label displays the following assessments:

- The Gross Vehicle Weight Rating (GVWR)
- The Gross Axle Weight Rating (GAWR) -- Front and Rear
- The vehicle's payload rating
- The original equipment tire sizes and the recommended tire pressures

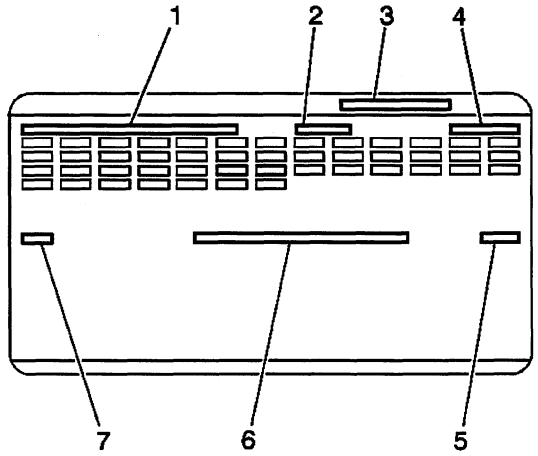
Gross vehicle weight (GVW) is the weight of the vehicle and everything it carries. Include the following items when figuring the GVW:

- The base vehicle weight factory weight
- The weight of all vehicle accessories, like the winches or the plows
- The weight of the driver and the passengers
- The weight of the cargo

The gross vehicle weight must not exceed the Gross Vehicle Weight Rating.

The front gross axle weight rating (GAWR FRT) is the weight exerted on the front axle. The rear gross axle weight rating (GAW RR) is the weight exerted on the rear axle. The front and rear gross axle weights must not exceed the front and rear gross axle weight ratings.

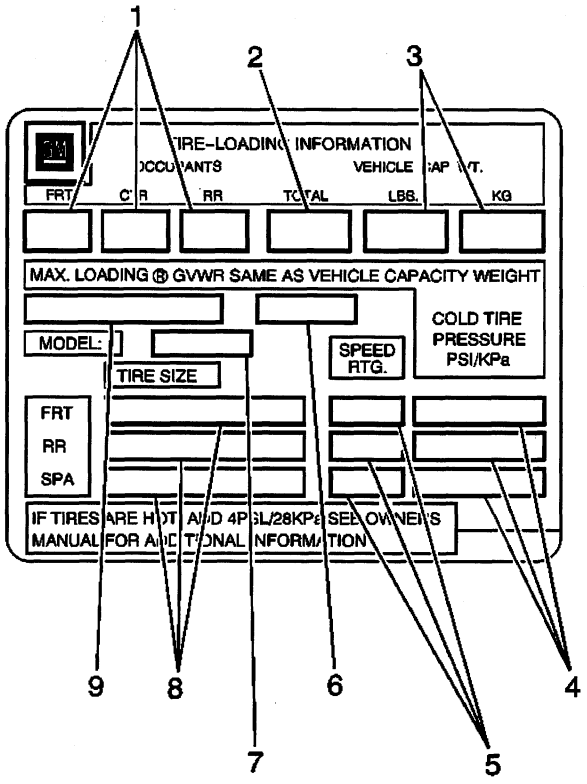
Service Parts Identification Label (SPID)



(1) Vehicle Identification Number
(2) Wheel Base
(3) Part Number Location
(4) Model Designation
(5) Order Number
(6) Exterior Color
(7) Paint Technology

The service parts identification label is located on the instrument panel storage compartment door in order to help service and parts personnel identify the vehicle's original parts and the vehicle's original options.

Tire Placard



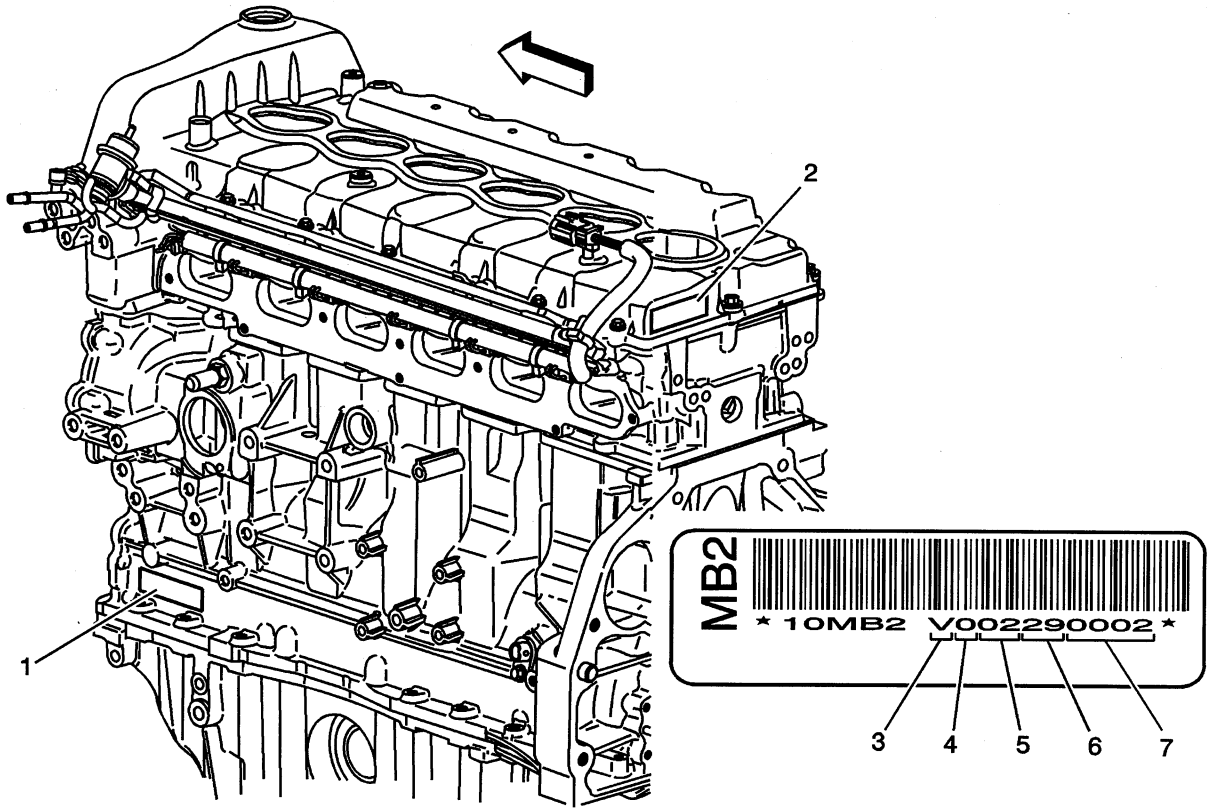
(1) Specified Occupant Seating Positions
(2) Total Occupant Seating
(3) Maximum Vehicle Capacity Weight
(4) Tire Pressures, Front, Rear, and Spare
(5) Tire Speed Rating, Front, Rear, and Spare
(6) Tire Label Code
(7) Engineering Model Minus First Character
(8) Tire Sizes, Front, Rear, and Spare
(9) Vehicle Identification Number

The Tire Placard is permanently located on the edge of the driver's door. Refer to the placard in order to obtain the following information:

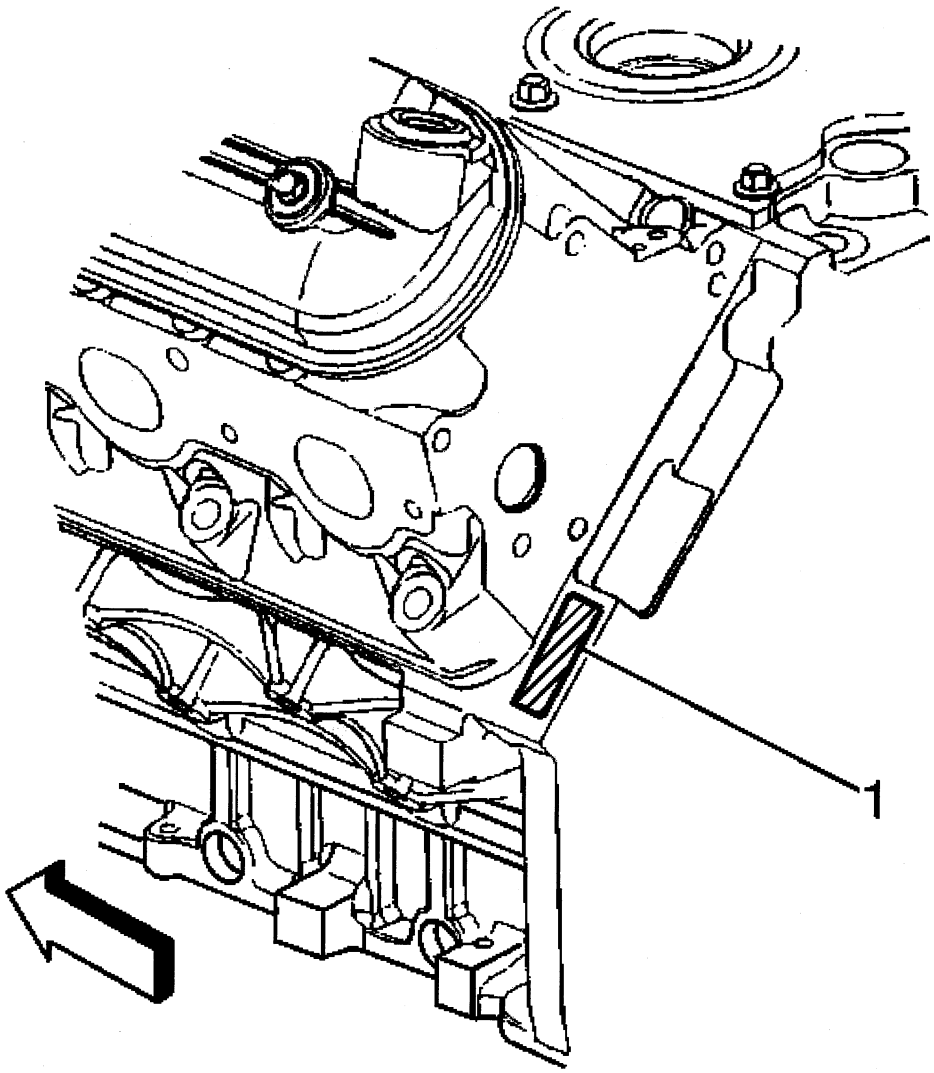
- The maximum vehicle capacity weight
- The cold tire inflation pressures
- The tire sizes (original equipment tires)
- The tire speed ratings (original equipment tires)

Engine ID and VIN Derivative Location

4.2L L6 Engine



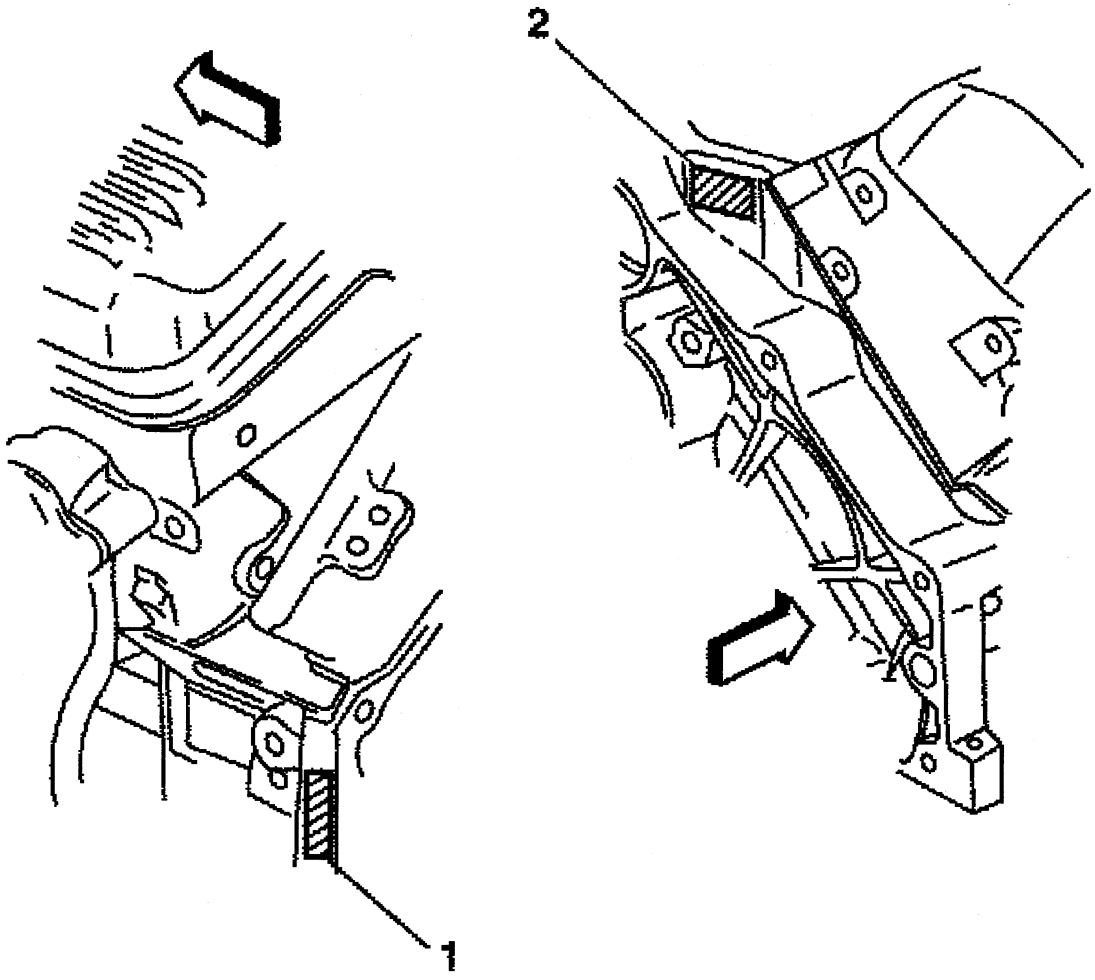
(1) Transmission ID Location
(2) Engine ID Location
(3) The first digit identifies the engine build location - All first digits will be a V, this engine is only being built at Flint Engine South
(4) The second digit identifies the build year
(5) The third and fourth digits identify the build month
(6) The fifth and sixth digits identify the build date
(7) The seventh through tenth digits identify the engine build sequence



The vehicle identification number (VIN) is located on the left side rear of the engine block (1) and is typically a nine digit number stamped or laser-etched onto the engine at the vehicle assembly plant.

- The first digit identifies the division.
- The second digit identifies the model year.
- The third digit identifies the assembly plant.
- The fourth through ninth digits are the last six digits of the VIN.

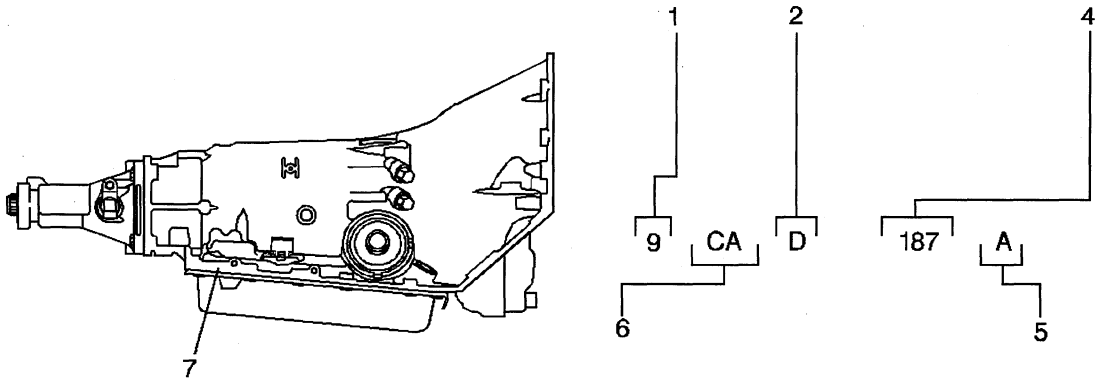
5.3L V-8 Engine

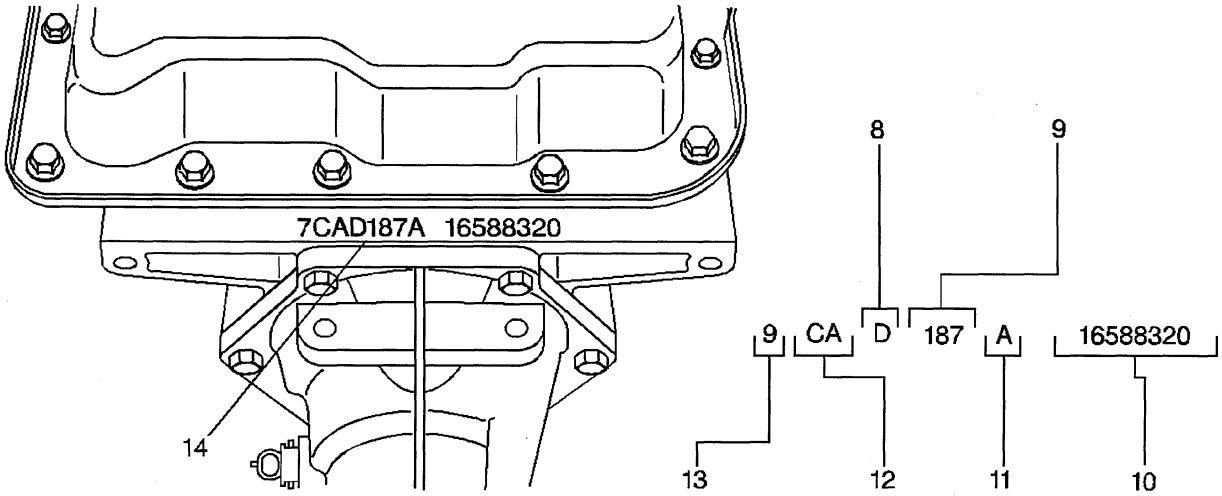


(1) Primary Engine Identification Number Location
(2) Secondary Engine Identification Number Location

Transmission ID and VIN Derivative Location

4L60-E Transmission ID Location





(1) Model Year
(2) Hydra-Matic 4L60-E
(4) Julian Date (or Day of the Year)
(5) Shift Built (A, B, J = First Shift; C, H, W = Second Shift)
(6) Model
(7) Transmission ID Location
(8) Hydra-Matic 4L60-E
(9) Julian Date (or Day of the Year)
(10) Serial No.
(11) Shift Built (A, B, J = First Shift; C, H, W = Second Shift)
(12) Model
(13) Model Year
(14) Transmission ID Location

Plant and Shift Build Chart

Plant	Build Line	1st Shift	2nd Shift	3rd Shift
Toledo, OH	ML1	J	W	X
	ML2	A	C	Not Used
	ML3	B	H	Not Used
	ML4	S	L	V
	ML5	K	E	Z
Romulus, MI	1	A	--	B
Ramos Arizpe, Mexico	1	A	--	--

Engine and Transmission Usage

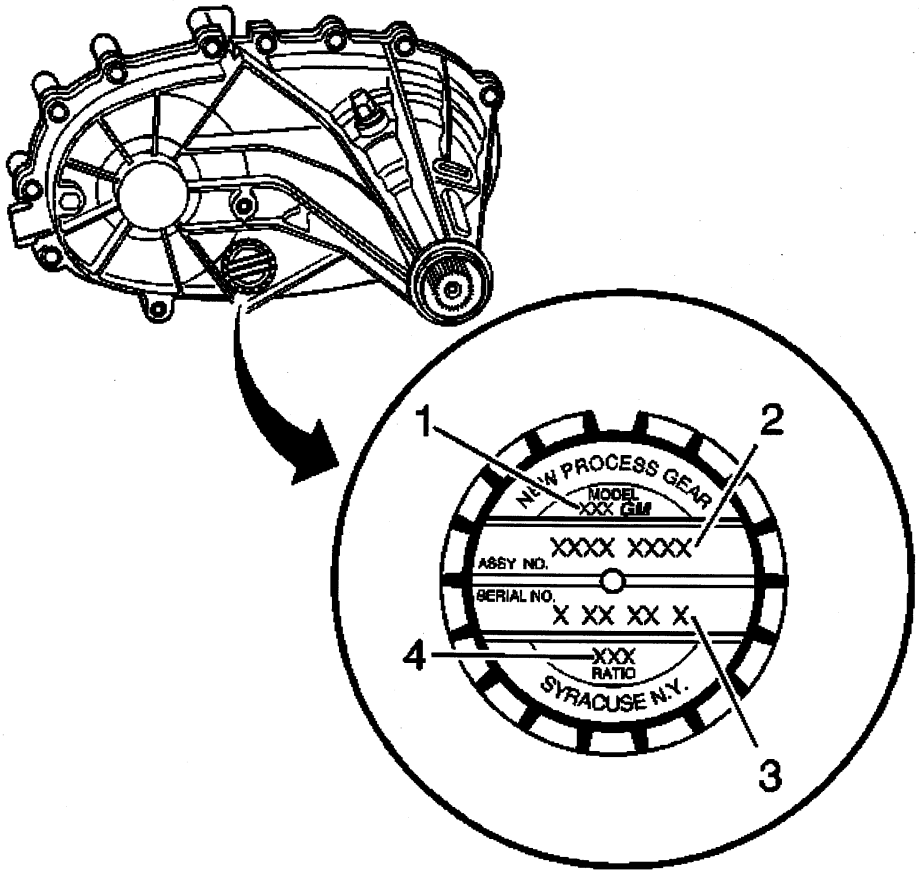
Standard (360)

Model	Engine		Transmission	
	Base	Option	Base	Option
S155 (06,16) T155 (06, 16)	4.2L, V6, MFI, DOHC	--	4L60E - Automatic, 4 speed	--
Model Codes: S-Two-Wheel Drive and T-Four-Wheel Drive 06--Four-Door Utility 16--Two-Door Utility				

Extended (EXT) (370)

Model	Engine		Transmission	
	Base	Option	Base	Option
S155 (06,16) T155 (06, 16)	4.2L, V6, SFI, DOHC (LL8)	5.3L SFI V8 (LM4)	4L60E (M30)	--
Model Codes: S-Two-Wheel Drive and T-Four-Wheel Drive 06--Four-Door Utility 16--Two-Door Utility				

Transfer Case Identification

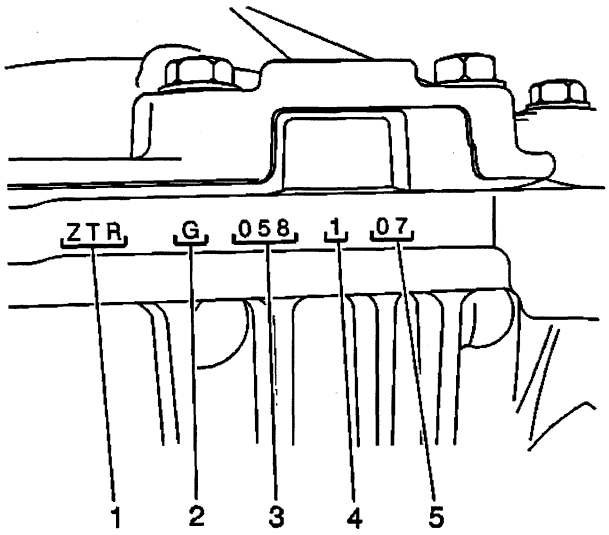


An identification tag is attached to the rear half of the transfer case. The tag provides the following information:

1 Model number (1)
   A First Digit-1 =Single Speed, 2=Two-Speed
   B Second Digit-2 = T Utility, 3 =T-Truck, L-Van, 4 or 6 = K Truck and Utility
   C Third Digit-1 = Manual, 3 = Electric Shift, 6 = Automatic, 9 = All Wheel Drive
2 Assembly number (2)
3 Serial number (Date and Shift Code) (3)
4 Low range reduction ratio (4)

The information on this tag is necessary for servicing the transfer case. If the tag is removed or becomes dislodged during service operations, keep the identification tag with the unit.

Axle Identification – Front



(1) Broadcast Code
(2) Supplier Code (G = American Axle)
(3) Julian Date (Day of Year)
(4) Shift Built (1 = First Shift; 2 = Second Shift) (Optional for 8.25" and 9.25" axles)
(5) Hour Built

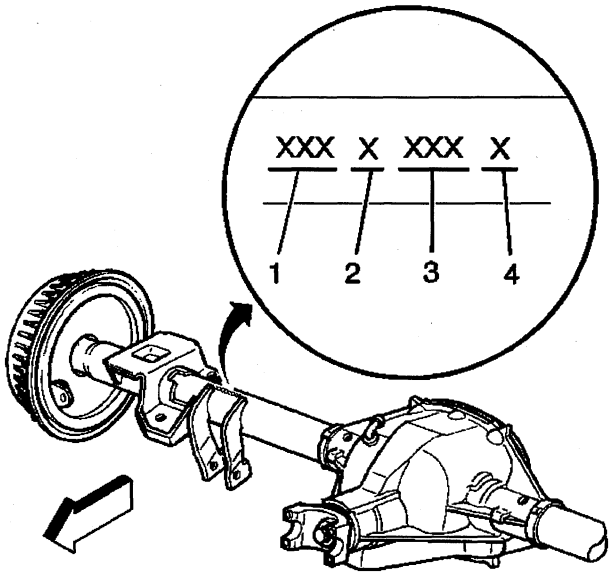
Front axle identification information is stamped on the top of the differential carrier assembly.

The following broadcast codes identifies the axle ratio:

Broadcast Code	Ratio
ZTM	3.08
ZTN, ZTU, ZTW, ZSY, ZA2, ZC2	3.42
ZTP, ZTR, ZTS, ZTX, ZSZ, ZB2,ZD2	3.73
ZTT,ZF2	4.10
ZH2	4.56

The information on the differential carrier assembly is necessary for servicing.

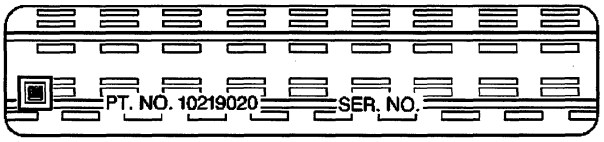
Axle Identification – Rear



(1) Rear Axle Ratio
(2) Build Source (C = Buffalo; K = Canada)
(3) Julian Date
(4) Shift Built (1 = First; 2 = Second)

All rear axles are identified by a broadcast code on the right axle tube near the carrier. The rear axle identification and manufacturer's codes must be known before attempting to adjust or to repair axle shafts or the rear axle case assembly. Rear axle ratio, differential type, manufacturer, and build date information is stamped on the right axle tube on the forward side.

Labeling - Anti-Theft



Notice

The anti-theft label found on some major body panels MUST be covered before performing any painting, rustproofing or undercoating procedures. The mask must also be removed following those procedures. Failure to follow these precautionary steps may result in liability for violation of the Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

Federal law requires General Motors (GM) to affix a label to certain parts on selected vehicles with the Vehicle Identification Number (VIN). The purpose of this law is to reduce the number of motor vehicle thefts by helping in the tracing and recovery of parts from stolen vehicles. The certification label on the driver's door qualifies as a theft deterrent label.

The theft deterrent label will be permanently affixed to an interior surface of the part and will contain the complete VIN. The label on replacement parts will contain the letter R, the manufacturer's logo, and the acronym for the Department of Transportation (DOT). DO NOT deface, or remove these labels.

RPO Code List

The production/process codes provide the description of the Regular Production Options (RPOs) used on the vehicle. The RPO list is printed on the Service Parts Identification Label. The following is a list of the RPO abbreviations and the description of each:

RPO	Description
AAB	Memory Driver Convenience Package
AJ1	Window Tinted, Deep Tint All Except W/S and Doors
AJ7	Inflatable Restraint System Seat, Driver and Passenger, Front and Side
AK5	Inflatable Restraint System Seat, Driver and Passenger
AL6	Restraint Cargo
AM7	Seat, Rear Folding
AM9	Seat Rear Split Back, Folding
AP9	Net Convenience
AR9	Seat Front Bucket, Deluxe
ATZ	Rear Seat Not Installed
AU0	Lock Control Remote Entry
AU5	Lock Control, Entry Remote Entry, Low Power
AU8	Lock Control, Entry Remote Entry, Specific Frequency
AX4	Restraint Conversion Seat, Manual, European
A26	All Windows, European Glazing
A50	Front Bucket Seat
BAE	Equipment Security System, Immobilization
BAG	Parts Package Export
BG2	Rear Floor Mat Covering
BNB	Unpainted Exterior Ornamentation
BVE	Side Steps Runningboard
B3N	Front and Rear Auxiliary Floor Mat Covering - Not Desired
B30	Covering Floor Carpet
B32	Covering Front Floor Mats, Auxiliary
B33	Covering Rear Floor Mats, Auxiliary
B42	Covering Floor Mat, Luggage Compartment, Fitted
B84	Molding B/S Exterior
B94	Ornamentation Exterior Emblem, Body, Variation 1
CE1	Wiper System Windshield, Pulse, Moisture Sensitive
CE4	Washer Headlamp, High Pressure
CF5	Electrical Sliding Glass Sun Roof
CJ2	HVAC System Air Conditioner Front, Automatic Temperature Control, Auxiliary Temperature Control
CJ3	HVAC System Air Conditioner Front, Manual Temperature Control, Auxiliary Temperature Control
CKD	Vehicle Completely Knocked Down
COP	Control Interim Change (Occupant Protection)
C4D	GVW Rating 5, 550 lbs
C49	Defogger RR Window, Electric
C5N	GVW Rating 5,750 lbs
C7H	GVW Rating 6, 400 lbs (2, 900 kg)
DAY	Plant Code, Moraine, OH, USA
DD7	Mirror I/S R/V, Light Sensitive Compass
DF5	Mirror I/S R/V Light Sensitive Compass, O/S Temperature Display
DH2	Mirror I/S Front Van Left and Right, Illuminated, with Dual Sunshade
DK2	Left and Right Outside Mirror, Remote Control, Electric, Heated, Color
DK7	Console Roof Interior, Custom

RPO	Description
DK9	Left and Right Outside Mirror, Remote Control, Electric, Heated, Turn Signal Indicator, Color
DL2	Left and Right Outside Mirror, Remote Control, Electric, Heated, Power FOlding, Turn Signal Indcator, Color
DNR	Equipment Dealer Installed
DP1	Mirror Provisions Convex Glass
DR1	Mirror, O/S Left and Right, Manual Control, Color
DS3	Left and Right Outside Mirror, Remote Control, Electric, Heated, Manual Folding, Turn Signal Indicator, Color
DT4	Ashtray Cigar Lighter
EB1	GVW Rating 6.001 lbs
EC0	Provisions, European Compliant HVAC Controls
EVA	Test DVT, EVAP Emission Requirement
E09	Equipment Additional, Europe
E12	Equipment Additional, Japan
F0F	Fleet Incentive Tourism Industry, Inc. DBA Budget Sales & Leasing
GT4	Axle Rear 3.73 Ratio
GT5	Axle Rear 4.10 Ratio (Dup with GT8)
GU6	Axle Rear 3.42 Ratio
G67	Level Control Auto, Air
G80	Axle Positraction Limited, Slip
JE1	Brake System Europe
JF4	Power Adjustable Pedals
JF8	Brake Vac Power, 4 Whl Disc
KA1	Heater Seat, Front
KG3	Generator 145 Amp
KG4	Generator 150 Amp
K05	Heater Engine Block
K18	Electric Air Injection Reactor System
K34	Cruise Control Automatic, Electronic
LL8	Engine, Gas, 6 Cyl, 4.2 L, MFI, DOHC, L6, Aluminum, GM
LM4	Engine, Gas, 8 Cyl, 5.3 L, SFI, Aluminum, GM
M30	Transmission, Auto 4 Speed, Hmd, 4L60-E, Electronic
NA3	Emission System, Japan
NC1	Emission System California, LEV
NF9	Emission System General, Unleaded
NP4	Transfer Case Active, All Wheel Drive (AWD)
NP5	Steering Wheel Leather Wrapped
NP7	Steer Column EEC Approved
NP8	Transfer Case Active, 2-Speed, Push Button Control
NT3	Emission System EEC 00
NT7	Emission System Federal, Tier 2
NT8	Emission System Federal, Tier 2 A
NT9	Emission System Federal, Tier 2 Phase-Out
NU1	Emission System California, LEV2
NU4	Emission System California, LEV2 Plus
NW7	Traction Control Powertrain Management Only
NZ3	Wheel Spare Full Size, 16-in, Steel
N40	Steering Power, Non-Variable Ratio
N74	Wheel 17 x 7, Aluminum, Sport
N75	Wheel 17 x 7, Aluminum, Custom
N77	Wheel 17 x 7, Aluminum, Deluxe
N79	Wheel Spare Full Size, Steel

RPO	Description
N80	Wheel 17 x 7, Aluminum, Premium
OKL	Plant Code Oklahoma City, OK, USA
PFE	Wheel 17 x 7, Aluminum
QC3	Wheel 16 x 7, Aluminum, Special
QRE	Tire All P245/70R16-106S, BW PE/ST TL ALS
QRF	Tire All P245/70R16-106S, WOL PE/ST TL ALS
QRH	Tire All 245/65R17-107H, BW PE/ST TL HWY
QRK	Tire All P255/60R17-105S BW PE/ST TL AL2
QTE	Tire All P245/65R17-105S BW PE/ST TL OOR
QTF	Tire All 215/70R16-100H, BW PE/ST TL HWY
QTM	Tire All P245/65R17-105S BW PE/ST TL ALS
QTR	Tire All P245/65R17-105S WOL PE/ST TL OOR
Q4B	GVW Rating 6, 200 lbs
RAE	Equipment Cargo Management System
RYJ	Covering Cargo Area, Retractable
STW	Steering Wheel Leather Wrapped with Redundant Controls
TB4	Body Equipment Lift Gate (Manual)
TR6	Headlamps Control Leveling System, Manual
T61	Lamp System Daytime Running
T62	Daytime Running Lamp System - Delete
T78	Headlamps Control - Delete
T79	Rear Fog Lamp
T84	Headlamps Right Rule of the Road, E Mark
T85	Headlamps Left Rule of the Road, E Mark
T89	Export Tail and Stop Lamp
T96	Lamp Fog, Front
UA2	Theft Deterrent System, Export Specific
UA6	Theft Deterrent System
UB0	Radio AM/FM Stereo, Seek/Scan, CD, Auto Tone, Data System, Clock, ETR
UB1	Radio AM/FM Stereo, Seek/Scan, Auto Reverse Music, Search Cassette, Compact Disc, Auto Tone, Data System, Clock, ETR
UC2	Speedometer Instrument, Kilometer and Miles, Kilometer Odometer, Positive Bias
UC6	Radio AM/FM Stereo, Seek/Scan, RDS, Multiple Compact Disc, Auto Tone Control, Clock, ETR
UD4	Alarm Vehicle Speed 120 K/H
UE1	Communication System Vehicle, G.P.S. 1
UG1	Opener Garage Door, Universal
UK1	Japanese Frequencies
UK6	Radio Control, Rear Seat and Earphone Jacks
UL2	European Frequencies
UM8	Radio AM/FM Stereo, Seek/Scan, CD, ETR Navigation Clock
UPC	Recorder Convenience, Recall
UQA	Speaker System Premium Performance Enhanced Audio
UVH	Equipment Driver Information Display Language (Portuguese)
UY7	Wiring Harness Truck Trailer, HD
U19	Speedometer Instrument, Kilometers and Miles, Kilometer Odometer
U2K	Digital Audio System S-Band
U42	Entertainment, Rear Seat Package
U68	Display Driver Information Center
U73	Antenna Fixed, Radio
VBW	Language Label, Japanese
VBX	Language Label, Arabic
VB1	Label Shipping, Japan

RPO	Description
VCG	Provisions, International Switch/Control Symbols
VC4	Label Price/Fuel Economy, Puerto Rico
VC5	Label Shipping, Except US, US Possessions, or Japan
VC7	Label Price/Fuel Economy, Guam
VG4	Protector Undervehicle Compound, Corrosion Preventive, Water Based, Black
VG8	Vehicle Buyer Notice Label
VJ1	License Plate Rear Mounting Package, Japanese
VJ3	Label, Plate ECE Approval and Vehicle Identification
VJ4	Label, Export Child Seat Location
VKA	Handling Charge Moraine Assembly to Automobile Specialty Co. Dayton, OH with final shipment through Moraine
VKO	Handling Charge Oklahoma Assembly to Automobile Specialty Co. Dayton, OH with final shipment through Moraine
VK3	Front License Plate, Front Mounting Package
VL4	Front License Plate, Front Mounting Package, EEC
VPH	Vehicle Preparation Overseas Delivery
VP6	Noise Control
VR6	Hook Tie-Down Shipping
VXS	Vehicle Complete
VZ3	Label, Mercury Disposal Notification
V1K	Bar Luggage Carrier, Center Cross
V40	Provision Options Ultra Seating Package - Power Adjuster, Recliner, Lumbar
V73	Vehicle Statement USA/Canada
V76	Hook Tow
V78	Vehicle Statement - Delete
V87	Vehicle Statement, Gulf States Organization
V98	Factory Delivery Processing
WX7	Wiring Provisions
W49	Market Brand Buick
W86	Equipment, Miscellaneous Equipment for Venezuela
W87	Parts, North American Parts Sourced in Venezuela (GMV Controlled)
W99	Equipment, Miscellaneous Equipment for Venezuela (GM Platform Controlled)
X44	Parts, North America Sourced and Shipped to Outside Supplier & Checked (GMCL Controlled)
X88	Market Brand, Chevrolet
YC3	Convenience Package Decor Level #3
YC5	Convenience Package Decor Level #5
YC6	Convenience Package Decor Level #6
Y92	Merchandised Package, Special Edition
ZM5	Sales Package Underbody Shield
ZW7	Chassis Package Premium Smooth Ride
ZY1	Color Combination Solid
ZY7	Color Combination, Two-Tone, Lower Accent
Z49	Export Canadian Modified, Mandatory Base Equipment
Z5X	Mirror Provisions, Arabic Language
Z70	Market Brand, Oldsmobile
Z88	Market Brand, GMC
Z89	Market Brand, Isuzu

Technical Information

Maintenance and Lubrication

Capacities - Approximate Fluid

Application	L6 Engine		V8 Engine	
	English	Metric	English	Metric
Cooling System				
Short W/B	13.9 quarts	13.1 L	15.3 quarts	14.5 L
Long W/B	15.2 quarts	14.4 L	17.9 quarts	17.0 L
Engine Oil with Filter	7.0 quarts	6.6 L	6.0 quarts	5.7 L
Transmission (Pan Removal)	5.0 quarts	4.7 L	5.0 quarts	4.7 L
After Complete Overhaul	11.0 quarts	10.6 L	11.0 quarts	10.6 L
Differential Fluid				
Rear	3.6 pints	1.7 L	4.3 pints	2.0 L
Front	1.7 pints	0.8 L	1.7 pints	0.8 L
Transfer Case	2.0 quarts	1.8 L	2.0 quarts	1.8 L
Fuel Tank				
Short W/B	22.0 gallons	83.3 L	22.0 gallons	83.3 L
Long W/B	25.3 gallons	95.8 L	25.3 gallons	95.8 L

All capacities are approximate. When adding, be sure to fill to the appropriate level, as recommended in this manual. Recheck the fluid level after filling.

Maintenance Items

Application	Type/Part Number
Engine Oil Filter	AC Delco/PF58
Engine Air Cleaner	AC Delco/A2014C
Automatic Transmission Filter Kit	GM P/N 24200796
Spark Plugs	AC Delco/410981
Fuel Filter	AC Delco/GF831
Windshield Wiper Blade	50.8 cm (20.0 in)
Back Glass Wiper Blade	35.6 cm (14.0 in)

Fluid and Lubricant Recommendations

Usage	Fluid/Lubricant
Engine Oil	Engine oil with the American Petroleum Institute Certified for Gasoline Engines starburst symbol of the proper viscosity. To determine the preferred viscosity for your vehicle's engine, see Engine Oil in the Index.
Engine Coolant	50/50 mixture of clean, drinkable water and use only GM Goodwrench® DEX-COOL® or Havoline® DEX-COOL® Coolant. See Engine Coolant in the Index.
Hydraulic Brake System	Delco Supreme 11® Brake Fluid (GM P/N 12377967, Canadian P/N 992667 or equivalent DOT-3 brake fluid).
Windshield Washer Solvent	GM Optikleen® Washer Solvent (GM P/N 1051515, Canadian P/N 993033) or equivalent.
Parking Brake Cable Guides	Chassis Lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Power Steering System	GM Power Steering Fluid (GM P/N 1052884 - 1 pint, 1050017 - 1 quart, Canadian P/N 993294 - 1 pint, Canadian P/N 992646 - 1 quart or equivalent).
Automatic Transmission	DEXRON III® Automatic Transmission Fluid.
Key Lock Cylinders	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241, Canadian P/N 10953474 or equivalent).

Usage	Fluid/Lubricant
Chassis Lubrication	Chassis Lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Front and Rear Axle	SAE 75W-90 Synthetic Axle Lubricant (GM P/N 12378261, Canadian P/N 10953455) or equivalent meeting GM Specification 9986115.
Transfer Case	AUTO-TRAK II Fluid (GM Part No. 12378508, Canadian P/N 10953626).
Rear Driveline Center Spline and universal Joints	Chassis Lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Constant Velocity Universal Joint	Chassis Lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Hood Latch Assembly, Secondary Latch, Pivots, Spring Anchor	Lubriplate® Lubricant Aerosol (GM P/N 12346293 or equivalent) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Hood and Door Hinges	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241, Canadian P/N 10953474 or equivalent).
Outer Tailgate Handle Pivot Points and Hinges	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241, Canadian P/N 10953474 or equivalent).
Weatherstrip Conditioning	Dielectric Silicone Grease (GM P/N 12345579, Canadian P/N 1974984 or equivalent).
Weatherstrip Squeaks	Synthetic Grease With Teflon, Superlube® (GM P/N 12371287, Canadian P/N 10953437 or equivalent).

GM Oil Life System - Resetting

This vehicle has an engine oil life monitor. The GM Oil Life System™ will show when to change the engine oil and oil filter. This will usually occur between 5 000 km (3,000 mi) and 12 500 km (7,500 mi) since the last oil change. Under severe conditions, the indicator may come on before 5 000 km (3,000 mi).

Vehicle should not be driven more than 12 500 km (7,500 mi) or 12 months without an oil and oil filter change. The system will not detect dust in the oil. So if the vehicle is driven in a dusty area, be sure to change the oil and oil filter every 5 000 km (3,000 mi) or sooner if the CHANGE OIL SOON indicator comes on. Reset the system when the oil has been changed.

Resetting Procedure

1. Press the fuel information button until ENGINE OIL LIFE appears in the display.
2. To reset the oil life system, press and hold the select button while ENGINE OIL LIFE is displayed.
3. If the light comes back on again when you start the engine, you will need to reset the system again.

With the Driver Information Center (DIC)

1. Press the fuel information button until ENGINE OIL LIFE appears in the display.
2. To reset the monitor, press and hold the select button while ENGINE OIL LIFE is displayed.

Descriptions and Operations

Power Steering System

The hydraulic power steering pump is a constant displacement vane-type pump that provides hydraulic pressure and flow for the power steering gear. The hydraulic power steering pumps are either belt-driven or direct-drive, cam-driven.

The power steering fluid reservoir holds the power steering fluid and may be integral with the power steering pump or remotely located. The following locations are typical locations for the remote reservoir:

- Mounted to the front of the dash panel
- Mounted to the inner fender
- Mounted to a bracket on the engine

The 2 basic types of power steering gears are listed below:

- A recirculating ball system
- A rack and pinion system

In the recirculating ball system, a worm gear converts steering wheel movement to movement of a sector shaft. A pitman arm attached to the bottom of the sector shaft actually moves one tie rod and an intermediate rod move the other tie rod.

In the rack and pinion system, the rack and the pinion are the 2 components that convert steering wheel rotation to lateral movement. The steering shaft is attached to the pinion in the steering gear. The pinion rotates with the steering wheel. Gear teeth on the pinion mesh with the gear teeth on the rack. The rotating pinion moves the rack from side to side. The lateral action of the rack pushes and pulls the tie rods in order to change the direction of the vehicle's front wheels.

The power steering pressure hose connects the power steering pump union fitting to the power steering gear and allows pressurized power steering fluid to flow from the pump to the gear.

The power steering return hose returns fluid from the power steering gear back to the power steering fluid reservoir. The power steering return line may contain an integral fin-type or line-type power steering fluid cooler.

In a typical power steering system, a pump generates hydraulic pressure, causing fluid to flow, via the pressure hose, to the steering gear valve assembly. The steering gear valve assembly regulates the incoming fluid to the right and left chambers in order to assist in right and left turns.

Turning the steering wheel activates the valve assembly, which applies greater fluid pressure and flow to 1 side of the steering gear piston, and lower pressure and flow to the other side of the piston. The pressure assists the movement of the gear piston. Tie rods transfer this force to the front wheels, which turn the vehicle right or left.

Steering Wheel and Column

The steering wheel and column has 4 primary functions:

- Vehicle steering
- Vehicle security
- Driver convenience
- Driver safety

Vehicle Steering

The steering wheel is the first link between the driver and the vehicle. The steering wheel is fastened to a steering shaft within the column. At the lower end of the column, the intermediate shaft connects the column to the steering gear.

Vehicle Security

Theft deterrent components are mounted and designed into the steering column. The following components allow the column to be locked in order to minimize theft:

- The ignition switch
- The steering column lock
- The ignition cylinder

Driver Convenience

The steering wheel and column may also have driver controls attached for convenience and comfort. The following controls may be mounted on or near the steering wheel or column.

- The turn signal switch
- The hazard switch
- The headlamp dimmer switch
- The wiper/washer switch
- The horn pad/cruise control switch
- The redundant radio/entertainment system controls
- The tilt or tilt/telescoping functions
- The navigation/OnStar® features
- The HVAC controls

Driver Safety

The energy-absorbing steering column compresses in the event of a front-end collision, which reduces the chance of injury to the driver. The mounting capsules break away from the mounting bracket in the event of an accident.

Ignition Lock Cylinder Control Actuator

If the vehicle is equipped with a floor mounted console gear shifter, it has a ignition lock cylinder control actuator system in the steering column as an added safety feature. The ignition lock cylinder control actuators purpose is to prevent the steering wheel from being locked when the transmission is in gear and the vehicle may still be moving. The column ignition lock system consists of a ignition lock cylinder control acutator, and a park position switch that is located in the A/T shift lock control switch. The ignition lock cylinder control acutator contains a pin that is spring loaded out to mechanically prevent the ignition key cylinder from being turned to the lock position when vehicle transmission is not in the Park position. If vehicle power is lost, and/or the transmission is not in the Park position the operator will not be able to turn the ignition key to the lock position and will not be able to remove the ignition key from the column.

Suspension Description and Operation

Front Suspension

The front suspension has 2 primary purposes:

- Isolate the driver from irregularities in the road surface.
- Define the ride and handling characteristics of the vehicle.

The front suspension absorbs the impact of the tires travelling over irregular road surfaces and dissipates this energy throughout the suspension system. This process isolates the vehicle occupants from the road surface. The rate at which the suspension dissipates the energy and the amount of energy that is absorbed is how the suspension defines the vehicle's ride characteristics. Ride characteristics are designed into the suspension system and are not adjustable. The ride characteristics are mentioned in this description in order to aid in the understanding of the functions of the suspension system. The suspension system must allow for the vertical movement of the tire and wheel assembly as the vehicle travels over irregular road surfaces while maintaining the tire's horizontal relationship to the road.

This requires that the steering knuckle be suspended between an upper and a lower control arm. The lower control arm attaches from the steering Knuckle at the outermost point of the control arm. The attachment is through a ball and socket type joint. The innermost end of the control arm attached at 2 points to the vehicle frame, through semi-rigid bushings. The upper control arm attaches to the frame in the same fashion. Between the lower control arm and a spring seat on the vehicle's frame, under tension, is a coil spring.

This up and down motion of the steering knuckle as the vehicle travels over bumps is absorbed predominantly by the coil spring. The vertical movement of the steering knuckle as the vehicle travels over irregular road surfaces will tend to compress the spring and spring tension will lead the spring to return to the original, at-rest state. This action isolates the vehicle from the road surface. The upper and lower control arms are allowed to pivot at the vehicle frame in a vertical fashion. The ball joint allows the steering knuckle to maintain the perpendicular relationship to the road surface.

A shock absorber is used in conjunction with this system in order to dampen out the oscillations of the coil spring. A shock absorber is a basic hydraulic cylinder. The shock is filled with oil and has a moveable shaft that connects to a piston inside the shock absorber. Valves inside the shock absorber offer resistance to oil flow and consequently inhibit rapid movement of the piston and shaft. Each end of the shock absorber is connected in such a fashion to utilize this recoil action of a spring alone.

Front suspensions systems utilize a stabilizer shaft. The stabilizer bar connects between the left and right lower control arm assemblies through the stabilizer link and stabilizer shaft insulators. This bar controls the amount of independent movement of the suspension when the vehicle turns. Limiting the independent movement defines the vehicle's handling characteristics on turns.

Rear Suspension

These vehicles use either a coil spring suspension or an air suspension configuration that utilizes two air springs. On vehicles equipped with the air springs, two separate height sensors control the air springs, one for the left spring and one for the right spring.

A separate air compressor is used to inflate the air springs and maintain proper ride height.

Two direct double-acting shock absorbers provide ride control. The shock absorbers are angle-mounted between the frame. The shock absorbers are attached with brackets. The brackets are attached to the anchor plate.

The rear spring steel stabilizing bar helps minimize body roll and sway during cornering. The rear stabilizer shaft is connected to the rear axle and the frame.

The rear suspension system on this vehicle consists of the following components:

- The rear axle
- Two coil springs or two air springs
- Two height sensors, air suspension only
- Air compressor, air suspension only
- Air supply lines, air suspension only
- Two shock absorbers
- The rear axle tie rod
- Two upper control arms
- Two lower control arms

Air Suspension

The primary mission of the Air Suspension System is the following for the rear suspension under loaded and unloaded conditions:

- Keep the vehicle visually level
- Provide optimal headlight aiming
- Maintain optimal ride height

The Air Suspension System consists of the following items:

- Air Suspension Compressor Assembly
- Air Suspension Sensors
- Rear Air Springs

The Air Suspension Compressor Assembly has the ability to detect faults and indicate the appropriate fault code via a blink code on the inflator switch LED. The Air Suspension Compressor Assembly will indicate the code when the condition to cause the code becomes current.

During compressor activation the exhaust valve will be activated for a calibrated length of time to provide compressor head relief. After a calibrated length of time the compressor relay will activate to start the compressor. When trim height is achieved the relay will be deactivated. The exhaust valve and compressor relay are part of the air suspension compressor assembly. The Air Suspension System shall maintain the rear trim height within 4 mm (0.15 in)in all loading conditions and the leveling function shall deactivate if the vehicle is overloaded. The side to side variation has to be maintained within 8 mm (0.31 in). After ignition is turned off, the module will stay awake for between 30 minutes and 2 1/2 hours. The system will exhaust pressure within 30 minutes after ignition is turned off to lower the vehicle after unloading. The leakage of the complete load leveling system shall not result in more than 1.4 mm (0.05 in) drop of rear suspension height at GVWR during a 24 hour period.

There are software Leveling Sequence Timers that detect conditions of excessive output at which no leveling is accruing. These timers shall keep track of conditions which cause excessive run time or no calibratable change in trim height. These timers are defined in more detail below.

Accumulator Timer

The primary purpose of the accumulator timer is to detect conditions in which excessive activity may occur. The conditions are generally as follows: in the compress mode the existences of pneumatic leaks in the system, in the exhaust mode the existence of pneumatic blockage or unloaded vehicle conditions. The accumulator shall keep track of the accumulated run time of the compressor. If the accumulator timer reaches its calibratable limit the output function will be disabled until the accumulator is reset. The accumulator timer will be reset with each transition into the RUN power mode or if the complementary output activation is required.

Progress Timer

The primary propose of the progress timer is to quickly detect conditions in which excessive output activity may occur at zero vehicle speed condition. If the Air Suspension System does not detect a calibratable change in position within a calibratable time period, the output function will be disabled. The timer will be reset with each ignition switch cycle into the RUN position.

Air Suspension Sensors

The air suspension sensor arm is attached to an armature that rotates inside a coil. The inductance of the coil, not the resistance, changes dependant on the position of the armature in the coil. The air suspension module determines the angle of the sensor arm by sending a pulse width modulated supply voltage through the coil and measuring the response time. The sensors must be calibrated to the correct D height and are not adjustable.

Rear Air Springs

The air springs are mounted in the frame in the same location were the coil spring is mounted for a vehicle without air suspension. Support pieces are affixed to the axle for the air springs.

Wheels and Tires

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Spare Wheel Hoist Assembly Mounting Bolts	50 N·m	37 lb ft
Wheel Nut	140 N·m	103 lb ft

General Description

The factory installed tires are designed to operate satisfactorily with loads up to and including the full rated load capacity when these tires are inflated to the recommended pressures.

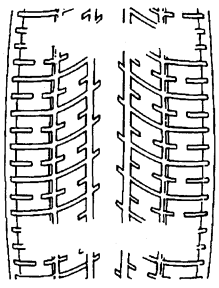
The following factors have an important influence on tire life:

- Correct tire pressures
- Correct wheel alignment
- Proper driving techniques
- Tire rotation

The following factors increase tire wear:

- Heavy cornering
- Excessively rapid acceleration
- Heavy braking

Tread Wear Indicators Description



The original equipment tires have tread wear indicators that show when you should replace the tires.

The location of these indicators are at 72 degree intervals around the outer diameter of the tire. The indicators appear as a 6 mm (0.25 in) wide band when the tire tread depth becomes 1.6 mm (2/32 in).

Metric Wheel Nuts and Bolts Description

Metric wheel/nuts and bolts are identified in the following way:

- The wheel/nut has the word Metric stamped on the face.
- The letter M is stamped on the end of the wheel bolt.

The thread sizes of metric wheel/nuts and the bolts are indicated by the following example: M12 x 1.5.

- M = Metric
- 12 = Diameter in millimeters
- 1.5 = Millimeters gap per thread

Tire Inflation Description

When you inflate the tires to the recommended inflation pressures, the factory-installed wheels and tires are designed in order to handle loads to the tire's rated load capacity. Incorrect tire pressures, or under-inflated tires, can cause the following conditions:

- Vehicle handling concerns
- Poor fuel economy
- Shortened tire life
- Tire overloading

Inspect the tire pressure when the following conditions apply:

- The vehicle has been sitting at least 3 hours.
- The vehicle has not been driven for more than 1.6 km (1 mi).
- The tires are cool.

Inspect the tires monthly or before any extended trip. Adjust the tire pressure to the specifications on the tire label. Install the valve caps or the extensions on the valves. The caps or the extensions keep out dust and water.

The kilopascal (kPa) is the metric term for pressure. The tire pressure may be printed in both kilopascal (kPa) and psi. One psi equals 6.9 kPa.

Inflation Pressure Conversion (Kilopascals to PSI)

kPa	psi	kPa	psi
140	20	215	31
145	21	220	32
155	22	230	33
160	23	235	34
165	24	240	35
170	25	250	36
180	26	275	40
185	27	310	45
190	28	345	50
200	29	380	55
205	30	415	60
Conversion: 6.9 kPa = 1 psi			

Tires with a higher than recommended pressure can cause the following conditions:

- A hard ride
- Tire bruising
- Rapid tread wear at the center of the tire

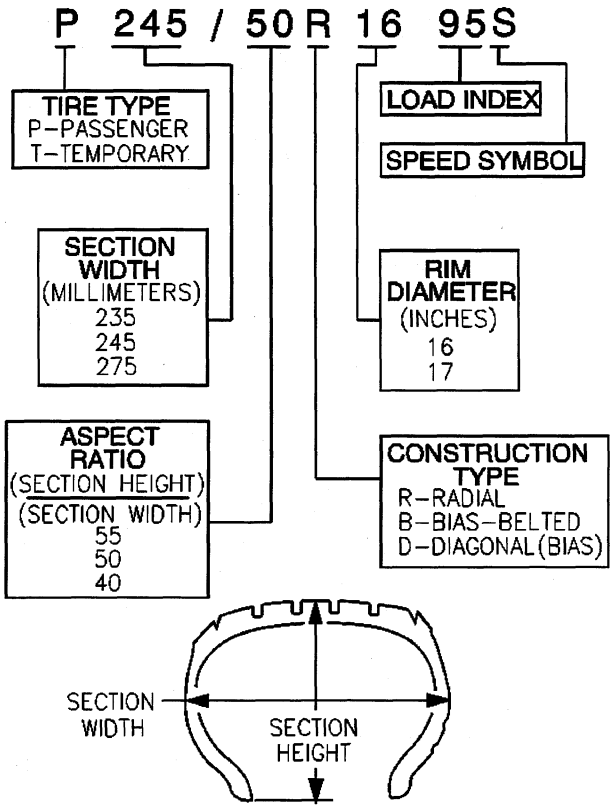
Tires with a lower than recommended pressure can cause the following conditions:

- A tire squeal on turns
- Hard steering
- Rapid wear and uneven wear on the edge of the tread
- Tire rim bruises and tire rim rupture
- Tire cord breakage
- High tire temperatures
- Reduced vehicle handling
- High fuel consumption
- Soft riding

Unequal pressure on the same axle can cause the following conditions:

- Uneven braking
- Steering lead
- Reduced vehicle handling

P-Metric Sized Tires Description



Most P-metric tire sizes do not have exact corresponding alphanumeric tire sizes. Replacement tires should be of the same tire performance criteria (TPC) specification number including the same size, the same load range, and the same construction as those originally installed on the vehicle. Consult a tire dealer if you must replace the P-metric tire with other sizes. Tire companies can best recommend the closest match of alphanumeric to P-metric sizes within their own tire lines.

Driveline System Description and Operation

Driveline/Axle – Propeller Shaft

The front propeller shaft consists of the following components:

- Propeller shaft tube
- Universal joint
- Flange yoke
- Constant velocity joint

The rear propeller shaft consists of the following components:

- Propeller shaft tube
- 2 universal joints
- Slip yoke

Front Propeller Shaft Operation

The front propeller shaft connects the transfer case to the front axle. It transmits the rotating force from the transfer case to the front axle when the transfer case is engaged.

Rear Propeller Shaft Operation

The rear propeller shaft connects the transmission or transfer case to the rear axle. It transmits the rotating force from the transmission or transfer case to the rear axle.

Propeller Shaft Phasing Description

The propeller shaft is designed and built with the yoke lugs or ears in line with each other. This produces the smoothest running shaft possible. A propeller shaft designed with built in yoke lugs in line is known as in - phase. An out of phase propeller shaft often causes vibration. The propeller shaft generates vibration from speeding up and slowing down each time the universal joint goes around. The vibration is the same as a person snapping a rope and watching the wave reaction flow to the end. An in phase propeller shaft is similar to 2 persons snapping a rope at the same time and watching the waves meet and cancel each other out. A total cancellation of vibration produces a smooth flow of power in the drive line. All splined shaft slip yokes are keyed in order to ensure proper phasing.

Universal Joint Description

The universal joint is connected to the propeller shaft. The universal consist of 4 caps with needle bearings and grease seals mounted on the trunnions of a cross or spider. These bearings and caps are greased at the factory and no periodic maintenance is required. The bearings and caps are pressed into the yokes and held in place with snap rings, except for 2 bearings on some models witch are strapped onto the pinion flange of the differential. Universal joints are designed to handle the effects of various loads and rear axle windup conditions during acceleration and braking. The universal joint operates efficiently and safely within the designed angle variations. when the design angles are exceeded, the operational life of the joint decreases.

Wheel Drive Shafts Description and Operation

Front Wheel Drive Shafts are flexible assemblies which consist of the following components:

- Front wheel drive shaft constant velocity joint (outer joint).
- Front wheel drive shaft tri-pot joint (inner joint).
- The front wheel drive shaft connects the front wheel drive shaft tri-pot joint and the front wheel drive shaft constant velocity joint.
- The front wheel drive shaft tri-pot joint is completely flexible, and moves with an in and out motion.
- The front wheel drive shaft constant velocity joint is flexible but can not move in and out.

The Wheel Drive Shaft is a balanced shaft that transmits rotational force from the front differential to the front wheels when the transfer case is engaged. The wheel drive shaft is mounted to the front differential

by bolting the flange of the wheel drive shaft to the flange on the inner output shaft of the front differential. The other end of the wheel drive shaft is splined to fit into and drive the hub assembly when the transfer case is engaged. The tri-pot joint and constant velocity joint on the wheel drive shaft allows the shaft to be flexible to move with the suspension travel of the vehicle.

Front Drive Axle Description and Operation

Selectable Four Wheel Drive (S4WD) Front Axle Description and Operation

The Selectable Four Wheel Drive (S4WD) Front Axle consist of the following components:

- Differential Carrier Housing
- Differential Case Assembly
- Inner Axle Shaft
- Intermediate Shaft Bearing Assembly (located on the right side of the oil pan)
- Electric Motor Actuator

The front axle on Selectable Four Wheel Drive (S4WD) model vehicles uses a disconnect feature mounted on the right side of the oil pan in order to engage and disengage the front axle. When the driver engages the 4WD system, the Transfer Case Control Module sends a signal to the electric motor actuator to energize and extend the plunger inside. The extended plunger moves the clutch fork and clutch fork sleeve across from the clutch fork outer gear that is splined to the right side wheel drive shaft to the clutch fork inner gear that is splined to the inner axle shaft. The locking of the two gears allows the axle to operate in the same manner as a semi-floating rear axle. A propeller shaft connects the transfer case to the front axle. The differential carrier assembly uses a conventional ring and pinion gear set to transmit the driving force of the engine to the wheels. The open differential allows the wheels to turn at different rates of speed while the axle continues to transmit the driving force. This prevents tire scuffing when going around corners and premature wear on internal axle parts. The ring and pinion set and the differential are contained within the carrier. The axle identification number is located on top of the differential carrier assembly or on a label on the bottom of the right half of differential carrier assembly. The wheel drive shafts are completely flexible assemblies consisting of inner and outer constant velocity CV joints protected by thermoplastic boots and connected by a wheel drive shaft.

Automatic Four Wheel Drive (A4WD) Front Axle Description and Operation

The Automatic Four Wheel Drive (A4WD) Front Axle consist of the following components:

- Differential Carrier Housing
- Differential Case Assembly
- Inner Axle Shaft
- Intermediate Shaft bearing Assembly (located on the right side of the oil pan)

The front axle on Automatic Four Wheel Drive (A4WD) model vehicles do not have a disconnect feature in order to engage and disengage the front axle. The Automatic Four Wheel Drive system uses the same differential carrier assembly and intermediate shaft bearing assembly, but the clutch fork, the clutch fork sleeve and the inner/outer gears have been replaced with a single splined sleeve that connects the inner axle shaft directly to the right side wheel drive shaft. This connection allows the right side wheel drive shaft and the intermediate axle shaft to be directly connected to the differential case assembly. It also results in having the wheel drive shafts, the intermediate axle shaft and the propeller shaft to spin continuously. When the transfer case is active, the clutch assembly within the transfer case controls the amount of torque applied to the front axle. The remaining components are the same as the selectable four wheel drive axle.

Rear Drive Axle Description and Operation

The rear axle for this vehicle consist of the following components:

- Aluminum Differential Carrier Housing
- Differential Case Assembly (Open or Locking)
- Ring Gear and Drive Pinion Shaft
- Left and right axle shaft tubes
- Left and right axle shafts
- Fill Plug
- Drain Plug

The rear axle receives power from the propeller shaft and transfers it to the drive pinion through the universal joint and the pinion yoke, which is attached to the drive pinion. The drive pinion transfers the power to the ring gear which is splined to the drive pinion at a 90 degree angle. The ring gear is attached to the differential case which contains four gears inside of it. Two of the gear are side gears and two are pinion gears. Each side gear is splined to an axle shaft so each axle shaft turns when it's side gear rotates. The pinion gears are mounted on a differential pinion shaft, and the pinion gears are free to rotate on this shaft. The pinion shaft is fitted into a bore in the differential case and is at right angles to the axle shafts. Power is transmitted through the differential as follows: the drive pinion rotates the ring gear. The ring gear rotates the differential case. The ring gear, as it rotates with the differential case, forces the pinion gears against the side gears. The side gears rotate the axle shafts to which the wheels are attached to. When both wheels have an equal amount of traction, the pinion gears do not rotate on the pinion shaft because of input force on the pinion gears is equally divided between the two side gears. Therefore, the pinion gears revolve with the pinion shaft, but do not rotate around the shaft itself. As long as the input force is equal between the two axle shafts, the axle shafts could be solidly attached to the ring gear. The addition of the two pinion gears and the two side gears are needed to allow the axle shafts to turn at different speeds. When the vehicle turns a corner, the inner wheel turns slower than the outer wheel. The amount slower the inner wheel spins is equal to the same amount the outer wheel spins faster, as compared to the straight line speed. When this happens, the pinion gears rotate around the pinion shaft and allow the wheels to spin at different speeds

Locking Differential Description and Operation

The locking differential consists of the following components:

- Differential case - 1 or 2 piece
- Locking differential spider - 2 piece case only
- Pinion gear shaft - 1 piece case only
- Differential pinion gear shaft lock bolt - 1 piece case only
- 2 clutch discs sets
- Locking differential side gear
- Thrust block
- Locking differential clutch disc guides
- Differential side gear shim
- Locking differential clutch disc thrust washer
- Locking differential governor
- Latching bracket
- Cam plate assembly
- Differential pinion gears
- Differential pinion gear thrust washers

The optional locking differential (RPO G80) enhances the traction capability of the rear axle by combining the characteristics of a limited-slip differential and the ability of the axle shafts to "lock" together when uneven traction surfaces exist. The differential accomplishes this in 2 ways. First by having a series of clutch plates at each side of the differential case to limit the amount of slippage between each wheel. Second, by using a mechanical locking mechanism to stop the rotation of the right differential side gear,

or the left differential side gear on the 10.5 inch axle, in order to transfer the rotating torque of the wheel without traction to the wheel with traction. Each of these functions occur under different conditions.

Limited-Slip Function

Under normal conditions, when the differential is not locked, a small amount of limited-slip action occurs. The gear separating force developed in the right-hand (left-hand side on 10.5 inch axle) clutch pack is primarily responsible for this.

The operation of how the limited-slip function of the unit works can be explained when the vehicle makes a right-hand turn. Since the left wheel travels farther than the right wheel, it must rotate faster than the ring gear and differential case assembly. This results in the left axle and left side gear rotating faster than the differential case. The faster rotation of the left-side gear causes the pinion gears to rotate on the pinion shaft. This causes the right-side gear to rotate slower than the differential case.

Although the side gear spreading force produced by the pinion gears compresses the clutch packs, primarily the right side, the friction between the tires and the road surface is sufficient to overcome the friction of the clutch packs. This prevents the side gears from being held to the differential case.

Locking Function

Locking action occurs through the use of some special parts:

- A governor mechanism with 2 flyweights
- A latching bracket
- The left side cam plate and cam side gear

When the wheel-to-wheel speed difference is 100 RPM or more, the flyweights of the governor will fling out and one of them will contact an edge of the latching bracket. This happens because the left cam side gear and cam plate are rotating at a speed different, either slower or faster, than that of the ring gear and differential case assembly. The cam plate has teeth on its outer diameter surface in mesh with teeth on the shaft of the governor.

As the side gear rotates at a speed different than that of the differential case, the shaft of the governor rotates with enough speed to force the flyweights outward against spring tension. One of the flyweights catches its edge on the closest edge of the latching bracket, which is stationary in the differential case. This latching process triggers a chain of events.

When the governor latches, it stops rotating. A small friction clutch inside the governor allows rotation, with resistance, of the governor shaft while one flyweight is held to the differential case through the latching bracket. The purpose of the governor's latching action is to slow the rotation of the cam plate as compared to the cam side gear. This will cause the cam plate to move out of its detent position.

The cam plate normally is held in its detent position by a small wave spring and detent humps resting in matching notches of the cam side gear. At this point, the ramps of the cam plate ride up on the ramps of the cam side gear, and the cam plate compresses the left clutch pack with a self-energizing action.

As the left clutch pack is compressed, it pushes the cam plate and cam side gear slightly toward the right side of the differential case. This movement of the cam side gear pushes the thrust block which compresses the right-hand side gear clutch pack.

At this point, the force of the self-energizing clutches and the side gear separating force combine to hold the side gears to the differential case in the locking stage.

The entire locking process occurs in less than 1 second. The process works with either the left or right wheel spinning, due to the design of the governor and cam mechanism. A torque reversal of any kind will unlatch the governor, causing the cam plate to ride back down to its detent position. Cornering or deceleration during a transmission shift will cause a torque reversal of this type. The differential unit returns to its limited-slip function.

The self-energizing process would not occur if it were not for the action of one of the left clutch discs. This energizing disc provides the holding force of the ramping action to occur. It is the only disc which is splined to the cam plate itself. The other splined discs fit on the cam side gear.

If the rotating speed of the ring gear and differential case assembly is high enough, the latching bracket will pivot due to centrifugal force. This will move the flyweights so that no locking is permitted. During vehicle driving, this happens at approximately 32 km/h (20 mph) and continues at faster speeds.

When comparing the effectiveness of the locking differential, in terms of percent-of-grade capability to open and limited-slip units, the locking differential has nearly 3 times the potential of the limited-slip unit under the same conditions.

Locking Differential Torque-Limiting Disc

The locking differential design was modified in mid-1986 to include a load-limiting feature to reduce the chance of breaking an axle shaft under abusive driving conditions. The number of tangs on the energizing disc in the left-hand clutch pack was reduced allowing these tangs to shear in the event of a high-torque engagement of the differential locking mechanism.

At the time of failure of the load-limiting disc, there will be a loud bang in the rear axle and the differential will operate as a standard differential with some limited-slip action of the clutch packs at low torques.

The service procedure, when the disc tangs shear, involves replacing the left-hand clutch plates and the wave spring. It is also necessary to examine the axle shafts for twisting because at high torques it is possible to not only shear the load-limiting disc, but to also twist the axle shafts.

Transfer Case - NVG 226-NP8

General Operation

The New Venture Gear model NVG 226 RPO NP8 transfer case is a two speed automatic, active, transfer case. The NVG 226 provides five modes, Auto 4WD, 4 HI, 4 LO, 2 HI and Neutral. The Auto 4WD position allows the capability of an active transfer case, which provides the benefits of on-demand torque biasing wet clutch and easy vehicle tuning through software calibrations. The software calibrations allow more features such as flexible adapt ready position and clutch preload torque levels. The technology allows for vehicle speed dependent clutch torque levels to enhance the performance of the system. For example, the system is calibrated to provide 0-5 lb ft of clutch torque during low speed, low engine torque operation, and predetermined higher torque for 32 km/h (20 mph) and greater. This prevents crow-hop and binding at low speeds and provides higher torque biases at higher vehicle speeds, to enhance stability.

The NVG 226 requires no clutch shimming. The transfer case control module controls for the wear of the clutch and different clutch torque levels. The software learns adapt ready positions, which are for the correct clutch torque. The learned adapt ready positions vary as the unit wears over its life.

The NVG 226 case halves are high-pressure die-cast aluminum. Ball bearings support the input shaft, the front output shaft, and the rear output shaft. A thrust bearing is located inside of the input shaft gear to support the front of the rear output shaft. The clutch discs have friction material on one side only, to prevent warpage. The transfer case requires Auto Trac II Fluid GM P/N 12378508 (Canadian P/N 10953626) which is blue in color. The fluid is designed for smooth clutch application. An oil pump, driven by the rear output shaft, pumps the fluid through the rear output shaft oil gallery to the clutch and bearings.

The NVG 226 transfer case features a rotary 4 mode shift control switch located on the instrument panel. When the ignition key is in the RUN position, the transfer case shift control module monitors the transfer case shift control switch to determine if the driver desires a new mode/range position. At a single turn of the transfer case shift control switch, the lamp of the new desired position will begin flashing to inform the driver that the transfer case shift control module has received the request for a new mode/range position. The lamp will continue to flash until all shifting criteria has been met and the new mode/range position has been reached, or has been engaged. Once the new mode/range position is fully active, the switch indicator lamp for the new position will remain ON constantly. During normal driving situations, the transfer case can operate in the Auto 4WD mode. In the Auto 4WD mode, the transfer case shift control module monitors rear wheel slip speed, based on the inputs from both the front and rear propshaft speed sensors. When the vehicle experiences a rear wheel slip condition, the transfer case shift control module sends a pulse width modulated (PWM) signal to an electronic motor, which is the transfer case encoder

motor. This motor rotates the transfer case control actuator lever shaft, applying a clutch pack. This clutch pack is designed to deliver a variable amount of torque, normally delivered to the rear wheels, and transfers it to the front wheels. Torque is ramped up to the front wheels until the front propshaft speed sensor matches that of the rear propshaft speed sensor. Torque is ramped down to the front wheels. The process would repeat if rear wheel slip is detected again. The NVG 226 transfer case has the added feature of also providing the driver with 3 manual mode/range positions:

- 4HI 4-Wheel Drive high range
- 2HI 2-Wheel Drive high range
- 4LO 4-Wheel Drive low range

The driver may choose to select any of these mode/range positions while driving the vehicle. However, the transfer case will not allow a shift into or out of 4LO unless the following criteria has been met:

- The engine is running.
- The automatic transmission is in Neutral.
- The vehicle speed is less than 5 km/h (3 mph).

This transfer case also has a Neutral position. A shift to the Neutral position allows the vehicle to be towed without rotating the transmission output shaft. Neutral position may be obtained only if the following criteria has been met:

- The engine is running.
- The automatic transmission is in Neutral.
- The vehicle speed is less than 5 km/h (3 mph).
- The transfer case is in 2HI mode.

Once these conditions have been met, turn the rotary switch clockwise past the last and hold for 10 seconds. When the system completes the shift to neutral, the red neutral lamp will illuminate.

The transfer case shift control module uses the VIN information for calculations that are required for the different calibrations used based on axle ratio, transmission, tire size, and engine. The system does not know which calibration to use without this information. When the vehicle is in the AWD mode, the transfer case shift control module monitors the speed of the front and rear propshafts in order to detect wheel slippage. When wheel slippage is detected, the module applies a clutch pack contained in side the transfer case. This clutch pack is used to lock-in and apply the front propshaft, transferring torque to the front wheels. The clutch pack is applied by a motor/encoder assembly. When slip is no longer detected by the transfer case shift control module, the clutch is no longer applied.

Transfer Case Motor/Encoder

The transfer case Motor/Encoder consists of a permanent magnet (PM) DC motor and gear reduction assembly. It is located on the left hand side (drivers side) of the transfer case. When activated it turns the sector shaft of the transfer case (clockwise or counter clockwise) to shift the transfer case. The Motor/Encoder is controlled with a pulse width modulated (PWM) signal by the transfer case shift control module. This circuit consists of a driver on both the Motor A and Motor B circuits. The encoder motor is bi-directional to allow the motor to shift the transfer case from 2HI or 4HI to NEUTRAL and 4LO positions.

Transfer Case Encoder

The encoder is mounted to the transfer case motor/encoder assembly and is replaced as an assembly. The encoder converts the sector shaft position (representing a mode or range) into an electrical signal input to the transfer case shift control module. The module can detect what position the transfer case is in by monitoring the voltage returned on the encoder signal circuit. This voltage translates into AUTO, 2H, 4H, NEUTRAL, and 4L or in transition between gears.

Transfer Case Motor Lock

The transfer case motor lock is used to provide a 2H, 4H, and 4L lock-up feature. When the lock circuit is energized, the transfer case encoder motor is allowed to turn. When the transfer case is placed 2H, 4H, or 4L the motor lock circuit is de-energized and the lock is applied. This assures that the transfer case remains in the current gear position until a new gear position is requested. When AUTO is selected the motor lock remains applied until an adaptive mode (torque is applied to the front propshaft) is required.

During an adaptive mode the motor lock circuit is energized and the motor lock is released, enabling the encoder motor to turn and apply or release torque at the front propshaft.

Transfer Case Speed Sensors

There are three speed sensors on the automatic transfer case (ATC), two on the rear output shaft and one on the front output shaft. Each speed sensor is a permanent magnet (PM) generator. The PM generator produces a pulsing AC voltage. The AC voltage level and number of pulses increases as speed increases.

Vehicle Speed Sensor

One of the two on the rear output shaft is the vehicle speed sensor (VSS) input to the powertrain control module (PCM). The PCM sends this information to the transfer case shift control module via the Class 2 Serial Data bus.

Rear Propshaft Speed Sensor

The transfer case shift control module converts the pulsating AC voltage from the rear transfer case speed sensor to a rear propshaft speed in RPM to be used for calculations. The rear propshaft speed can be displayed with a scan tool.

Front Propshaft Speed Sensor

The transfer case shift control module converts the pulsating AC voltage from the front transfer case speed sensor to front propshaft speed in RPM to be used for calculations, and to monitor the difference between the front and rear sensor speed. It is also used in the AUTO (Adapt) mode of operation to determine the amount of slip and the percent of torque to apply to the front axle. The front propshaft speed can be displayed with a scan tool.

SERVICE 4WD Indicator

The SERVICE 4WD indicator is an integral part of the cluster and cannot be serviced separately. This lamp is used to inform the driver of the vehicle that a transfer case system malfunction. The SERVICE 4WD indicator is controlled by the transfer case shift control module via Class 2.

Braking System Description and Operation

Hydraulic Brake System Description and Operation

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir

Contains supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.

Hydraulic output pressure is distributed from the master cylinder through two hydraulic circuits, supplying diagonally-opposed wheel apply circuits.

Hydraulic Brake Pressure Balance Control System

Regulates brake fluid pressure delivered to hydraulic brake wheel circuits, in order to control the distribution of braking force.

Pressure balance control is achieved through dynamic rear proportioning (DRP), which is a function of the ABS modulator.

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

Converts hydraulic input pressure into mechanical output force.

System Operation

Mechanical force is converted into hydraulic pressure by the master cylinder, regulated to meet braking system demands by the pressure balance control system, and delivered to the hydraulic brake wheel circuits by the pipes and flexible hoses. The wheel apply components then convert the hydraulic pressure back into mechanical force which presses linings against rotating brake system components.

Brake Assist System Description and Operation

System Component Description

The brake assist system consists of the following:

Brake Pedal

Receives, multiplies and transfers brake system input force from driver.

Brake Pedal Pushrod

Transfers multiplied input force received from brake pedal to brake booster.

Vacuum Brake Booster

Uses source vacuum to decrease effort required by driver when applying brake system input force.

When brake system input force is applied, air at atmospheric pressure is admitted to the rear of both vacuum diaphragms, providing a decrease in brake pedal effort required. When input force is removed, vacuum replaces atmospheric pressure within the booster.

Vacuum Source

Supplies force used by vacuum brake booster to decrease brake pedal effort.

Vacuum Source Delivery System

Enables delivery and retention of source vacuum for vacuum brake booster.

System Operation

Brake system input force is multiplied by the brake pedal and transferred by the pedal pushrod to the hydraulic brake master cylinder. Effort required to apply the brake system is reduced by the vacuum brake booster.

Disc Brake System Description and Operation

System Component Description

The disc brake system consists of the following components:

Disc Brake Pads

Applies mechanical output force from the hydraulic brake calipers to friction surfaces of brake rotors.

Disc Brake Rotors

Uses mechanical output force applied to friction surfaces from the disc brake pads to slow speed of tire and wheel assembly rotation.

Disc Brake Pad Hardware

Secures disc brake pads firmly in proper relationship to the hydraulic brake calipers. Enables a sliding motion of brake pads when mechanical output force is applied.

Disc Brake Caliper Hardware

Provides mounting for hydraulic brake caliper and secures the caliper firmly in proper relationship to caliper bracket. Enables a sliding motion of the brake caliper to the brake pads when mechanical output force is applied.

System Operation

Mechanical output force is applied from the hydraulic brake caliper pistons to the inner brake pads. As the pistons press the inner brake pads outward, the caliper housings draw the outer brake pads inward. This allows the output force to be equally distributed. The brake pads apply the output force to the friction surfaces on both sides of the brake rotors, which slows the rotation of the tire and wheel assemblies. The

correct function of both the brake pad and brake caliper hardware is essential for even distribution of braking force.

Park Brake System Description and Operation

System Component Description

The park brake system consists of the following:

Park Brake Lever Assembly

Receives, multiplies, and transfers park brake system apply input force from operator to park brake cable system.

Releases applied park brake system when lever is returned to at-rest, lowered, position.

Park Brake Cables

Transfers input force received from park brake lever, through park brake cable equalizer, to park brake apply levers.

Park Brake Cable Equalizer

Evenly distributes input force to both the left and right park brake units.

Park Brake Apply Lever

Multiplies and transfers input force to park brake actuator/adjuster.

Park Brake Actuator/Adjuster

Uses multiplied input force from apply lever to expand park brake shoe (rear disc, drum-in-hat system), or drum brake shoes toward the friction surface of the drum-in-hat of the rear brake rotor, or the brake drum.

Threaded park brake actuators/adjusters are also used to control clearance between the park brake shoe (rear disc, drum-in-hat system), or the drum brake shoes and the friction surface of the drum-in-hat (of the rear brake rotor), or the brake drum.

Park Brake Shoe (Rear Disc, Drum-In-Hat System)

Applies mechanical output force from park brake actuator to friction surface of the drum-in-hat (of the rear brake rotor).

System Operation

Park brake apply input force is received by the park brake pedal assembly being depressed, transferred and evenly distributed, through the park brake cables and the park brake cable equalizer, to the left and right park brake apply levers. The park brake apply levers multiply and transfer the apply input force to the park brake actuators/adjusters which expand the park brake shoe (rear disc, drum-in-hat system), or the drum brake shoes toward the friction surface of the drum-in-hat (of the rear brake rotor), or the brake drum in order to prevent the rotation of the rear tire and wheel assemblies. The park brake release handle assembly releases an applied park brake system when it is pulled rearward.

ABS Description and Operation

Antilock Brake System

When wheel slip is detected during a brake application, the ABS enters antilock mode. During antilock braking, hydraulic pressure in the individual wheel circuits is controlled to prevent any wheel from slipping. A separate hydraulic line and specific solenoid valves are provided for each wheel. The ABS can decrease, hold, or increase hydraulic pressure to each wheel brake. The ABS cannot, however, increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During antilock braking, a series of rapid pulsations is felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as the EBCM responds to wheel speed sensor inputs and attempts to prevent wheel slip. These pedal pulsations are present only during

antilock braking and stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves cycle rapidly. During antilock braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during antilock operation.

Vehicles equipped with ABS may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking is no different than that of previous non-ABS systems. Maintaining a constant force on the brake pedal provides the shortest stopping distance while maintaining vehicle stability.

Engine Description and Operation

Engine Description – 4.2L (LL8)

Engine Mechanical Specifications 4.2L

Application	Specification	
	Metric	English
General		
• Engine Type	In-Line-6	
• Displacement	4.2L	256 cu in
• RPO	LL8	
• VIN	"S"	
• Bore	93 mm	3.66 in
• Stroke	102 mm	4.02 in
• Compression Ratio	10:1	
• Engine Compression Test	1482 KPa	215 psi
• Firing Order	1-5-3-6-2-4	
• Spark Plug Gap	1.07 mm	0.042 in
Block		
• Crankshaft Main Bearing Bore Diameter	78.070-78.088 mm	3.0760-3.0766 in
• Cylinder Bore Diameter	92.990-93.006 mm	3.6638-3.6644 in
• Cylinder Bore Out-of-Round	0.013 mm	0.0005 in
• Cylinder Head Deck Surface Flatness	0.08 mm	0.003 in
• Cylinder Liner Recession	0.015 mm	0.0006 in
Camshaft		
• Camshaft End Play - Exhaust	0.045-0.215 mm	0.0017-0.0084 in
• Camshaft End Play - Intake	0.051-0.201 mm	0.0020-0.0079 in
• Camshaft Journal Diameter - All Intake and Exhaust #2-#7	26.936-26.960 mm	1.0612-1.0622 in
• Camshaft Journal Diameter - Exhaust #1	29.936-29.960 mm	1.1794-1.1804 in
• Camshaft Journal to Bore Clearance	0.040-0.085 mm	0.0015-0.0033 in
Connecting Rod		
• Connecting Rod Bearing Clearance	0.021-0.065 mm	0.0008-0.0025 in
• Connecting Rod Bore Diameter - Bearing End	60.322-60.338 mm	2.3749-2.3755 in
• Connecting Rod Bore Out-of-Round - Bearing End	0.005 mm	0.0002 in
Connecting Rod Side Clearance	0.05-0.35 mm	0.0019-0.0137 in
Crankshaft		
• Crankshaft End Play	0.112-0.388 mm	0.0044-0.0153 in
• Crankshaft Main Bearing Clearance	0.012-0.064 mm	0.0004-0.0025 in
• Crankshaft Main Journal Diameter	69.968-69.984 mm	2.7567-2.7574 in
• Crankshaft Main Journal Out-of-Round	0.005 mm	0.0002 in
• Crankshaft Main Journal Taper	0.005 mm	0.0002 in
Cylinder Head		
• Surface Flatness - Block Deck	0.08 mm	0.003 in
• Surface Flatness - Exhaust Manifold Deck	0.08 mm	0.003 in
• Surface Flatness - Intake Manifold Deck	0.08 mm	0.003 in
Exhaust Manifold		
• Surface Flatness	0.08 mm	0.003 in

Application	Specification	
	Metric	English
Lubrication System		
• Oil Capacity - with Filter	6.6 L	7.0 qts
• Oil Capacity - without Filter	6.1 L	6.5 qts
• Oil Pressure - Minimum	85 KPa	12 psi @ 1200 RPM
Oil Pump		
• Gear Diameter - Drive	73.415-73.370 mm	2.893-2.891 in
• Gear Diameter - Driven	87-86.975 mm	3.428-3.426 in
• Gear Pocket - Depth	15.609-15.584 mm	0.615-0.614 in
• Gear Pocket - Diameter	87.065-87.040 mm	3.430-3.429 in
• Gear Thickness - Drive	15.546-15.521 mm	0.613-0.611 in
• Gear Thickness - Driven	15.360-15.511 mm	0.605-0.611 in
• Lobe Inner Diameter - Maximum	11.9 mm	0.469 in
• Relief Valve-to-Bore Clearance	2.57-1.63 mm	0.101-0.064 in
Piston Rings		
• Piston Ring End Gap - First Compression Ring	0.15-0.3 mm	0.0059-0.0118 in
• Piston Ring End Gap - Second Compression Ring	0.36-0.51 mm	0.0142-0.0201 in
• Piston Ring End Gap - Oil Control Ring	0.250-0.760 mm	0.0098-0.0299 in
• Piston Ring to Groove Clearance - First Compression Ring	0.043-0.093 mm	0.0017-0.0037 in
• Piston Ring to Groove Clearance - Second Compression Ring	0.043-0.093 mm	0.0017-0.0037 in
• Piston Ring to Groove Clearance - Oil Control Ring	0.059-0.215 mm	0.0023-0.0085 in
Pistons and Pins		
• Piston - Piston Diameter	92.971-93.005 mm	3.6603-3.6616 in
• Piston - Piston Pin Bore Diameter	23.002-23.008 mm	0.9056-0.9058 in
• Piston - Piston to Bore Clearance	-0.015-0.035 mm	-0.0006-0.0014 in
• Pin - Piston Pin Clearance to Connecting Rod Bore	0.001-0.018 mm	0.0004-0.0007 in
• Pin - Piston Pin Clearance to Piston Pin Bore	0.003-0.012 mm	0.00012-0.0005 in
• Pin - Piston Pin Diameter	22.996-22.999 mm	0.9054-0.9055 in
Valve System		
• Valves - Valve Face Runout	0.038 mm	0.0015 in
• Valves - Valve Seat Runout	0.05 mm	0.002 in
• Valves - Valve Stem-to-Guide Clearance - Exhaust	0.0375-0.0775 mm	0.0015-0.0030 in
• Valves - Valve Stem-to-Guide Clearance - Intake	0.030-0.065 mm	0.0011-0.0025 in
• Valve Springs - Valve Spring Load - Closed	211.4-233.4 N @ 35 mm	47.5-52.5 lb @ 1.701 in
• Valve Springs - Valve Spring Load - Open	579-631 N @ 24.5 mm	130-142 lb @ 1.260 in

Fastener Tightening Specifications

Application	Specifications	
	Metric	English
A/C Line Bracket Nut at Oil Level Indicator Tube	7 N·m	61 lb in
A/C Line Bracket Bolt at Engine Lift Bracket	10 N·m	89 lb in
A/C Compressor Bolts	50 N·m	37 lb ft
A.I.R. Cover Stud	25 N·m	18 lb ft
Camshaft Cap Bolt	12 N·m	106 lb in
Camshaft Cover Bolt	10 N·m	89 lb in
Camshaft Position Actuator Valve Bolt	10 N·m	89 lb in
Connecting Rod Cap Bolt		
• First Pass	25 N·m	18 lb ft
• Final Pass	110 degrees	
Coolant Temperature Sensor	20 N·m	15 lb ft
Cooling Fan Hub Nut	56 N·m	41 lb ft
Crankshaft Balancer Bolt		
• First Pass	150 N·m	110.6 lb ft
• Final Pass	180 degrees	
Crankshaft Main Bearing Cap Bolt		
• First Pass	25 N·m	18 lb ft
• Final Pass	180 degrees	
Crankshaft Position Sensor Bolt	10 N·m	89 lb in
Crankshaft Rear Housing Bolt	10 N·m	89 lb in
Cylinder Head Access Hole Plug - Plastic	5 N·m	44 lb in
Cylinder Head Bolt - 14		
• First Pass	30 N·m	22 lb ft
• Final Pass	155 degrees	
Cylinder Head End Bolts - 2 Short		
• First Pass	7 N·m	62 lb in
• Final Pass	60 degrees	
Cylinder Head End Bolts - 1 Long		
• First Pass	7 N·m	62 lb in
• Final Pass	120 degrees	
Cylinder Head Oil Gallery Plug	38 N·m	28 lb ft
Drive Belt Idler Pulley Bolt	50 N·m	37 lb ft
Drive Belt Tensioner Bolt	50 N·m	37 lb ft
Engine Block Oil Gallery Plug - Front and Rear	80 N·m	60 lb ft
Engine Block Oil Gallery Plug - Side	35 N·m	26 lb ft
Engine Flywheel Bolt		
• First Pass	25 N·m	18 lb ft
• Final Pass	50 degrees	
Engine Front Cover Bolt	10 N·m	89 lb in
Engine Front Cover Spacer Bolt	10 N·m	89 lb in
Engine Front Lift Bracket Bolt	50 N·m	37 lb ft
Engine Harness Bracket Bolt	10 N·m	89 lb in
Engine Mount Bracket Bolt - Engine	50 N·m	37 lb ft
Engine Mount Bracket Bolt - Frame	110 N·m	81 lb ft
Engine Mount Nuts - Upper and Lower	70 N·m	52 lb ft
Engine Protection Shield Bolts	25 N·m	18 lb ft
EVAP Purge Solenoid Valve Bolt	10 N·m	89 lb in

Application	Specifications	
	Metric	English
Exhaust Camshaft Actuator Bolt		
• First Pass	25 N·m	18 lb ft
• Final Pass	135 degrees	
Exhaust Camshaft Position Sensor Bolt	10 N·m	89 lb in
Exhaust Manifold Bolt		
• First Pass	20 N·m	15 lb ft
• Second Pass	20 N·m	15 lb ft
• Final Pass	20 N·m	15 lb ft
Exhaust Manifold Heat Shield Nut	10 N·m	89 lb in
Exhaust Manifold Heat Shield Stud	10 N·m	89 lb in
Exhaust Pipe Bolt	50 N·m	37 lb ft
Front Differential Bolt	85 N·m	63 lb ft
Fuel Injector Rail Bolt	10 N·m	89 lb in
Generator Battery Lead Nut	9 N·m	80 lb in
Heater Inlet Fitting	45 N·m	33 lb ft
Heater Outlet Fitting	45 N·m	33 lb ft
Ignition Coil Bolt	10 N·m	89 lb in
Intake Camshaft Sprocket Bolt		
• First Pass	20 N·m	15 lb ft
• Final Pass	100 degrees	
Intake Manifold Bolt	10 N·m	89 lb in
Knock Sensor	25 N·m	18 lb ft
Oil Filter - PF 58	30 N·m	23 lb ft
Oil Filter Adapter	50 N·m	37 lb ft
Oil Filter Bypass Hole Plug	14 N·m	124 lb in
Oil Level Indicator Tube Stud	10 N·m	89 lb in
Oil Level Sensor Bolt	10 N·m	89 lb in
Oil Pan Bolt - Ends	10 N·m	89 lb in
Oil Pan Bolt - Sides	25 N·m	18 lb ft
Oil Pan Drain Plug	26 N·m	19 lb ft
Oil Pan Nut	25 N·m	18 lb ft
Oil Pan Stud	11 N·m	97 lb in
Oil Pressure Sensor	20 N·m	15 lb ft
Oil Pump Cover Bolt	10 N·m	89 lb in
Oil Pump Pickup Tube	10 N·m	89 lb in
Oil Pump Pressure Relief Valve	14 N·m	124 lb in
Power Steering Pump Bolt	25 N·m	18 lb ft
Power Steering Pump Bracket Bolt	50 N·m	37 lb ft
Spark Plug	18 N·m	13 lb ft
Starter Motor Bolt	50 N·m	37 lb ft
Starter Motor Nut	50 N·m	37 lb ft
Thermostat Housing bolt	10 N·m	89 lb in
Throttle Control Module Bolt	10 N·m	89 lb in
Timing Chain Tensioner Bolt	25 N·m	18 lb ft
Timing Chain Tensioner Guide Bolt	14 N·m	124 lb in
Timing Chain Tensioner Shoe Bolt	25 N·m	18 lb ft
Timing Chain Top Guide Bolt	10 N·m	89 lb in
Torque Converter Bolts	60 N·m	44 lb ft
Transmission Bell Housing Bolts	50 N·m	37 lb ft
Transmission Fluid Tube to Air Adapter Nut	10 N·m	89 lb in
Water Outlet Bolt	10 N·m	89 lb in

Application	Specifications	
	Metric	English
Water Pump Bolt	10 N·m	89 lb in
Water Pump Pulley Bolt	25 N·m	18 lb ft

Engine Component Description

Engine Block

The lost foam all aluminum engine block utilizes a deep skirt design for increased rigidity. The cylinders are positioned in a straight in-line 6 cylinder orientation. The crankshaft bearing caps have a bearing beam or "ladder" for enhaced structural rigidity and vibration reduction.

Oil Pan

A single piece cast aluminum oil pan contributes to crankshaft and block rigidity while reducing overall weight. The oil pan bolts to the bell housing as well as the block. This eliminates points of vibration and makes the complete powertrain act as a single casting. Jack screws are used to remove the oil pan.

Crankshaft

The crankshaft is a nodular iron design with seven main bearings.

Connecting Rods

The connecting rods are forged powdered metal. The connecting rods and caps are of a fractured split design to improve durability and reduce internal friction. Care must be taken to ensure the mating surfaces are not damaged during service procedures.

Pistons

The pistons are a full-floating design. The piston pins are a slip fit in the bronze bushed connecting rod and are retained in the piston by round wire retainers. There are two compression rings and one oil control ring.

Cylinder Head

The cylinder head is also made of the lost foam aluminum for lighter weight and rapid heat dissipation. There are 4 valves per cylinder and the ports are of a high swirl design for improved combustion. The cylinder head gasket consist of a steel laminated construction.

Valve Train

The engine utilizes dual overhead camshafts and roller followers for reduced friction, which results in improved gas mileage.

Fuel System

A new electronic throttle control system is used on the engine. A throttle actuator control or TAC system eliminates cable linkage from the pedal to the throttle control module. All throttle movements are controlled by the PCM.

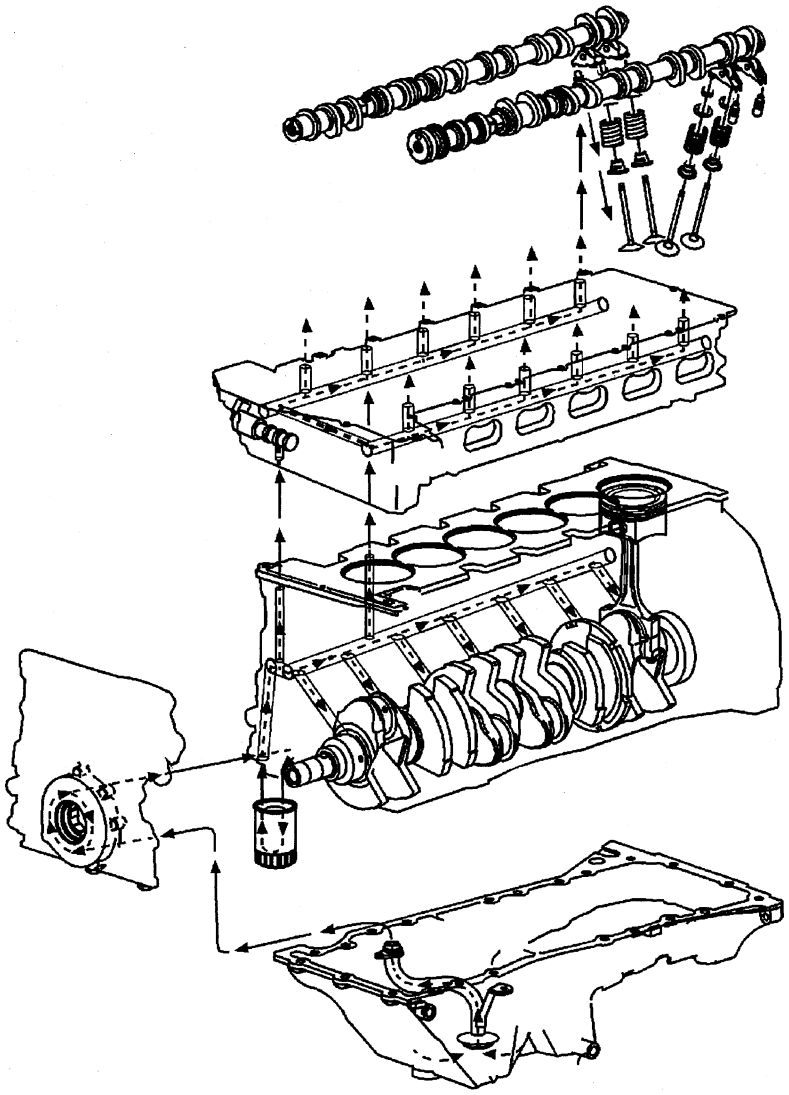
Oil Pump

The oil pump is gear driven directly from the crankshaft. The oil pump drive gear is a slip fit to the crankshaft.

Engine Covers

There is a front engine cover and a rear engine cover, both are made of aluminum. The front engine cover and rear engine cover have "T" sealing joints and need to be removed after the oil pan. The front and rear covers need to be installed before the oil pan. Jack screws are used to remove the covers. Guide pins are used to aid in the installation of both covers.

Lubrication Description



The engine lubrication system is of the force-feed type. The oil is supplied under full pressure to the crankshaft, connecting rods, valve lash adjusters, and cam phasing system. A controlled volume of oil is supplied to the camshaft and valve rocker arms. Gravity flow or splash lubricates all other parts. The engine oil is stored in the oil pan, which is filled through a fill cap in the camshaft cover. A removable oil level indicator, on the right side of the engine block, is provided to check the oil level. The oil pump is located in the engine front cover and is driven by the crankshaft. It is a gerotor-style pump, which is a combination of a gear, and a rotor pump. It is connected by a passage in the cylinder block to an oil screen and pipe assembly. The screen is submerged in the oil supply and has ample volume for all operating conditions. Oil is drawn into the pump through the screen and pipe assembly, and a passage in the crankcase, connecting to the passages in the engine front cover. Oil is discarged from the oil pump to the oil filter. The oil pressure relief valve limits the oil pressure. The oil filter bypass valve opens when the oil filter is restricted to approximately 68.95 kPa (10 psi) of pressure difference between the oil filter inlet and discharge. The oil will then bypass the oil filter and channel unfiltered oil directly to the main oil galleries of the engine. A full-flow oil filter is mounted to the oil filter adapter on the lower right front side of the engine. The main oil galleries run the full length of the engine block and cut into the valve lash adjuster holes to supply oil at full pressure to the valve lash adjusters. Holes are drilled from the crankshaft bearings to the main oil gallery. Oil is transferred from the crankshaft bearings to the connecting rod bearings through holes drilled in the crankshaft. Pistons, piston pins, and cylinder walls

are lubricated by oil splash from the crankshaft and connecting rods. The camshafts and valve rocker arms are supplied with oil from the oil passages drilled into the camshaft mounting areas.

Exhaust Camshaft Position Actuator Description

The camshaft position actuator is bolted to the front of the exhaust camshaft and is integral with the sprocket. The actuator and sprocket can only be replaced as one unit. The actuator has a hydraulically actuated piston located in the hub. The piston has an internal helical spline that slides in mesh with the gear. As the piston moves, the piston and gear mechanism changes the timing of the exhaust camshaft, relative to the cam drive sprocket. When oil pressure is applied to one side of the piston, the cam moves clockwise and timing is advanced. When oil pressure is applied to the other side of the piston the cam moves counter-clockwise to retard timing. The total range of actuator rotation is 0 to 25 camshaft degrees. At idle, the exhaust camshaft position actuator is at full advance or 0 degrees.

Crankcase Ventilation System Description

A closed crankcase ventilation system is used in order to provide a more complete scavenging of crankcase vapors. Fresh air from the throttle body is supplied to the crankcase, mixed with blow-by gases, and then passed through a crankcase ventilation pipe/passage into the intake manifold.

Results of Incorrect Operation

A plugged PCV Pipe/passage way may cause:

- Rough idle
- Stalling or slow idle speed
- Oil leaks
- Sludge in engine

Drive Belt System Description

The drive belt system consists of the following components:

- The drive belt
- The drive belt tensioner
- The drive belt idler pulley
- The crankshaft balancer pulley
- The accessory drive component mounting brackets
- The accessory drive components
  - The power steering pump, if belt driven
  - The generator
  - The A/C compressor, if equipped
  - The engine cooling fan, if belt driven
  - The water pump, if belt driven
  - The vacuum pump, if equipped
  - The air compressor, if equipped

The drive belt system may use one belt or two belts. The drive belt is thin so that it can bend backwards and has several ribs to match the grooves in the pulleys. There also may be a V-belt style belt used to drive certain accessory drive components. The drive belts are made of different types of rubbers (chloroprene or EPDM) and have different layers or plys containing either fiber cloth or cords for reinforcement.

Both sides of the drive belt may be used to drive the different accessory drive components. When the back side of the drive belt is used to drive a pulley, the pulley is smooth.

The drive belt is pulled by the crankshaft balancer pulley across the accessory drive component pulleys. The spring loaded drive belt tensioner keeps constant tension on the drive belt to prevent the drive belt from slipping. The drive belt tensioner arm will move when loads are applied to the drive belt by the accessory drive components and the crankshaft.

The drive belt system may have an idler pulley, which is used to add wrap to the adjacent pulleys. Some systems use an idler pulley in place of an accessory drive component when the vehicle is not equipped with the accessory.

Exhaust Camshaft Position Actuator Description

The camshaft position actuator is bolted to the front of the exhaust camshaft and is integral with the sprocket. The actuator and sprocket can only be replaced as one unit. The actuator has a hydraulically actuated piston located in the hub. The piston has an internal helical spline that slides in mesh with the gear. As the piston moves, the piston and gear mechanism changes the timing of the exhaust camshaft, relative to the cam drive sprocket. When oil pressure is applied to one side of the piston, the cam moves clockwise and timing is advanced. When oil pressure is applied to the other side of the piston the cam moves counter-clockwise to retard timing. The total range of actuator rotation is 0 to 25 camshaft degrees. At idle, the exhaust camshaft position actuator is at full advance or 0 degrees.

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A closed crankcase ventilation system is used in order to provide a more complete scavenging of crankcase vapors. Fresh air from the throttle body is supplied to the crankcase, mixed with blow-by gases, and then passed through a crankcase ventilation pipe/passage into the intake manifold.

Results of Incorrect Operation

A plugged PCV Pipe/passage way may cause:

- Rough idle
- Stalling or slow idle speed
- Oil leaks
- Sludge in engine

Engine Description – 5.3L (LM4)

General Specifications

Application	Specification	
	Metric	English
General		
Engine Type	V8	
Displacement	5.3L	325 CID
RPO	LM4	
VIN	P	
Bore	96.0-96.018 mm	3.779-3.78 in
Stroke	92.0 mm	3.622 in
Compression Ratio	9.49:1	
Firing Order	1-8-7-2-6-5-4-3	
Spark Plug Gap	1.524 mm	0.06 in
Block		
Camshaft Bearing Bore 1 and 5 Diameter - First Design	59.08-59.13 mm	2.325-2.327 in
Camshaft Bearing Bore 2 and 4 Diameter - First Design	58.83-58.88 mm	2.316-2.318 in
Camshaft Bearing Bore 3 Diameter - First Design	58.58-58.63 mm	2.306-2.308 in
Camshaft Bearing Bore 1 and 5 Diameter - Second Design	59.58-59.63 mm	2.345-2.347 in
Camshaft Bearing Bore 2 and 4 Diameter - Second Design	59.08-59.13 mm	2.325-2.327 in
Camshaft Bearing Bore 3 Diameter - Second Design	58.58-58.63 mm	2.306-2.308 in
Crankshaft Main Bearing Bore Diameter	69.871-69.889 mm	2.75-2.751 in
Crankshaft Main Bearing Bore Out-of-Round	0.006 mm	0.0002 in
Cylinder Bore Diameter	96.0-96.018 mm	3.779-3.78 in
Cylinder Bore Taper - Thrust Side	0.018 mm	0.0007 in
Cylinder Head Deck Height - Measuring from the Centerline of Crankshaft to the Deck Face	234.57-234.82 mm	9.235-9.245 in
Cylinder Head Deck Surface Flatness - Measured Within a 152.4 mm (6.0 in) Area	0.11 mm	0.004 in
Cylinder Head Deck Surface Flatness - Measuring the Overall Length of the Block Deck	0.22 mm	0.008 in
Valve Lifter Bore Diameter	21.417-21.443 mm	0.843-0.844 in
Camshaft		
Camshaft End Play	0.025-0.305 mm	0.001-0.012 in
Camshaft Journal Diameter	54.99-55.04 mm	2.164-2.166 in
Camshaft Journal Out-of-Round	0.025 mm	0.001 in
Camshaft Lobe Lift - Exhaust	6.96 mm	0.274 in
Camshaft Lobe Lift - Intake	6.82 mm	0.268 in
Camshaft Runout - Measured at the Intermediate Journals	0.05 mm	0.002 in
Connecting Rod		
Connecting Rod Bearing Clearance - Production	0.023-0.065 mm	0.0009-0.0025 in
Connecting Rod Bearing Clearance - Service	0.023-0.076 mm	0.0009-0.003 in
Connecting Rod Bore Diameter - Bearing End	56.505-56.525 mm	2.224-2.225 in
Connecting Rod Bore Out-of-Round - Bearing End - Production	0.004-0.008 mm	0.00015-0.0003 in
Connecting Rod Bore Out-of-Round - Bearing End - Service	0.004-0.008 mm	0.00015-0.0003 in
Connecting Rod Side Clearance	0.11-0.51 mm	0.00433-0.02 in

Application	Specification	
	Metric	English
Crankshaft		
Connecting Rod Journal Diameter - Production	53.318-53.338 mm	2.0991-2.0999 in
Connecting Rod Journal Diameter - Service	53.308 mm	2.0987 in
Connecting Rod Journal Out-of-Round - Production	0.005 mm	0.0002 in
Connecting Rod Journal Out-of-Round - Service	0.01 mm	0.0004 in
Connecting Rod Journal Taper - Maximum for 1/2 of Journal Length - Production	0.005 mm	0.0002 in
Connecting Rod Journal Taper - Maximum for 1/2 of Journal Length - Service	0.02 mm	0.00078 in
Crankshaft End Play	0.04-0.2 mm	0.0015-0.0078 in
Crankshaft Main Bearing Clearance - Production	0.02-0.052 mm	0.0008-0.0021 in
Crankshaft Main Bearing Clearance - Service	0.02-0.065 mm	0.0008-0.0025 in
Crankshaft Main Journal Diameter - Production	64.992-65.008 mm	2.558-2.559 in
Crankshaft Main Journal Diameter - Service	64.992 mm	2.558 in
Crankshaft Main Journal Out-of-Round - Production	0.003 mm	0.000118 in
Crankshaft Main Journal Out-of-Round - Service	0.008 mm	0.0003 in
Crankshaft Main Journal Taper - Production	0.01 mm	0.0004 in
Crankshaft Main Journal Taper - Service	0.02 mm	0.00078 in
Crankshaft Rear Flange Runout	0.05 mm	0.002 in
Crankshaft Reluctor Ring Runout - Measured 1.0 mm (0.04 in) Below Tooth Diameter	0.7 mm	0.028 in
Crankshaft Thrust Surface - Production	26.14-26.22 mm	1.029-1.0315 in
Crankshaft Thrust Surface - Service	26.22 mm	1.0315 in
Crankshaft Thrust Surface Runout	0.025 mm	0.001 in
Cylinder Head		
Cylinder Head Height/Thickness - Measured from the Cylinder Head Deck to the Valve Rocker Arm Cover Seal Surface	120.2 mm	4.732 in
Surface Flatness - Block Deck - Measured Within a 152.4 mm (6.0 in) Area	0.08 mm	0.003 in
Surface Flatness - Block Deck - Measuring the Overall Length of the Cylinder Head	0.1 mm	0.004 in
Surface Flatness - Exhaust Manifold Deck	0.13 mm	0.005 in
Surface Flatness - Intake Manifold Deck	0.08 mm	0.0031 in
Valve Guide Installed Height - Measured from the Spring Seat Surface to the Top of the Guide	17.32 mm	0.682 in
Intake Manifold		
Surface Flatness - Measured at Gasket Sealing Surfaces and Measured Within a 200 mm (7.87 in) Area that Includes Two Runner Port Openings	0.3 mm	0.118 in
Lubrication System		
Oil Capacity - with Filter	5.68 liters	6.0 quarts
Oil Capacity - without Filter	5.20 liters	5.5 quarts
Oil Pressure - Minimum - Hot	41 kPa at 1,000 engine RPM 124 kPa at 2,000 engine RPM 165 kPa at 4,000 engine RPM	6 psig at 1,000 engine RPM 18 psig at 2,000 engine RPM 24 psig at 4,000 engine RPM

Application	Specification	
	Metric	English
Oil Pan		
Front Cover Alignment - at Oil Pan Surface	0.0-0.5 mm	0.0-0.02 in
Rear Cover Alignment - at Oil Pan Surface	0.0-0.5 mm	0.0-0.02 in
Oil Pan Alignment - to Rear of Engine Block at Transmission Bell Housing Mounting Surface	0.0-0.25 mm	0.0-0.01 in
Piston Rings		
Piston Ring End Gap - First Compression Ring - Measured in Cylinder Bore - Production	0.23-0.44 mm	0.009-0.017 in
Piston Ring End Gap - First Compression Ring - Measured in Cylinder Bore - Service	0.23-0.5 mm	0.009-0.0196 in
Piston Ring End Gap - Second Compression Ring - Measured in Cylinder Bore - Production	0.44-0.7 mm	0.017-0.027 in
Piston Ring End Gap - Second Compression Ring - Measured in Cylinder Bore - Service	0.44-0.76 mm	0.0173-0.03 in
Piston Ring End Gap - Oil Control Ring - Measured in Cylinder Bore - Production	0.18-0.75 mm	0.007-0.029 in
Piston Ring End Gap - Oil Control Ring - Measured in Cylinder Bore - Service	0.18-0.81 mm	0.007-0.032 in
Piston Ring to Groove Clearance - First Compression Ring - Production	0.04-0.085 mm	0.00157-0.00335 in
Piston Ring to Groove Clearance - First Compression Ring - Service	0.04-0.085 mm	0.00157-0.00335 in
Piston Ring to Groove Clearance - Second Compression Ring - Production	0.04-0.078 mm	0.00157-0.0031 in
Piston Ring to Groove Clearance - Second Compression Ring - Service	0.04-0.078 mm	0.00157-0.0031 in
Piston Ring to Groove Clearance - Oil Control Ring - Production	0.012-0.2 mm	0.0005-0.0078 in
Piston Ring to Groove Clearance - Oil Control Ring - Service	0.012-0.2 mm	0.0005-0.0078 in
Pistons and Pins		
Piston - Piston Diameter - Measured Over Skirt Coating	96.002-96.036 mm	3.779-3.78 in
Piston - Piston to Bore Clearance - Production	-0.036-0.016 mm	-0.0014-0.0006 in
Piston - Piston to Bore Clearance - Service Limit with Skirt Coating Worn Off	0.071 mm	0.0028 in
Pin - Piston Pin Fit in Connecting Rod Bore	0.02-0.043 mm - Interference	0.00078-0.00169 in - Interference
Pin - Piston Pin Clearance to Piston Pin Bore - Production	0.007-0.02 mm	0.00027-0.00078 in
Pin - Piston Pin Clearance to Piston Pin Bore - Service	0.007-0.021 mm	0.00027-0.00082 in
Pin - Piston Pin Diameter	23.997-24.0 mm	0.9447-0.9448 in
Valve System		
Valves - Valve Face Angle	45 degrees	
Valves - Valve Face Width	1.25 mm	0.05 in
Valves - Valve Lash	Net Lash - No Adjustment	
Valves - Valve Lift - Intake	11.6 mm	0.457 in
Valves - Valve Lift - Exhaust	11.85 mm	0.466 in
Valves - Valve Seat Angle	46 degrees	
Valves - Valve Seat Runout	0.05 mm	0.002 in
Valves - Valve Seat Width - Exhaust	1.78 mm	0.07 in
Valves - Seat Width - Intake	1.02 mm	0.04 in

Application	Specification	
	Metric	English
Valves - Valve Stem Diameter - Production	7.955-7.976 mm	0.313-0.314 in
Valves - Valve Stem Diameter - Service	7.95 mm	0.313 in
Valves - Valve Stem-to-Guide Clearance - Production - Intake	0.025-0.066 mm	0.001-0.0026 in
Valves - Valve Stem-to-Guide Clearance - Service - Intake	0.093 mm	0.0037 in
Valves - Valve Stem-to-Guide Clearance - Production - Exhaust	0.025-0.066 mm	0.001-0.0026 in
Valves - Valve Stem-to-Guide Clearance - Service - Exhaust	0.093 mm	0.0037 in
Rocker Arms - Valve Rocker Arm Ratio	1.70:1	
Valve Springs - Valve Spring Free Length	52.9 mm	2.08 in
Valve Springs - Valve Spring Installed Height	45.75 mm	1.8 in
Valve Springs - Valve Spring Load - Closed	340 N at 45.75 mm	76 lb at 1.8 in
Valve Springs - Valve Spring Load - Open	980 N at 33.55 mm	220 lb at 1.32 in

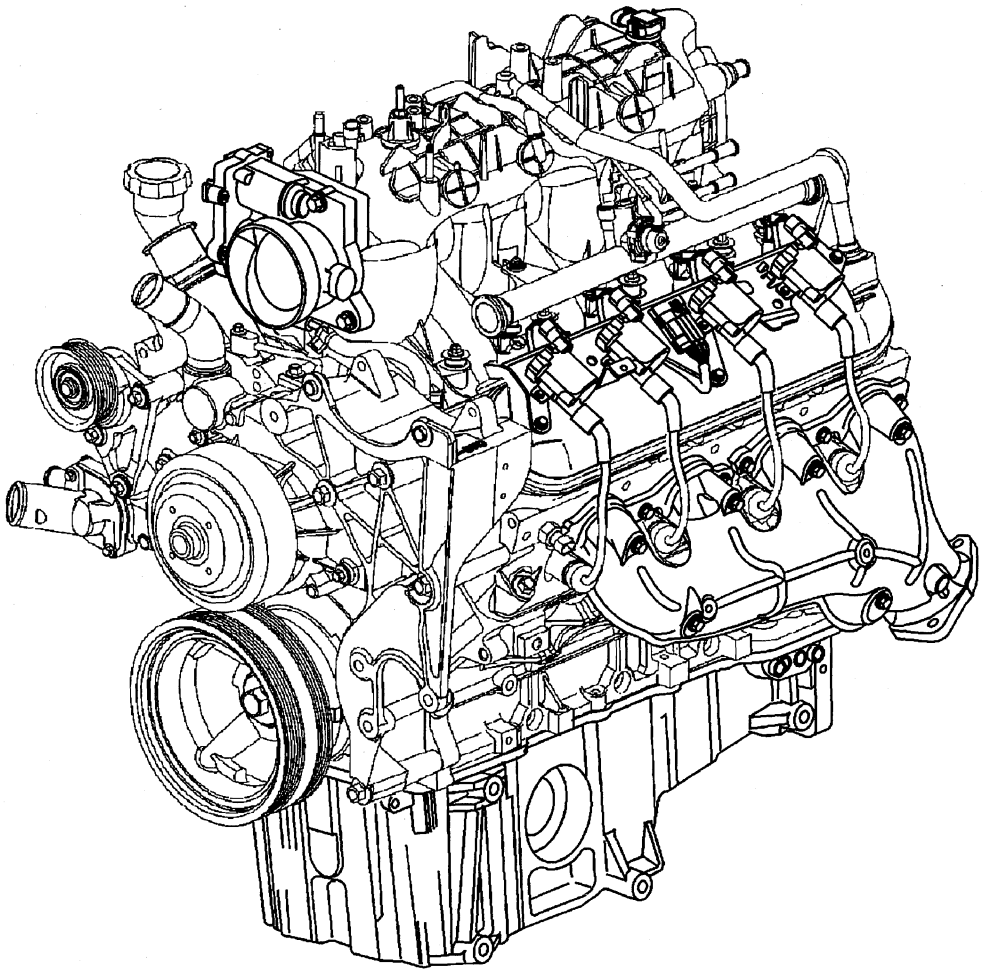
Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Cleaner Outlet Duct Bolt	10 N·m	89 lb in
Air Cleaner Outlet Duct Clamp	7 N·m	62 lb in
Air Conditioning Belt Tensioner Bolt	50 N·m	37 lb ft
Air Conditioning Bracket Bolt	50 N·m	37 lb ft
Battery Cable Channel Bolt	12 N·m	106 lb in
Brake Hose Retaining Bolt	25 N·m	18 lb ft
Camshaft Retainer Bolts	25 N·m	18 lb ft
Camshaft Sensor Bolt	25 N·m	18 lb ft
Camshaft Sprocket Bolts	35 N·m	26 lb ft
Connecting Rod Bolts - First Pass	20 N·m	15 lb ft
Connecting Rod Bolts - Final Pass	75 degrees	
Coolant Temperature Gage Sensor	20 N·m	15 lb ft
Crankshaft Balancer Bolt - Installation Pass to Ensure the Balancer is Completely Installed	330 N·m	240 lb ft
Crankshaft Balancer Bolt - First Pass - Install a NEW Bolt After the Installation Pass and Tighten as Described in the First and Final Passes	50 N·m	37 lb ft
Crankshaft Balancer Bolt - Final Pass	140 degrees	
Crankshaft Bearing Cap Bolts - Inner Bolts - First Pass in Sequence	20 N·m	15 lb ft
Crankshaft Bearing Cap Bolts - Inner Bolts - Final Pass in Sequence	80 degrees	
Crankshaft Bearing Cap Bolts - Outer Bolts - First Pass in Sequence	20 N·m	15 lb ft
Crankshaft Bearing Cap Bolts - Outer Bolts - Final Pass in Sequence	51 degrees	
Crankshaft Bearing Cap Side Bolts	25 N·m	18 lb ft
Crankshaft Oil Deflector Nuts	25 N·m	18 lb ft
Crankshaft Position Sensor Bolt	25 N·m	18 lb ft
Cylinder Head Bolts - First Pass all M11 Bolts in Sequence	30 N·m	22 lb ft
Cylinder Head Bolts - Second Pass all M11 Bolts in Sequence	90 degrees	
Cylinder Head Bolts - Final Pass all M11 Bolts in Sequence - Excluding the Medium Length Bolts at the Front and Rear of Each Cylinder	90 degrees	
Cylinder Head Bolts - Final Pass M11 Medium Length Bolts at the Front and Rear of Each Cylinder Head in Sequence	50 degrees	
Cylinder Head Bolts - M8 Inner Bolts in Sequence	30 N·m	22 lb ft
Cylinder Head Coolant Plug	20 N·m	15 lb ft
Differential Bolt	85 N·m	63 lb ft
Drive Belt Idler Pulley Bolt	50 N·m	37 lb ft

Application	Specification	
	Metric	English
Drive Belt Tensioner Bolt	50 N·m	37 lb ft
Engine Block Coolant Drain Plugs	60 N·m	44 lb ft
Engine Block Heater	40 N·m	30 lb ft
Engine Block Oil Gallery Plugs	60 N·m	44 lb ft
Engine Coolant Air Bleed Pipe and Cover Bolts	12 N·m	106 lb in
Engine Flywheel Bolts - First Pass	20 N·m	15 lb ft
Engine Flywheel Bolts - Second Pass	50 N·m	37 lb ft
Engine Flywheel Bolts - Final Pass	100 N·m	74 lb ft
Engine Front Cover Bolts	25 N·m	18 lb ft
Engine Harness Bracket Nut	10 N·m	89 lb in
Engine Mount Bracket Spacer	50 N·m	37 lb ft
Engine Mount Frame Bracket	100 N·m	74 lb ft
Engine Mount Nuts	50 N·m	37 lb ft
Engine Mount-to-Engine Bolts	50 N·m	37 lb ft
Engine Rear Cover Bolts	25 N·m	18 lb ft
Engine Service Lift Bracket M10 Bolts	50 N·m	37 lb ft
Engine Service Lift Bracket M8 Bolt	25 N·m	18 lb ft
Engine Shield Bolt	20 N·m	15 lb ft
Engine Sight Shield Bolt	10 N·m	89 lb in
Engine Sight Shield Retainer Bolt	5 N·m	44 lb in
Engine Valley Cover Bolts	25 N·m	18 lb ft
Evaporative Emission - EVAP - Purge Solenoid Bolt	10 N·m	89 lb in
Exhaust Manifold Bolts - First Pass	15 N·m	11 lb ft
Exhaust Manifold Bolts - Final Pass	25 N·m	18 lb ft
Exhaust Manifold Heat Shield Bolts	9 N·m	80 lb in
Front Shock Upper Retaining Nut	100 N·m	74 lb ft
Fuel Rail Bolts	10 N·m	89 lb in
Fuel Rail Crossover Tube Bolts	3.8 N·m	34 lb in
Fuel Rail Stop Bracket Bolt	50 N·m	37 lb ft
Ignition Coil-to-Bracket Bolts	8 N·m	71 lb in
Ignition Coil Bracket-to-Valve Rocker Arm Cover Bolts	12 N·m	106 lb in
Intake Manifold Bolts - First Pass in Sequence	5 N·m	44 lb in
Intake Manifold Bolts - Final Pass in Sequence	10 N·m	89 lb in
Intake Manifold Wiring Harness Stud	10 N·m	89 lb in
Knock Sensors	20 N·m	15 lb ft
Oil Filter	30 N·m	22 lb ft
Oil Filter Fitting	55 N·m	40 lb ft
Oil Level Indicator Tube Bolt	25 N·m	18 lb ft
Oil Pan Baffle Bolts	12 N·m	106 lb in
Oil Pan Closeout Cover Bolt - Left Side	9 N·m	80 lb in
Oil Pan Closeout Cover Bolt - Right Side	9 N·m	80 lb in
Oil Pan Cover Bolts	12 N·m	106 lb in
Oil Pan Drain Plug	25 N·m	18 lb ft
Oil Pan M8 Bolts - Oil Pan-to-Engine Block and Oil Pan-to-Front Cover	25 N·m	18 lb ft
Oil Pan M6 Bolts - Oil Pan-to-Rear Cover	12 N·m	106 lb in
Oil Pressure Sensor	20 N·m	15 lb ft
Oil Pump-to-Engine Block Bolts	25 N·m	18 lb ft
Oil Pump Cover Bolts	12 N·m	106 lb in
Oil Pump Relief Valve Plug	12 N·m	106 lb in
Oil Pump Screen Nuts	25 N·m	18 lb ft
Oil Pump Screen-to-Oil Pump Bolt	12 N·m	106 lb in

Application	Specification	
	Metric	English
Propeller Shaft Yoke Retainer Bolt	20 N·m	15 lb ft
Spark Plugs - New Cylinder Heads	20 N·m	15 lb ft
Spark Plugs - All Subsequent Installations	15 N·m	11 lb ft
Throttle Body Nuts	10 N·m	89 lb in
Throttle Body Studs	6 N·m	53 lb in
Transmission Bellhousing Bolt	50 N·m	37 lb ft
Transmission Oil Cooler Line Bracket Bolt	9 N·m	80 lb in
Upper Ball Joint Pinch Bolt	40 N·m	30 lb ft
Upper Engine Mount Bracket	50 N·m	37 lb ft
Valve Lifter Guide Bolts	12 N·m	106 lb in
Valve Rocker Arm Bolts	30 N·m	22 lb ft
Valve Rocker Arm Cover Bolts	12 N·m	106 lb in
Water Inlet Housing Bolts	15 N·m	11 lb ft
Water Pump Bolts - First Pass	15 N·m	11 lb ft
Water Pump Bolts - Final Pass	30 N·m	22 lb ft
Water Pump Cover Bolts	15 N·m	11 lb ft

Engine Component Description



The 5.3 Liter V8 engine is identified as RPO LM4 VIN P (5.3L).

Camshaft and Drive System

A billet steel one piece camshaft is supported by five bearings pressed into the engine block. The camshaft has a machined camshaft sensor reluctor ring incorporated between the fourth and fifth bearing journals. The camshaft timing sprocket is mounted to the front of the camshaft and is driven by the crankshaft sprocket through the camshaft timing chain. The splined crankshaft sprocket is positioned to the crankshaft by a key and keyway. The crankshaft sprocket splines drive the oil pump driven gear. A retaining plate mounted to the front of the engine block maintains camshaft location.

Crankshaft

The crankshaft is cast nodular iron. The crankshaft is supported by five crankshaft bearings. The bearings are retained by crankshaft bearing caps which are machined with the engine block for proper alignment and clearance. The crankshaft journals are undercut and rolled. The center main journal is the thrust journal. A crankshaft position reluctor ring is press fit mounted at the rear of the crankshaft. The reluctor ring is not serviceable separately. All crankshafts will have a short rear flange at the crankshaft rear oil seal area.

Cylinder Heads

The cylinder heads are cast aluminum and have pressed in place powdered metal valve guides and valve seats. Passages for the engine coolant air bleed system are at the front of each cylinder head. The valve rocker arm covers are retained to the cylinder head by four center mounted rocker arm cover bolts.

Engine Block

The engine block is a cam-in-block deep skirt 90 degree V configuration with five crankshaft bearing caps. The engine block is cast aluminum. The five crankshaft bearing caps each have four vertical M10 and two horizontal M8 mounting bolts. The camshaft is supported by five camshaft bearings pressed into the block.

Exhaust Manifolds

The exhaust manifolds are a one piece cast iron design. The exhaust manifolds direct exhaust gasses from the combustion chambers to the exhaust system. Each manifold also has an externally mounted heat shield that is retained by bolts.

Intake Manifold

The intake manifold is a one piece composite design that incorporates brass threaded inserts for mounting the fuel rail, throttle body, evaporative emission (EVAP) solenoid and wire harness stud. Each side of the intake manifold is sealed to the cylinder head by a nonreusable silicone sealing gasket and nylon carrier assembly. The electronically actuated throttle body bolts to the front of the intake manifold. The throttle body is sealed by a one piece push in place silicone gasket. The fuel rail assembly with eight separate fuel injectors is retained to the intake by four bolts. The injectors are seated into their individual manifold bores with O-ring seals to provide sealing. A fuel rail stop bracket is retained to the rear of the left cylinder head by a mounting bolt. The manifold absolute pressure (MAP) sensor is installed and retained to the top rear of the intake manifold and sealed by an O-ring seal. The EVAP solenoid is mounted to the top front of the intake manifold and retained by one bolt. There are no coolant passages within the intake manifold.

Oil Pan

The structural oil pan is cast aluminum. Incorporated into the design are the oil filter mounting boss, drain plug opening, oil level indicator tube opening, and oil pan baffle. An internal tube assembly directs pressurized oil from the engine block to the oil filter which is mounted in the center area of the pan. Filtered oil is then returned to the engine block through the tube assembly into the engine block oil galleries. The alignment of the structural oil pan to the rear of the engine block and transmission bell housing is critical.

Piston and Connecting Rod Assembly

The pistons are cast aluminum. The pistons use two compression rings and one oil control ring assembly. The piston is a low friction, lightweight design with a flat or recessed top and barrel shaped skirt. The piston pins are chromium steel, have floating fit in the piston, and are retained by a press fit in the connecting rod. The connecting rods are powdered metal. The connecting rods are fractured at the connecting rod journal and then machined for the proper clearance. 2003 applications use a piston with a graphite coated skirt. The piston, pin, and connecting rod are to be serviced as an assembly. The piston, pin, and connecting rod are to be serviced as an assembly.

Valve Rocker Arm Cover Assemblies

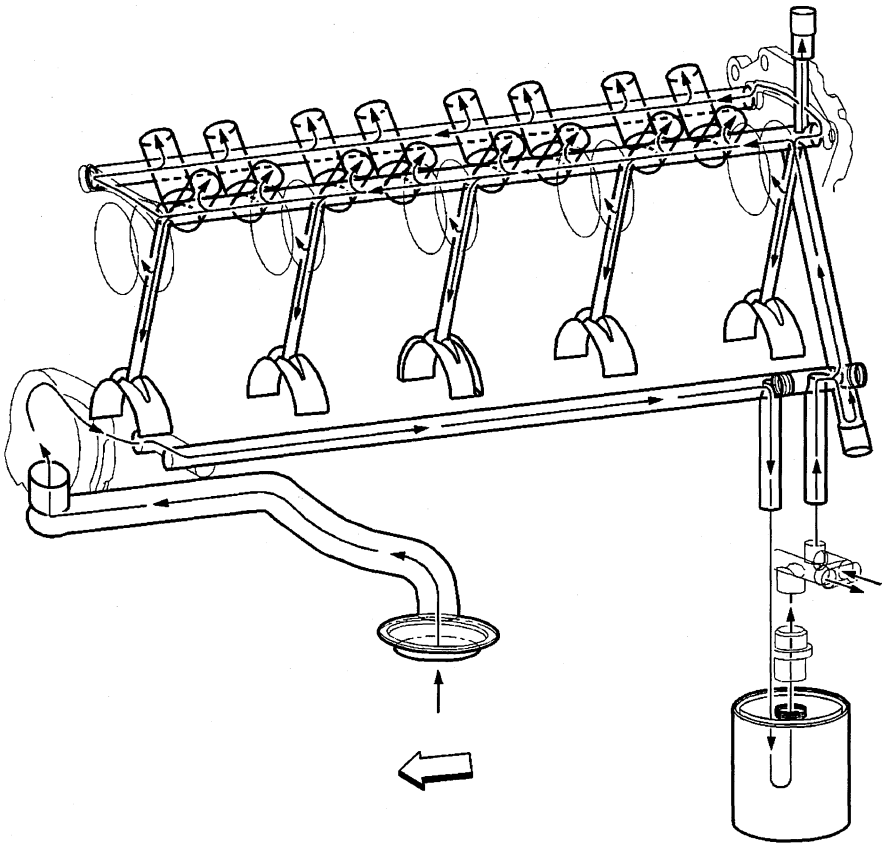
The valve rocker arm covers are cast aluminum and use a pre-molded silicon gasket for sealing. Mounted to each rocker cover are the coil and bracket assemblies. Incorporated into the covers are the oil fill tube, the positive crankcase ventilation (PCV) system passages, and the engine fresh air passages.

Valve Train

Motion is transmitted from the camshaft through the hydraulic roller valve lifters and tubular pushrods to the roller type rocker arms. The nylon valve lifter guides position and retain the valve lifters. The valve

rocker arms for each bank of cylinders are mounted on pedestals, pivot supports. Each rocker arm is retained on the pivot support and cylinder head by a bolt. Valve lash is net build.

Lubrication Description



Engine lubrication is supplied by a gerotor type oil pump assembly. The pump is mounted on the front of the engine block and driven directly by the crankshaft sprocket. The pump gears rotate and draw oil from the oil pan sump through a pick-up screen and pipe. The oil is pressurized as it passes through the pump and is sent through the engine block oil galleries. Contained within the oil pump assembly is a pressure relief valve that maintains oil pressure within a specified range. Pressurized oil is directed through the lower gallery to the full flow oil filter where harmful contaminants are removed. A bypass valve is incorporated into the oil pan, at the oil filter boss, which will permit oil flow in the event the filter becomes restricted. At the rear of the block, oil is then directed to the upper main oil galleries which are drilled just above the camshaft assembly. From there oil is then directed to the crankshaft and camshaft bearings. Oil that has entered the upper main oil galleries also pressurizes the valve lifter assemblies and is then pumped through the pushrods to lubricate the valve rocker arms and valve stems. Oil returning to the pan is directed by the crankshaft oil deflector. Oil pressure and crankcase level are each monitored by individual sensors.

An external oil cooler is available on certain applications, all 6.0L. Oil is directed from the oil pump, through the lower main oil gallery to the full flow oil filter. Oil is then directed through the oil pan outlet oil gallery, located in the left rear of the oil pan, and to the external oil cooler via a hose assembly. Oil flows through the oil cooler and returns to the engine at the oil pan inlet oil gallery, located in the left rear of the oil pan. Oil is then directed to the upper main oil galleries and the remainder of the engine assembly.

Drive Belt System Description

See Drive Belt System Description above.

Crankcase Ventilation System Description

A closed crankcase ventilation system is used in order to provide a more complete scavenging of the crankcase vapors. Fresh air from the throttle body is supplied to the crankcase, mixed with blow-by gases, and then passed through a crankcase ventilation valve into the intake manifold.

The primary control is through the crankcase ventilation valve which meters the flow at a rate depending on manifold vacuum. To maintain idle quality, the crankcase ventilation valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the engine air inlet to be consumed by normal combustion.

Filtered fresh air is routed from up-stream of the throttle blade to the front of the right rocker arm cover via a formed rubber hose. To reduce the potential of oil pullover into the throttle bore area due to back flow of the ventilation system, the fitting in the right rocker arm cover is shielded from the rocker arms. From there fresh air and gases are routed through the crankcase and up to the opposite rocker arm cover where the positive crankcase ventilation (PCV) valve is located. Gases are then routed through a hose to the intake manifold.

Engine Cooling

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Cleaner Outlet Duct Bolt (5.3L)	10 N·m	89 lb in
Air Cleaner Outlet Duct Clamp (5.3L)	7 N·m	62 lb in
Air Conditioning Condenser Bolt	28 N·m	21 lb ft
Auxiliary Heater Inlet and Outlet Hose/Pipe Nut (5.3L)	10 N·m	89 lb in
Coolant Air Bleed Pipe Bolt (5.3L)	12 N·m	106 lb in
Coolant Air Bleed Pipe Cover Bolt (5.3L)	12 N·m	106 lb in
Coolant Heater	50 N·m	37 lb ft
Coolant Recovery Reservoir Bolt	12 N·m	106 lb in
Coolant Recovery Reservoir Nut	10 N·m	89 lb in
Cooling Fan Nut	56 N·m	41 lb ft
Engine Harness Bracket Bolt (4.2L)	45 N·m	33 lb ft
Fan Blade Bolt	27 N·m	20 lb ft
Fan Shroud Bolt	28 N·m	21 lb ft
Thermostat Housing Bolt (4.2L)	10 N·m	89 lb in
Thermostat Housing Bolt (5.3L)	15 N·m	11 lb ft
Water Pump Bolt (4.2L)	10 N·m	89 lb in
Water Pump Bolt (5.3L)		
• First Pass	15 N·m	11 lb ft
• Final Pass	30 N·m	22 lb ft
Water Pump Pulley Bolt (4.2L)	25 N·m	18 lb ft

Cooling System Description and Operation

Coolant Heater

The optional engine coolant heater (RPO K05) operates using 110-volt AC external power and is designed to warm the coolant in the engine block area for improved starting in very cold weather -29°C (-20°F). The coolant heater helps reduce fuel consumption when a cold engine is warming up. The unit is equipped with a detachable AC power cord. A weather shield on the cord is provided to protect the plug when not in use.

Cooling System

The cooling system's function is to maintain an efficient engine operating temperature during all engine speeds and operating conditions. The cooling system is designed to remove approximately one-third of the heat produced by the burning of the air-fuel mixture. When the engine is cold, the coolant does not flow to the radiator until the thermostat opens. This allows the engine to warm quickly.

Cooling Cycle

Coolant flows from the radiator outlet and into the water pump inlet. Some coolant flows from the water pump, to the heater core, then back to the water pump. This provides the passenger compartment with heat and defrost capability as the coolant warms up.

Coolant also flows from the water pump outlet and into the engine block. In the engine block, the coolant circulates through the water jackets surrounding the cylinders where it absorbs heat.

The coolant then flows through the cylinder head gasket openings and into the cylinder heads. In the cylinder heads, the coolant flows through the water jackets surrounding the combustion chambers and valve seats, where it absorbs additional heat.

From the cylinder heads, the coolant flows to the thermostat. The flow of coolant will either be stopped at the thermostat until the engine reaches normal operating temperature, or it will flow through the thermostat and into the radiator where it is cooled. At this point, the coolant flow cycle is completed.

Efficient operation of the cooling system requires proper functioning of all cooling system components. The cooling system consists of the following components:

Coolant

The engine coolant is a solution made up of a 50-50 mixture of DEX-COOL and suitable drinking water. The coolant solution carries excess heat away from the engine to the radiator, where the heat is dissipated to the atmosphere.

Radiator

The radiator is a heat exchanger. It consists of a core and two tanks. The aluminum core is a tube and fin crossflow design that extends from the inlet tank to the outlet tank. Fins are placed around the outside of the tubes to improve heat transfer to the atmosphere.

The inlet and outlet tanks are a molded, high temperature, nylon reinforced plastic material. A high temperature rubber gasket seals the tank flange edge to the aluminum core. The tanks are clamped to the core with clinch tabs. The tabs are part of the aluminum header at each end of the core.

The radiator also has a drain cock located in the bottom of the left hand tank. The drain cock unit includes the drain cock and drain cock seal.

The radiator removes heat from the coolant passing through it. The fins on the core transfer heat from the coolant passing through the tubes. As air passes between the fins, it absorbs heat and cools the coolant.

Pressure Cap

The pressure cap seals the cooling system. It contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring, which protects the radiator from excessive cooling system pressure. The vacuum valve is held against its seat by a spring, which permits opening of the valve to relieve vacuum created in the cooling system as it cools off. The vacuum, if not relieved, might cause the radiator and/or coolant hoses to collapse.

The pressure cap allows cooling system pressure to build up as the temperature increases. As the pressure builds, the boiling point of the coolant increases. Engine coolant can be safely run at a temperature much higher than the boiling point of the coolant at atmospheric pressure. The hotter the coolant is, the faster the heat transfers from the radiator to the cooler, passing air.

The pressure in the cooling system can get too high. When the cooling system pressure exceeds the rating of the pressure cap, it raises the pressure valve, venting the excess pressure.

As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum causes the vacuum valve to open, allowing outside air into the surge tank. This equalizes the pressure in the cooling system with atmospheric pressure, preventing the radiator and coolant hoses from collapsing.

Coolant Recovery System

The coolant recovery system consists of a plastic coolant recovery reservoir and overflow tube. The recovery reservoir is also called a recovery tank or expansion tank. It is partially filled with coolant and is connected to the radiator fill neck with the overflow tube. Coolant can flow back and forth between the radiator and the reservoir.

In effect, a cooling system with a coolant recovery reservoir is a closed system. When the pressure in the cooling system gets too high, it will open the pressure valve in the pressure cap. This allows the coolant, which has expanded due to being heated, is allowed to flow through the overflow tube and into the recovery reservoir. As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum opens the vacuum valve in the pressure cap, allowing some of the coolant in the reservoir to be siphoned back into the radiator. Under normal operating conditions,

no coolant is lost. Although the coolant level in the recovery reservoir goes up and down, the radiator and cooling system are kept full. An advantage to using a coolant recovery reservoir is that it eliminates almost all air bubbles from the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Air Baffles and Seals

The cooling system uses deflectors, air baffles and air seals to increase cooling system capability. Deflectors are installed under the vehicle to redirect airflow beneath the vehicle and through the radiator to increase engine cooling. Air baffles are also used to direct airflow through the radiator and increase cooling capability. Air seals prevent air from bypassing the radiator and A/C condenser, and prevent recirculation of hot air for better hot weather cooling and A/C condenser performance.

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing with coolant inlet and outlet passages and an impeller. The impeller is mounted on the pump shaft and consists of a series of flat or curved blades or vanes on a flat plate. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force.

The impeller shaft is supported by one or more sealed bearings. The sealed bearings never need to be lubricated. Grease cannot leak out, dirt and water cannot get in as long as the seal is not damaged or worn.

The purpose of the water pump is to circulate coolant throughout the cooling system. The water pump is driven by the crankshaft via the drive belt.

Thermostat

The thermostat is a coolant flow control component. It's purpose is to help regulate the operating temperature of the engine. It utilizes a temperature sensitive wax-pellet element. The element connects to a valve through a small piston. When the element is heated, it expands and exerts pressure against the small piston. This pressure forces the valve to open. As the element is cooled, it contracts. This contraction allows a spring to push the valve closed.

When the coolant temperature is below the rated thermostat opening temperature, the thermostat valve remains closed. This prevents circulation of the coolant to the radiator and allows the engine to warm up. After the coolant temperature reaches the rated thermostat opening temperature, the thermostat valve will open. The coolant is then allowed to circulate through the thermostat to the radiator where the engine heat is dissipated to the atmosphere. The thermostat also provides a restriction in the cooling system, after it has opened. This restriction creates a pressure difference which prevents cavitation at the water pump and forces coolant to circulate through the engine block.

Engine Oil Cooler

The engine oil cooler is a heat exchanger. It is located inside the left side end tank of the radiator. The engine oil temperature is controlled by the temperature of the engine coolant that surrounds the oil cooler in the radiator.

The engine oil pump, pumps the oil through the engine oil cooler line to the oil cooler. The oil then flows through the cooler where the engine coolant absorbs heat from the oil. The oil is then pumped through the oil cooler return line, to the oil filter, to the engine block oil system.

Transmission Oil Cooler

The transmission oil cooler is a heat exchanger. It is located inside the right side end tank of the radiator. The transmission fluid temperature is regulated by the temperature of the engine coolant in the radiator.

The transmission oil pump, pumps the fluid through the transmission oil cooler line to the transmission oil cooler. The fluid then flows through the cooler where the engine coolant absorbs heat from the fluid. The fluid is then pumped through the transmission oil cooler return line, to the transmission.

Engine Electrical

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Conditioning Line Bracket Bolt (4.2L)	10 N·m	89 lb in
Battery Cable Channel Bolt (5.3L)	12 N·m	106 lb in
Battery Hold Down Retainer Nut	15 N·m	11 lb ft
Battery Negative Cable	15 N·m	11 lb ft
Battery Positive Cable	15 N·m	11 lb ft
Battery Positive Cable Lead to Starter Nut	9 N·m	80 lb in
Battery Tray Bolt	20 N·m	15 lb ft
Battery Tray Brace Bolt	10 N·m	89 lb in
Engine Harness to Engine Block Bolt (4.2L)	50 N·m	37 lb ft
Engine Harness to Shock Tower Bolt (4.2L)	10 N·m	89 lb in
Engine Harness to Wheelhouse Panel Bolt (4.2L)	10 N·m	89 lb in
Engine Lift Hook Bolt (4.2L)	50 N·m	37 lb ft
Generator Bolt	50 N·m	37 lb ft
Generator Bracket Bolt (5.3L)	50 N·m	37 lb ft
Generator Cable Nut	9 N·m	80 lb in
Ground Cable to Shock Tower Bolt (5.3L)	10 N·m	89 lb in
Ground Terminal to Engine Block Bolt (5.3L)	50 N·m	37 lb ft
Ground Terminal to Front Fender Bolt (5.3L)	10 N·m	89 lb in
Positive Terminal to Underhood Junction Block Bolt	10 N·m	89 lb in
Starter Bolt	50 N·m	37 lb ft
Starter Solenoid Nut	3.4 N·m	30 lb in
Transmission Cover Bolt (5.3L)	9 N·m	80 lb in

Battery Usage

Base	
Cold Cranking Amperage (CCA)	690 A
Reserve Capacity Rating	90 Minutes
Replacement Battery Number	78-6YR

Battery Temperature vs Minimum Voltage

Estimated Temperature °F	Estimated Temperature °C	Minimum Voltage
70 or above	21 or above	9.6
50	10	9.4
32	0	9.1
15	-10	8.8
0	-18	8.5
Below 0	Below -18	8.0

Starter Motor Usage

Applications	Starter Type
4.2L (LL8)	PG-260L
5.3L (LM4)	PG-260G

Generator Usage

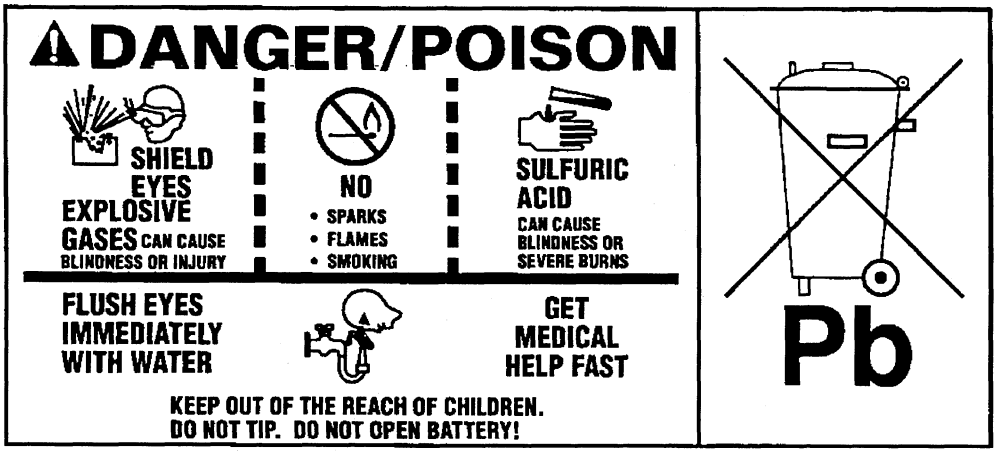
Engine	Generator Model	Rated Output AMPS	Load Test Output AMPS
Gasoline Engine	AD244	150 A	105 A

Battery Description and Operation

Caution

Batteries produce explosive gases, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:

- **Always shield your eyes and avoid leaning over the battery whenever possible.**
- **Do not expose the battery to open flames or sparks.**
- **Do not allow the battery electrolyte to contact the eyes or the skin. Flush immediately and thoroughly any contacted areas with water and get medical help.**
- **Follow each step of the jump starting procedure in order.**
- **Treat both the booster and the discharged batteries carefully when using the jumper cables.**



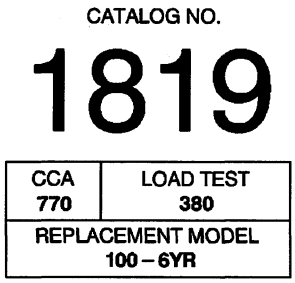
The maintenance free battery is standard. There are no vent plugs in the cover. The battery is completely sealed except for two small vent holes in the side. These vent holes allow the small amount of gas that is produced in the battery to escape.

The battery has three functions as a major source of energy:

- Engine cranking
- Voltage stabilizer
- Alternate source of energy with generator overload.

The battery specification label (example below) contains information about the following:

- The test ratings
- The original equipment catalog number
- The recommended replacement model number



A battery has 2 ratings:

- Reserve capacity
- Cold cranking amperage

When a battery is replaced use a battery with similar ratings. Refer to the battery specification label on the original battery or refer to Battery Usage .

Reserve Capacity

Reserve capacity is the amount of time in minutes it takes a fully charged battery, being discharged at a constant rate of 25 amperes and a constant temperature of 27°C (80°F) to reach a terminal voltage of 10.5 V. Refer to Battery Usage for the reserve capacity rating of the original equipment battery.

Cold Cranking Amperage

The cold cranking amperage is an indication of the ability of the battery to crank the engine at cold temperatures. The cold cranking amperage rating is the minimum amperage the battery must maintain for 30 seconds at -18°C (0°F) while maintaining at least 7.2 volts. Refer to Battery Usage for the cold cranking amperage rating for this vehicle.

Circuit Description

The battery positive terminal supplies Battery Positive voltage to the under hood fuse block and the rear fuse block. The under hood fuse block provides a cable connection for the generator and a cable connection for the starter.

The battery negative terminal is connected to chassis ground G305 and supplies ground for the AD converter in the DIM.

Starting System Description and Operation

The PG-260L is a non-repairable starter motor. It has pole pieces that are arranged around the armature within the starter housing. When the solenoid windings are energized, the pull-in winding circuit is completed to ground through the starter motor. The hold-in winding circuit is completed to ground through the solenoid. The windings work together magnetically to pull in and hold in the plunger. The plunger moves the shift lever. This action causes the starter drive assembly to rotate on the armature shaft spline as it engages with the flywheel ring gear on the engine. At the same time, the plunger closes the solenoid switch contacts in the starter solenoid. Full battery voltage is then applied directly to the starter motor and it cranks the engine.

As soon as the solenoid switch contacts close, current stops flowing thorough the pull-in winding as battery voltage is now applied to both ends of the windings. The hold-in winding remains energized; its magnetic field is strong enough to hold the plunger, shift lever, starter drive assembly, and solenoid switch contacts in place to continue cranking the engine. When the engine starts, the pinion gear overrun sprag protects the armature from excessive speed until the switch is opened.

When the ignition switch is released from the CRANK position, voltage is removed from the starter solenoid S terminal. Current flows from the motor contacts through both windings to ground at the end of the hold-in winding. However, the direction of the current flow through the pull-in winding is now in the opposite direction of the current flow when the winding was first energized.

The magnetic fields of the pull-in and hold-in windings now oppose one another. This action of the windings, along with the help of the return spring, cause the starter drive assembly to disengage and the solenoid switch contacts to open simultaneously. As soon as the contacts open, the starter motor is turned off.

Charging System Description and Operation

Generator

The generator features the following major components:

- The delta stator
- The rectifier bridge
- The rotor with slip rings and brushes
- A conventional pulley
- Dual internal fans
- The regulator

The pulley and the fan cool the slip ring and the frame.

The generator features permanently lubricated bearings. Service should only include tightening of mount components. Otherwise, replace the generator as a complete unit.

Regulator

The voltage regulator controls the rotor field current in order to limit the system voltage. When the field current is on, the regulator switches the current on and off at a rate of 400 cycles per second in order to perform the following functions:

- Radio noise control
- Obtain the correct average current needed for proper system voltage control

At high speeds, the on-time may be 10 percent with the off-time at 90 percent. At low speeds, the on-time may be 90 percent and the off-time 10 percent.

Circuit Description

The generator provides voltage to operate the vehicle's electrical system and to charge its battery. A magnetic field is created when current flows through the rotor. This field rotates as the rotor is driven by the engine, creating an AC voltage in the stator windings. The AC voltage is converted to DC by the rectifier bridge and is supplied to the electrical system at the battery terminal.

When the engine is running, the generator turn-on signal is sent to the generator from the PCM, turning on the regulator. The generator's voltage regulator controls current to the rotor, thereby controlling the output voltage. The rotor current is proportional to the electrical pulse width supplied by the regulator. When the engine is started, the regulator senses generator rotation by detecting AC voltage at the stator through an internal wire. Once the engine is running, the regulator varies the field current by controlling the pulse width. This regulates the generator output voltage for proper battery charging and electrical system operation. The generator F terminal is connected internally to the voltage regulator and externally to the PCM. When the voltage regulator detects a charging system problem, it grounds this circuit to signal the PCM that a problem exists. The PCM monitors the generator field duty cycle signal circuit. The

system voltage sense circuit receives battery positive voltage that is Hot At All Times through a fuse link that is connected to the starter motor. This voltage is used by the regulator as the reference for system voltage control.

Load Shed System Description and Operation

Load Shed Level	Affected Systems	Action Taken
Load-Shed Level 0	No systems affected	Normal operation
Load-Shed Level 1	Heated Outside Rear View Mirrors, Heated Rear Window / Rear Window Defrost, Heated Seats	Cycled at 80% duty cycle, OFF for 4 of every 20 second cycle. Indicator and timer not affected.
	Front Automatic HVAC	Reduce blower speed to 80% of current setting if the HVAC is not in the Defrost mode. The HVAC controller uses a ramping program to make the change invisible to the operator. No action is taken if the HVAC system is in Defrost.
	Rear Automatic HVAC	Turn OFF blower. The operator must turn ON system when load-shed level is exited. System will not respond to operator input until current load-shed level is exited.
	Message Center, Instrument Cluster	No messages or indicators are displayed. Data (DPID) indicating that the Load-Shed 1 was entered is stored and may be accessed with a scan tool. DPID will reset after 50 ignition switch cycles with no repeated load-shed 1 action or with a battery disconnection.
Load-Shed Level 2	Heated Outside Rear View Mirrors, Heated Rear Window / Rear Window Defrost, Heated Seats	Turned OFF. Indicator and timer also turned OFF. The operator must turn ON system when load-shed level is exited. System will not respond to operator input until current load-shed level is exited. This system will respond to only one Load-Shed Level 2 command per ignition switch cycle.
	Front Automatic HVAC	Blower turned OFF if the HVAC system is not in the Defrost mode. No action is taken if the HVAC system is in the Defrost mode. Operator may over-ride by manually turning the blower ON. This system will respond to only one Load-Shed 2 command per ignition switch cycle.
	Rear Automatic HVAC	Rear HVAC blower remains OFF. The operator must turn ON system when load-shed level is exited. System will not respond to operator input until current load-shed level is exited. This system will respond to only one Load-Shed Level 2 command per ignition switch cycle.
	Message Center, Instrument Cluster	"Battery Saver Action" message is displayed. Battery / Charging System Failure icon is illuminated. Chime may be activated constantly until the load-shed level is exited. Data (DPID) indicating that the Load-Shed Level 2 was entered is stored and may be accessed with a scan tool. DPID will reset after 50 ignition switch cycles with no repeated Load-Shed 2 actions or with a battery disconnection.

Engine Controls

Engine Controls – 4.2L

Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-5-3-6-2-4	
Spark Plug Torque	18 N·m	13 lb ft
Spark Plug Gap	1.08 mm	0.0425 in
Spark Plug Type	AC 41-981	

Fastener Tightening Specifications

Application	Specifications	
	Metric	English
Accelerator Pedal Position (APP) Sensor Bolt	10 N·m	89 lb in
Air Cleaner Cover/Resonator Retaining Screw	4 N·m	35 lb in
Air Cleaner Lower Housing/Washer Solvent Tank Assembly Nut	15 N·m	11 lb ft
Air Cleaner Outlet Duct Clamp	4 N·m	35 lb in
Air Cleaner Outlet Resonator Bolt	6 N·m	53 lb in
Camshaft Position (CMP) Sensor Bolt	10 N·m	89 lb in
Crankshaft Position (CKP) Sensor Bolt	10 N·m	89 lb in
Engine Coolant Temperature (ECT) Sensor	16 N·m	12 lb ft
EVAP Canister Purge Solenoid Bracket Bolt	25 N·m	18 lb ft
Fuel Fill Hose Clamp	2.5 N·m	22 lb in
Fuel Fill Pipe Bracket Nut	10 N·m	89 lb in
Fuel Fill Pipe Ground Strap Bolt	10 N·m	89 lb in
Fuel Filter Bracket Screw	1.5 N·m	13 lb in
Fuel Pipe Assembly Bracket Bolt	3.75 N·m	33 lb in
Fuel Pressure Regulator Screw	8 N·m	71 lb in
Fuel Rail Bolt	10 N·m	89 lb in
Fuel Tank Strap Bolt	32 N·m	24 lb ft
Heated Oxygen Sensor (HO2S)	41 N·m	30 lb ft
Ignition Coil Bolt	10 N·m	89 lb in
Knock Sensor (KS)	25 N·m	18 lb ft
Powertrain Control Module (PCM) Connector End Bolt	8 N·m	71 lb in
Powertrain Control Module (PCM) Mounting Stud	6 N·m	53 lb in
Powertrain Control Module (PCM) Retaining Bolt	10 N·m	89 lb in
Powertrain Control Module (PCM) Retaining Nut	10 N·m	89 lb in
Spark Plug	17-23 N·m	13-16 lb ft
Throttle Body Bolt	10 N·m	89 lb in

Fuel System Specifications

Use regular unleaded gasoline rated at 87 octane or higher. It is recommended that the gasoline meet specifications which have been developed by the American Automobile Manufacturers Association (AAMA) and endorsed by the Canadian Motor Vehicle Manufacturers Association for better vehicle performance and engine protection. Gasoline meeting the AAMA specification could provide improved driveability and emission control system performance compared to other gasolines. For more information, write to: American Automobile Manufacturer's Association, 7430 Second Ave, Suite 300, Detroit MI 48202.

Be sure the posted octane is at least 87. If the octane is less than 87, you may get a heavy knocking noise when you drive. If the knocking is bad enough, the knocking can damage your engine.

If you are using fuel rated at 87 octane or higher and you hear heavy knocking, your engine needs service. But do not worry if you hear a little pinging noise when you are accelerating or driving up a hill. That is normal, and you do not have to buy a higher octane fuel to get rid of the pinging. However, if there is a heavy, constant knock, that means you have a problem.

Notice

Your vehicle was not designed for fuel that contains methanol. Do not use methanol fuel which can corrode metal parts in your fuel system and also damage plastic and rubber parts. This kind of damage would not be covered under your warranty.

If your vehicle is certified to meet California Emission Standards, indicated on the under hood emission control label, your vehicle is designed to operate on fuels that meet California specifications. If such fuels are not available in states adopting California emissions standards, your vehicle will operate satisfactorily on fuels meeting federal specifications, but emission control system performance may be affected. The malfunction indicator lamp on your instrument panel may turn ON and/or your vehicle may fail a smog-check test. If this occurs, return to your authorized dealer for diagnosis to determine the cause of failure. In the event there is a determination that the cause of the condition is the type of fuels used, repairs may not be covered by your warranty.

Some gasolines that are not reformulated for low emissions may contain an octane-enhancing additive called methylcyclopentadienyl manganese tricarbonyl (MMT). Ask your service station operator whether or not the fuel contains MMT.

Engine Controls – 5.3L V-8

Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-8-7-2-6-5-4-3	
Spark Plug Wire Resistance	1000 ohms per ft	
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Gap	1.52 mm	0.060 in
Spark Plug Type	25171803 [AC plug type] 12567759 [NGK plug type]	

Fastener Tightening Specifications

Application	Specifications	
	Metric	English
Accelerator Pedal Position (APP) Sensor Bolt	20 N·m	15 lb ft
Air Cleaner Housing Nut	12 N·m	106 lb in
Air Cleaner Outlet Duct Bolt	10 N·m	89 lb in
Air Cleaner Outlet Duct Clamp	7 N·m	62 lb in
Camshaft Position (CMP) Sensor Bolt	29 N·m	21 lb ft
Crankshaft Position (CKP) Sensor Bolt	25 N·m	18 lb ft
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
Engine Wiring Harness Retaining Nut	5.5 N·m	49 lb in
EVAP Canister Purge Solenoid Bolt	10.5 N·m	93 lb in
Front End Diagonal Brace Bolt	25 N·m	18 lb ft
Fuel Fill Hose Clamp	2.5 N·m	22 lb in
Fuel Fill Pipe Bracket Nut	10 N·m	89 lb in
Fuel Fill Pipe Ground Strap Bolt	10 N·m	89 lb in
Fuel Filter Bracket Screw	12 N·m	106 lb in
Fuel Pipe Bracket Nut	10 N·m	89 lb in
Fuel Rail Bolt	10 N·m	89 lb in
Fuel Rail Crossover Pipe Retainer Clip Attaching Screw	3.8 N·m	34 lb in
Fuel Return Pipe Attaching Screw	5 N·m	44 lb in
Fuel Tank Shield Bolt	25 N·m	18 lb ft
Fuel Tank Strap Bolt	32 N·m	24 lb ft
Heated Oxygen Sensor (HO2S)	42 N·m	31 lb ft
Ignition Coil Bolt	8 N·m	71 lb in
Knock Sensor (KS)	20 N·m	15 lb ft
Mass Airflow/Intake Air Temperature (MAF/IAT) Sensor Clamp	7 N·m	62 lb in
Powertrain Control Module (PCM) Connector End Bolts	8 N·m	71 lb in
Spark Plug		
New Cylinder Heads	20 N·m	15 lb ft
Used Cylinder Heads	15 N·m	11 lb ft
Throttle Acutator Control (TAC) Module Bracket Nut	9 N·m	80 lb in
Throttle Body Bolt	10 N·m	89 lb in

Fuel System Specifications

See Fuel System Specifications above.

Exhaust System

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Catalytic Converter Heat Shield Bolts	7 N·m	62 lb in
Exhaust Muffler Nuts	45 N·m	33 lb ft
Exhaust Manifold Bolts (4.2L)		
• First Pass	25 N·m	18 lb ft
• Second Pass	25 N·m	18 lb ft
• Final Pass	25 N·m	18 lb ft
Exhaust Manifold Bolt (5.3L)		
• First Pass	15 N·m	11 lb ft
• Final Pass	25 N·m	18 lb ft
Exhaust Manifold Heat Shield Bolt (5.3L)	9 N·m	80 lb in
Exhaust Manifold Heat Shield Nut (4.2L)	5 N·m	44 lb in
Exhaust Manifold Heat Shield Stud (4.2L)	10 N·m	89 lb in
Exhaust Muffler Heat Shield Bolt	7 N·m	62 lb in
Exhaust Pipe Clamp Nut	50 N·m	37 lb ft
Exhaust Pipe Nut	50 N·m	37 lb ft
Heated Oxygen Sensor (HO2S) (5.3L)	42 N·m	31 lb ft
Transmission Filler Tube Bracket Nut (4.2L)	10 N·m	89 lb in

Exhaust System Description

Important

Use of non-OEM parts may cause driveability concerns.

The exhaust system carries exhaust gases, treated by the catalytic converter, through a resonator, if applicable and into the exhaust muffler where exhaust noise is lessened.

In order to secure the exhaust pipe to the exhaust manifold, a flange and seal-joint coupling is utilized. The exhaust system may utilize a slip-joint coupling design with a clamp and a U-bolt or a flange connection with a gasket.

Exhaust hangers and rubber insulators help to support the weight of the exhaust pipe along with insulating any exhaust system vibration, rattle, or noise.

Exhaust hangers also space the exhaust system away from the underbody of the vehicle and allows the exhaust system to expand as the exhaust system warms up.

Exhaust heat shields are used to protect the body and other components from damage due to the heat from the exhaust system.

The exhaust system may be comprised of the following components:

- Exhaust manifold
- Exhaust pipes
- Catalytic converters
- Exhaust muffler
- Exhaust resonator, if equipped
- Exhaust tail pipe, if equipped
- Exhaust hangers
- Exhaust heat shields

Resonator

Some exhaust systems are equipped with a resonator. The resonator, located either before or after the muffler, allows the use of mufflers with less back pressure. Resonators are used when vehicle characteristics require specific exhaust tuning.

Catalytic Converter

The catalytic converter is an emission control device added to the engine exhaust system in order to reduce hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx) pollutants from the exhaust gas.

The catalytic converter is comprised of a ceramic monolith substrate, supported in insulation and housed within a sheet metal shell. The substrate may be washcoated with 3 noble metals:

- Platium (Pt)
- Palladium (Pd)
- Rhodium (Rh)

The catalyst in the converter is not serviceable.

Muffler

The exhaust muffler reduces the noise levels of the engine exhaust by the use of tuning tubes. The tuning tubes create channels inside the exhaust muffler that lower the sound levels created by the combustion of the engine.

Transmission/Transaxle Description and Operation

Automatic Transmission - 4L60-E

Transmission General Specifications

Name	Hydra-matic 4L60-E
RPO Codes	M30
Production Location	Toledo, Ohio Romulus, MI Ramos Arizpe, Mexico
Vehicle Platform (Engine/Transmission) Usage	S/T
Transmission Drive	Longitudinally-Mounted Rear Wheel Drive
1st Gear Ratio	3.059:1
2nd Gear Ratio	1.625:1
3rd Gear Ratio	1.000:1
4th Gear Ratio	0.696:1
Reverse	2.294:1
Torque Converter Size (Diameter of Torque Converter Turbine)	245 mm 258 mm 298 mm 300 mm
Pressure Taps	Line Pressure
Transmission Fluid Type	DEXRON® III
Transmission Type: 4	Four Forward Gears
Transmission Type: L	Longitudinal Mount
Transmission Type: 60	Product Series
Transmission Type: E	Electronic Controls
Position Quadrant	P, R, N, , D, 2, 1 P, R, N, , 3, 2, 1
Case Material	Die Cast Aluminum
Transmission Weight Dry (Approximate)	245 mm Converter 65.4 kg (144.30 lbs) 258 mm Converter 79.9 kg (176.6 lbs) 298 mm Converter 70.5 kg (155.70 lbs) 300 mm Converter 86.17 kg (190.5 lbs)
Transmission Weight Wet (Approximate)	245 mm Converter 72.4 kg (159.55 lbs) 258 mm Converter 89.2 kg (197.7 lbs) 298 mm Converter 80.5 kg (176.16 lbs) 300 mm Converter 98.4 kg (218.0 lbs)
Maximum Trailer Towing Capacity	6,130 kg (13,500 lbs)
Maximum Gross Vehicle Weight (GVW)	3,900 kg (8,600 lbs)

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accumulator Cover to Case Bolt	8.0-14.0 N·m	6-10 lb ft
Case Extension to Case Bolt	42.0-48.0 N·m	31-35 lb ft
Case Extension to Case Bolt (4WD Shipping)	11.2-22.6 N·m	8.3-16.7 lb ft
Converter Cover Bolt	10 N·m	89 lb in
Converter Housing to Case Screw	65.0-75.0 N·m	48-55 lb ft
Cooler Pipe Connector	35.0-41.0 N·m	26-30 lb ft
Detent Spring to Valve Body Bolt	20.0-27.0 N·m	15-20 lb ft
Floorshift Control Bolt	10 N·m	89 lb in
Flywheel to Torque Converter Bolt	63 N·m	46 lb ft
Forward Accumulator Cover to Valve Body Bolt	8.0-14.0 N·m	6-10 lb ft
Heat Shield to Transmission Bolt	17 N·m	13 lb ft
Line Pressure Plug	8.0-14.0 N·m	6-10 lb ft
Manual Shaft to Inside Detent Lever Nut	27.0-34.0 N·m	20-25 lb ft
Negative Battery Cable Bolt	15 N·m	11 lb ft
Oil Level Indicator Bolt	47 N·m	35 lb ft
Oil Pan to Transmission Case Bolt	11 N·m	97 lb in
Oil Passage Cover to Case Bolt	8-14.0 N·m	6-10 lb ft
Park Brake Bracket to Case Bolt	27.0-34.0 N·m	20-25 lb ft
Park/Neutral Position Switch Screw	3 N·m	27 lb in
Plate to Case Bolt (Shipping)	27.0-34.0 N·m	20-25 lb ft
Plate to Converter Bolt (Shipping)	27.0-34.0 N·m	20-25 lb ft
Plug Assembly, Automatic Transmission Oil Pan (C/K)	30-40 N·m	22.1-29.5 lb ft
Plug Assembly, Automatic Transmission Oil Pan (Y)	28-32 N·m	20.7-23.6 lb ft
Pressure Control Solenoid Bracket to Valve Body Bolt	8.0-14.0 N·m	6-10 lb ft
Pump Assembly to Case Bolt	26.0-32.0 N·m	19-24 lb ft
Pump Cover to Pump Body Bolt	20.0-27.0 N·m	15-20 lb ft
Shift Cable Grommet Screw	1.7 N·m	15 lb in
Shift Control Cable Attachment	20 N·m	15 lb ft
Speed Sensor Retainer Bolt	10.5-13.5 N·m	7.7-10 lb ft
Stud, Automatic Transmission Case Extension (Y-car)	18.0-22.0 N·m	13-16 lb ft
TCC Solenoid Assembly to Case Bolt	8.0-14.0 N·m	6-10 lb ft
Transmission Fluid Pressure Manual Valve Position Switch to Valve Body Bolt	8.0-14.0 N·m	6-10 lb ft
Transmission Mount to Exhaust Hanger Bracket Bolt	30 N·m	22 lb ft
Transmission Mount Spacer Bolts	65 N·m	48 lb ft
Transmission Mount to Transmission Bolt	65 N·m	48 lb ft
Transmission Mount to Transmission Support Nut	46 N·m	35 lb ft
Transmission Oil Cooler Pipe Fitting	35.0-41.0 N·m	26-30 lb ft
Transmission Oil Pan to Case Bolt	9.5-13.8 N·m	7-10 lb ft
Transmission to Engine Bolt	47 N·m	35 lb ft
Valve Body to Case Bolt	8.0-14.0 N·m	6-10 lb ft

Fluid Capacity Specifications

Application	Specification	
	Metric	English
Pan Removal	4.7 L	5 qts
Overhaul	10.6 L	11 qts
245 mm Torque Converter Approximate Fluid Capacity Dry Fill	8.3 L	8.8 qts
258 mm Torque Converter Approximate Fluid Capacity Dry Fill	8.8 L	9.3 qts
298 mm Torque Converter Approximate Fluid Capacity Dry Fill	11.25 L	11.9 qts
300 mm Torque Converter Approximate Fluid Capacity Dry Fill	11.50 L	12.1 qts

Transmission Component and System Description

The 4L60E transmission consists primarily of the following components:

- A torque converter with an electronically controlled capacity clutch (ECCC) This transmission is equipped with an ECCC. The pressure plate does not fully lock to the torque converter cover. Instead, the pressure plate maintains a small amount of slippage, about 20 RPM, in SECOND, THIRD, and FOURTH gears, depending on the vehicle application. ECCC was developed to reduce the possibility of noise, vibration, or chuggle caused by TCC apply. Typical apply speeds are 49-52 km/h (30-32 mph) in THIRD gear and 65-73 km/h (40-45 mph) in FOURTH gear. Full lockup is available at highway speeds on some applications.
- Torque converter assembly
- Servo assembly and 2-4 band assembly
- Reverse input clutch and housing
- Overrun clutch
- Forward clutch
- 3-4 clutch
- Forward sprag clutch assembly
- Lo and reverse roller clutch assembly
- Lo and reverse clutch assembly
- Two planetary gear sets: Input and Reaction
- Oil pump assembly
- Control valve body assembly

The electrical components of the 4L60-E are as follows:

- 1-2 and 2-3 shift solenoid valves
- 3-2 shift solenoid valve assembly
- Transmission pressure control (PC) solenoid
- Torque converter clutch (TCC) solenoid valve
- TCC pulse width modulation (PWM) solenoid valve
- Automatic transmission fluid pressure (TFP) manual valve position switch
- Automatic transmission fluid temperature (TFT) sensor
- Vehicle speed sensor assembly

Adapt Function

Transmission Adapt Function

The 4L60-E transmission uses a line pressure control system, which has the ability to continuously adapt the system's line pressure. This compensates for normal wear of the following parts:

- The clutch fiber plates
- The seals
- The springs

The PCM maintains the Upshift Adapt parameters for the transmission The PCM monitors the AT ISS sensor and the AT OSS during commanded shifts in order to determine if a shift is occurring too fast or

too slow. The PCM adjusts the signal from the transmission pressure control solenoid in order to maintain a set shift feel.

Transmission adapts must be reset whenever the transmission is overhauled or replaced.

Automatic Transmission Shift Lock Control Description

The automatic transmission shift lock control is a safety device that prevents an inadvertent shift out of PARK when the ignition is ON. The driver must press the brake pedal before moving the shift lever out of the PARK position. The system consist of the following components:

- The automatic transmission shift lock control solenoid.
- The automatic transmission shift lock control switch.
- The park/neutral position switch.

With the ignition in the ON position battery positive voltage is supplied to the park/neutral position switch. With the transmission in the PARK position the contacts in the park/neutral position switch are closed. This allows current to flow through the switch to the automatic transmission shift lock control switch. The circuit continues through the normally-closed switch to the automatic transmission shift lock control solenoid. The automatic transmission shift lock control soleniod is permanently grounded. This energizes the automatic transmission shift lock control solenoid, locking the shift linkage in the PARK position. When the driver presses the brake pedal the contacts in the automatic transmission shift lock control switch open, causing the automatic transmission shift lock control solenoid to release. This allows the shift lever to move from the PARK position.

Transmission Indicators and Messages

The following transmission-related indicators and messages may be displayed on the Instrument Panel Cluster (IPC).

"Change Trans Fluid"

The IPC illuminates the "change trans fluid" message when the PCM determines that the transmission oil should be changed. The PCM sends a message to the IPC requesting illumination. The select button will allow this message to clear it from the DIC display.

Abbreviations and Meanings

Abbreviation	Meaning
A	
A	Ampere(s)
ABS	Antilock Brake System
A/C	Air Conditioning
AC	Alternating Current
ACC	Accessory, Automatic Climate Control
ACL	Air Cleaner
ACR4	Air Conditioning Refrigerant, Recovery, Recycling, Recharging
AD	Automatic Disconnect
A/D	Analog to Digital
ADL	Automatic Door Lock
A/F	Air/Fuel Ratio
AH	Active Handling
AIR	Secondary Air Injection
ALC	Automatic Level Control, Automatic Lamp Control
AM/FM	Amplitude Modulation/Frequency Modulation
Ant	Antenna
AP	Accelerator Pedal
APCM	Accessory Power Control Module
API	American Petroleum Institute
APP	Accelerator Pedal Position
APT	Adjustable Part Throttle
ASM	Assembly, Accelerator and Servo Control Module
ASR	Acceleration Slip Regulation
A/T	Automatic Transmission/Transaxle
ATC	Automatic Transfer Case, Automatic Temperature Control
ATDC	After Top Dead Center
ATSLC	Automatic Transmission Shift Lock Control
Auto	Automatic
avg	Average
A4WD	Automatic Four-Wheel Drive
AWG	American Wire Gage
B	
B+	Battery Positive Voltage
BARO	Barometric Pressure
BATT	Battery
BBV	Brake Booster Vacuum
BCA	Bias Control Assembly
BCM	Body Control Module
BHP	Brake Horsepower
BLK	Black
BLU	Blue
BP	Back Pressure
BPCM	Battery Pack Control Module
BPMV	Brake Pressure Modulator Valve
BPP	Brake Pedal Position
BRN	Brown

BTDC	Before Top Dead Center
BTM	Battery Thermal Module
BTSI	Brake Transmission Shift Interlock
Btu	British Thermal Units
	C
°C	Degrees Celsius
CAC	Charge Air Cooler
CAFE	Corporate Average Fuel Economy
Cal	Calibration
Cam	Camshaft
CARB	California Air Resources Board
CC	Coast Clutch
cm^3	Cubic Centimeters
CCM	Convenience Charge Module, Chassis Control Module
CCOT	Cycling Clutch Orifice Tube
CCP	Climate Control Panel
CD	Compact Disc
CE	Commutator End
CEAB	Cold Engine Air Bleed
CEMF	Counter Electromotive Force
CEX	Cabin Exchanger
cfm	Cubic Feet per Minute
cg	Center of Gravity
CID	Cubic Inch Displacement
CKP	Crankshaft Position
CKT	Circuit
C/Ltr	Cigar Lighter
CL	Closed Loop
CLS	Coolant Level Switch
CMC	Compressor Motor Controller
CMP	Camshaft Position
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO2	Carbon Dioxide
Coax	Coaxial
COMM	Communication
Conn	Connector
CPA	Connector Position Assurance
CPP	Clutch Pedal Position
CPS	Central Power Supply
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CRTC	Cathode Ray Tube Controller
CS	Charging System
CSFI	Central Sequential Fuel Injection
CTP	Closed Throttle Position
cu ft	Cubic Foot/Feet
cu in	Cubic Inch/Inches
CV	Constant Velocity Joint
CVRSS	Continuously Variable Road Sensing Suspension

Cyl	Cylinder(s)
	D
DAB	Delayed Accessory Bus
dB	Decibels
dBA	Decibels on A-weighted Scale
DC	Direct Current, Duty Cycle
DCM	Door Control Module
DE	Drive End
DEC	Digital Electronic Controller
DERM	Diagnostic Energy Reserve Module
DI	Distributor Ignition
dia	Diameter
DIC	Driver Information Center
Diff	Differential
DIM	Dash Integration Module
DK	Dark
DLC	Data Link Connector
DMCM	Drive Motor Control Module
DMM	Digital Multimeter
DMSDS	Drive Motor Speed and Direction Sensor
DMU	Drive Motor Unit
DOHC	Dual Overhead Camshafts
DR, Drvr	Driver
DRL	Daytime Running Lamps
DTC	Diagnostic Trouble Code
	E
EBCM	Electronic Brake Control Module
EBTCM	Electronic Brake and Traction Control Module
EC	Electrical Center, Engine Control
ECC	Electronic Climate Control
ECI	Extended Compressor at Idle
ECL	Engine Coolant Level
ECM	Engine Control Module, Electronic Control Module
ECS	Emission Control System
ECT	Engine Coolant Temperature
EEPROM	Electrically Erasable Programmable Read Only Memory
EEVIR	Evaporator Equalized Values in Receiver
EFE	Early Fuel Evaporation
EGR	Exhaust Gas Recirculation
EGR TVV	Exhaust Gas Recirculation Thermal Vacuum Valve
EHPS	Electro-Hydraulic Power Steering
EI	Electronic Ignition
ELAP	Elapsed
ELC	Electronic Level Control
E/M	English/Metric
EMF	Electromotive Force
EMI	Electromagnetic Interference
Eng	Engine
EOP	Engine Oil Pressure
EOT	Engine Oil Temperature

EPA	Environmental Protection Agency
EPR	Exhaust Pressure Regulator
EPROM	Erasable Programmable Read Only Memory
ESB	Expansion Spring Brake
ESC	Electronic Suspension Control
ESD	Electrostatic Discharge
ESN	Electronic Serial Number
ETC	Electronic Throttle Control, Electronic Temperature Control, Electronic Timing Control
ETCC	Electronic Touch Climate Control
ETR	Electronically Tuned Receiver
ETS	Enhanced Traction System
EVAP	Evaporative Emission
EVO	Electronic Variable Orifice
Exh	Exhaust
F	
°F	Degrees Fahrenheit
FC	Fan Control
FDC	Fuel Data Center
FED	Federal All United States except California
FEDS	Fuel Enable Data Stream
FEX	Front Exchanger
FF	Flexible Fuel
FFH	Fuel-Fired Heater
FI	Fuel Injection
FMVSS	Federal U.S. Motor Vehicle Safety Standards
FP	Fuel Pump
ft	Foot/Feet
FT	Fuel Trim
F4WD	Full Time Four-Wheel Drive
4WAL	Four-Wheel Antilock
4WD	Four-Wheel Drive
FW	Flat Wire
FWD	Front Wheel Drive, Forward
G	
g	Grams, Gravitational Acceleration
GA	Gage, Gauge
gal	Gallon
gas	Gasoline
GCW	Gross Combination Weight
Gen	Generator
GL	Gear Lubricant
GM	General Motors
GM SPO	General Motors Service Parts Operations
gnd	Ground
gpm	Gallons per Minute
GRN	Green
GRY	Gray
GVWR	Gross Vehicle Weight Rating

H	
H	Hydrogen
H2O	Water
Harn	Harness
HC	Hydrocarbons
H/CMPR	High Compression
HD	Heavy Duty
HDC	Heavy Duty Cooling
hex	Hexagon, Hexadecimal
Hg	Mercury
Hi Alt	High Altitude
HO2S	Heated Oxygen Sensor
hp	Horsepower
HPL	High Pressure Liquid
HPS	High Performance System
HPV	High Pressure Vapor
HPVS	Heat Pump Ventilation System
Htd	Heated
HTR	Heater
HUD	Head-up Display
HVAC	Heater-Ventilation-Air Conditioning
HVACM	Heater-Vent-Air Conditioning Module
HVIL	High Voltage Interlock Loop
HVM	Heater Vent Module
Hz	Hertz
I	
IAC	Idle Air Control
IAT	Intake Air Temperature
IC	Integrated Circuit, Ignition Control
ICCS	Integrated Chassis Control System
ICM	Ignition Control Module
ID	Identification, Inside Diameter
IDI	Integrated Direct Ignition
IGBT	Insulated Gate Bi-Polar Transistor
ign	Ignition
ILC	Idle Load Compensator
in	Inch/Inches
INJ	Injection
inst	Instantaneous, Instant
IP	Instrument Panel
IPC	Instrument Panel Cluster
IPM	Instrument Panel Module
I/PEC	Instrument Panel Electrical Center
ISC	Idle Speed Control
ISO	International Standards Organization
ISS	Input Speed Shaft, Input Shaft Speed
K	
KAM	Keep Alive Memory
KDD	Keyboard Display Driver
kg	Kilogram

kHz	Kilohertz
km	Kilometer
km/h	Kilometers per Hour
km/l	Kilometers per Liter
kPa	Kilopascals
KS	Knock Sensor
kV	Kilovolts
L	
L	Liter
L4	Four Cylinder Engine, In-Line
L6	Six-Cylinder Engine, In-Line
lb	Pound
lb ft	Pound Feet Torque
lb in	Pound Inch Torque
LCD	Liquid Crystal Display
LDCL	Left Door Closed Locking
LDCM	Left Door Control Module
LDM	Lamp Driver Module
LED	Light Emitting Diode
LEV	Low Emissions Vehicle
LF	Left Front
lm	Lumens
LR	Left Rear
LT	Left
LT	Light
LT	Long Term
LTPI	Low Tire Pressure Indicator
LTPWS	Low Tire Pressure Warning System
M	
MAF	Mass Air Flow
Man	Manual
MAP	Manifold Absolute Pressure
MAT	Manifold Absolute Temperature
max	Maximum
M/C	Mixture Control
MDP	Manifold Differential Pressure
MFI	Multiport Fuel Injection
mi	Miles
MIL	Malfunction Indicator Lamp
min	Minimum
MIN	Mobile Identification Number
mL	Milliliter
mm	Millimeter
mpg	Miles per Gallon
mph	Miles per Hour
ms	Millisecond
MST	Manifold Surface Temperature
MSVA	Magnetic Steering Variable Assist, Magnasteer®
M/T	Manual Transmission/Transaxle
MV	Megavolt

mV	Millivolt
	N
NAES	North American Export Sales
NC	Normally Closed
NEG	Negative
Neu	Neutral
NI	Neutral Idle
NiMH	Nickel Metal Hydride
NLGI	National Lubricating Grease Institute
N·m	Newton-meter Torque
NO	Normally Open
NOx	Oxides of Nitrogen
NPTC	National Pipe Thread Coarse
NPTF	National Pipe Thread Fine
NOVRAM	Non-Volatile Random Access Memory
	O
O2	Oxygen
O2S	Oxygen Sensor
OBD	On-Board Diagnostics
OBD II	On-Board Diagnostics Second Generation
OC	Oxidation Converter Catalytic
OCS	Opportunity Charge Station
OD	Outside Diameter
ODM	Output Drive Module
ODO	Odometer
OE	Original Equipment
OEM	Original Equipment Manufacturer
OHC	Overhead Camshaft
ohms	Ohm
OL	Open Loop, Out of Limits
ORC	Oxidation Reduction Converter Catalytic
ORN	Orange
ORVR	On-Board Refueling Vapor Recovery
OSS	Output Shaft Speed
oz	Ounce(s)
	P
PAG	Polyalkylene Glycol
PAIR	Pulsed Secondary Air Injection
PASS, PSGR	Passenger
PASS-Key®	Personalized Automotive Security System
P/B	Power Brakes
PC	Pressure Control
PCB	Printed Circuit Board
PCM	Powertrain Control Module
PCS	Pressure Control Solenoid
PCV	Positive Crankcase Ventilation
PEB	Power Electronics Bay
PID	Parameter Identification
PIM	Power Inverter Module
PM	Permanent Magnet Generator

P/N	Part Number
PNK	Pink
PNP	Park/Neutral Position
PRNDL	Park, Reverse, Neutral, Drive, Low
POA	Pilot Operated Absolute Valve
POS	Positive, Position
POT	Potentiometer Variable Resistor
PPL	Purple
ppm	Parts per Million
PROM	Programmable Read Only Memory
P/S, PS	Power Steering
PSCM	Power Steering Control Module, Passenger Seat Control Module
PSD	Power Sliding Door
PSP	Power Steering Pressure
psi	Pounds per Square Inch
psia	Pounds per Square Inch Absolute
psig	Pounds per Square Inch Gauge
pt	Pint
PTC	Positive Temperature Coefficient
PWM	Pulse Width Modulated
Q	
QDM	Quad Driver Module
qt	Quart(s)
R	
R-12	Refrigerant-12
R-134a	Refrigerant-134a
RAM	Random Access Memory, Non-permanent memory device, memory contents are lost when power is removed.
RAP	Retained Accessory Power
RAV	Remote Activation Verification
RCDLR	Remote Control Door Lock Receiver
RDCM	Right Door Control Module
Ref	Reference
Rev	Reverse
REX	Rear Exchanger
RIM	Rear Integration Module
RF	Right Front, Radio Frequency
RFA	Remote Function Actuation
RFI	Radio Frequency Interference
RH	Right Hand
RKE	Remote Keyless Entry
Rly	Relay
ROM	Read Only Memory, Permanent memory device, memory contents are retained when power is removed.
RPM	Revolutions per Minute Engine Speed
RPO	Regular Production Option
RR	Right Rear
RSS	Road Sensing Suspension
RTD	Real Time Damping
RT	Right

RTV	Room Temperature Vulcanizing Sealer
RWAL	Rear Wheel Antilock
RWD	Rear Wheel Drive
S	
s	Second(s)
SAE	Society of Automotive Engineers
SC	Supercharger
SCB	Supercharger Bypass
SCM	Seat Control Module
SDM	Sensing and Diagnostic Module
SEO	Special Equipment Option
SFI	Sequential Multiport Fuel Injection
SI	System International Modern Version of Metric System
SIAB	Side Impact Air Bag
SIR	Supplemental Inflatable Restraint
SLA	Short/Long Arm Suspension
sol	Solenoid
SO2	Sulfur Dioxide
SP	Splice Pack
S/P	Series/Parallel
SPO	Service Parts Operations
SPS	Service Programming System, Speed Signal
sq ft, ft^2	Square Foot/Feet
sq in, in^2	Square Inch/Inches
SRC	Service Ride Control
SRI	Service Reminder Indicator
SRS	Supplemental Restraint System
SS	Shift Solenoid
ST	Scan Tool
STID	Station Identification Station ID
S4WD	Selectable Four-Wheel Drive
Sw	Switch
SWPS	Steering Wheel Position Sensor
syn	Synchronizer
T	
TAC	Throttle Actuator Control
Tach	Tachometer
TAP	Transmission Adaptive Pressure, Throttle Adaptive Pressure
TBI	Throttle Body Fuel Injection
TC	Turbocharger, Transmission Control
TCC	Torque Converter Clutch
TCS	Traction Control System
TDC	Top Dead Center
TEMP	Temperature
Term	Terminal
TFP	Transmission Fluid Pressure
TFT	Transmission Fluid Temperature
THM	Turbo Hydro-Matic
TIM	Tire Inflation Monitoring, Tire Inflation Module
TOC	Transmission Oil Cooler

TP	Throttle Position
TPA	Terminal Positive Assurance
TPM	Tire Pressure Monitoring, Tire Pressure Monitor
TR	Transmission Range
TRANS	Transmission/Transaxle
TT	Tell Tail Warning Lamp
TV	Throttle Valve
TVRS	Television and Radio Suppression
TVV	Thermal Vacuum Valve
TWC	Three Way Converter Catalytic
TWC+OC	Three Way + Oxidation Converter Catalytic
TXV	Thermal Expansion Valve
U	
UART	Universal Asynchronous Receiver Transmitter
U/H	Underhood
U/HEC	Underhood Electrical Center
U-joint	Universal Joint
UTD	Universal Theft Deterrent
UV	Ultraviolet
V	
V	Volt(s), Voltage
V6	Six-Cylinder Engine, V-Type
V8	Eight-Cylinder Engine, V-Type
Vac	Vacuum
VAC	Vehicle Access Code
VATS	Vehicle Anti-Theft System
VCIM	Vehicle Communication Interface Mode
VCM	Vehicle Control Module
V dif	Voltage Difference
VDOT	Variable Displacement Orifice Tube
VDV	Vacuum Delay Valve
vel	Velocity
VES	Variable Effort Steering
VF	Vacuum Fluorescent
VIO	Violet
VIN	Vehicle Identification Number
VLR	Voltage Loop Reserve
VMV	Vacuum Modulator Valve
VR	Voltage Regulator
V ref	Voltage Reference
VSES	Vehicle Stability Enhancement System
VSS	Vehicle Speed Sensor
W	
w/	With
W/B	Wheel Base
WHL	Wheel
WHT	White
w/o	Without
WOT	Wide Open Throttle
W/P	Water Pump

W/S	Windshield
WSS	Wheel Speed Sensor
WU-OC	Warm Up Oxidation Converter Catalytic
WU-TWC	Warm Up Three-Way Converter Catalytic
X	
X-valve	Expansion Valve
Y	
yd	Yard(s)
YEL	Yellow

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Conversion - English/Metric

English	Multiply/ Divide by	Metric
In order to calculate English measurement, divide by the number in the center column. In order to calculate metric measurement, multiply by the number in the center column.		
Length		
in	25.4	mm
ft	0.3048	m
yd	0.9144	
mi	1.609	km
Area		
sq in	645.2	sq mm
	6.45	sq cm
sq ft	0.0929	sq m
sq yd	0.8361	
Volume		
cu in	16,387.00	cu mm
	16.387	cu cm
	0.0164	L
qt	0.9464	
gal	3.7854	
cu yd	0.764	cu m
Mass		
lb	0.4536	kg
ton	907.18	
	0.907	tonne (t)
Force		
Kg F	9.807	newtons (N)
oz F	0.278	
lb F	4.448	
Acceleration		
ft/s²	0.3048	m/s²
In/s²	0.0254	
Torque		
Lb in	0.11298	N·m
lb ft	1.3558	
Power		
hp	0.745	kW
Pressure (Stress)		
inches of H2O	0.2488	kPa
lb/sq in	6.895	
Energy (Work)		
Btu	1055	J (J= one Ws)
lb ft	1.3558	
kW hour	3,600,000.00	
Light		
Foot Candle	10.764	lm/m²

Velocity		
mph	1.6093	km/h
Temperature		
(°F - 32) 5/9	=	°C
°F	=	(9/5 °C + 32)
Fuel Performance		
235.215/mpg	=	100 km/L

Equivalents - Decimal and Metric

Fraction (in)	Decimal (in)	Metric (mm)
1/64	0.015625	0.39688
1/32	0.03125	0.79375
3/64	0.046875	1.19062
1/16	0.0625	1.5875
5/64	0.078125	1.98437
3/32	0.09375	2.38125
7/64	0.109375	2.77812
1/8	0.125	3.175
9/64	0.140625	3.57187
5/32	0.15625	3.96875
11/64	0.171875	4.36562
3/16	0.1875	4.7625
13/64	0.203125	5.15937
7/32	0.21875	5.55625
15/64	0.234375	5.95312
1/4	0.25	6.35
17/64	0.265625	6.74687
9/32	0.28125	7.14375
19/64	0.296875	7.54062
5/16	0.3125	7.9375
21/64	0.328125	8.33437
11/32	0.34375	8.73125
23/64	0.359375	9.12812
3/8	0.375	9.525
25/64	0.390625	9.92187
13/32	0.40625	10.31875
27/64	0.421875	10.71562
7/16	0.4375	11.1125
29/64	0.453125	11.50937
15/32	0.46875	11.90625
31/64	0.484375	12.30312
1/2	0.5	12.7
33/64	0.515625	13.09687
17/32	0.53125	13.49375
35/64	0.546875	13.89062
9/16	0.5625	14.2875
37/64	0.578125	14.68437
19/32	0.59375	15.08125
39/64	0.609375	15.47812
5/8	0.625	15.875
41/64	0.640625	16.27187

Fraction (in)	Decimal (in)	Metric (mm)
21/32	0.65625	16.66875
43/64	0.671875	17.06562
11/16	0.6875	17.4625
45/64	0.703125	17.85937
23/32	0.71875	18.25625
47/64	0.734375	18.65312
3/4	0.75	19.05
49/64	0.765625	19.44687
25/32	0.78125	19.84375
51/64	0.796875	20.24062
13/16	0.8125	20.6375
53/64	0.828125	21.03437
27/32	0.84375	21.43125
55/64	0.859375	21.82812
7/8	0.875	22.225
57/64	0.890625	22.62187
29/32	0.90625	23.01875
59/64	0.921875	23.41562
15/16	0.9375	23.8125
61/64	0.953125	24.20937
31/32	0.96875	24.60625
63/64	0.984375	25.00312
1	1.0	25.4

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Fasteners

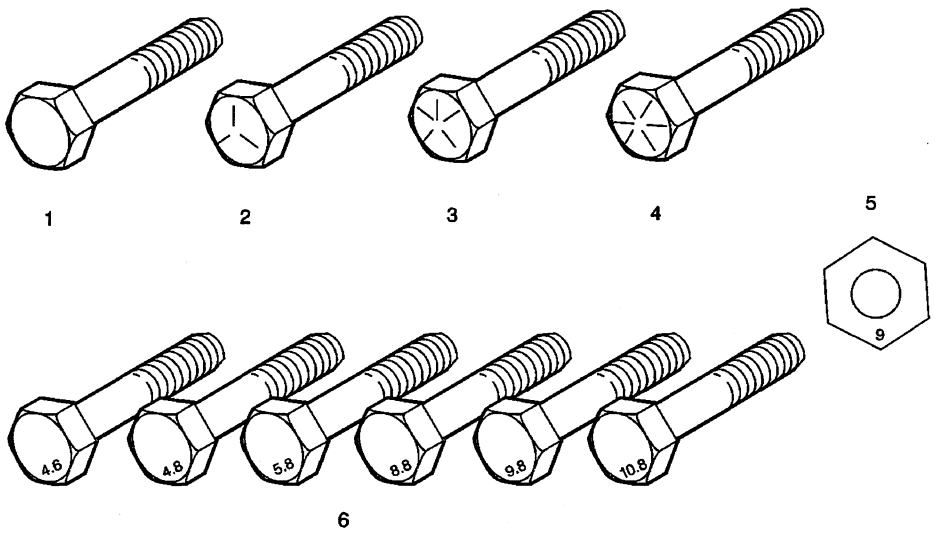
Metric Fasteners

This vehicle provides fastener dimensions using the metric system. Most metric fasteners are approximate in diameter to equivalent English fasteners. Make replacements using fasteners of the same nominal diameter, thread pitch, and strength.

A number marking identifies the OE metric fasteners except cross-recess head screws. The number also indicates the strength of the fastener material. A Posidrive® or Type 1A cross-recess identifies a metric cross-recess screw. For best results, use a Type 1A cross-recess screwdriver, or equivalent, in Posidrive® recess head screws.

GM Engineering Standards and North American Industries have adopted a portion of the ISO-defined standard metric fastener sizes. The purpose was to reduce the number of fastener sizes used while retaining the best thread qualities in each thread size. For example, the metric M6.0 X 1 screw, with nearly the same diameter and 25.4 threads per inch replaced the English 1/4-20 and 1/4-28 screws. The thread pitch is midway between the English coarse and fine thread pitches.

Fastener Strength Identification



1. English Bolt, Grade 2 (Strength Class)
2. English Bolt, Grade 5 (Strength Class)
3. English Bolt, Grade 7 (Strength Class)
4. English Bolt, Grade 8 (Strength Class)
5. Metric Nut, Strength Class 9
6. Metric Bolts, Strength Class Increases as Numbers Increase

The most commonly used metric fastener strength property classes are 9.8 and 10.9. The class identification is embossed on the head of each bolt. The English, inch strength classes range from grade 2 to grade 8. Radial lines are embossed on the head of each bolt in order to identify the strength class. The number of lines on the head of the bolt is 2 lines less than the actual grade. For example, a grade 8 bolt will have 6 radial lines on the bolt head. Some metric nuts are marked with a single digit strength identification number on the nut face.

The correct fasteners are available through GM SPO. Many metric fasteners available in the aftermarket parts channels are designed to metric standards of countries other than the United States, and may exhibit the following:

- Lower strength
- No numbered head marking system
- Wrong thread pitch

The metric fasteners on GM products are designed to new, international standards. The following are the common sizes and pitches, except for special applications:

- M6.0 X 1
- M8 X 1.25
- M10 X 1.5
- M12 X 1.75
- M14 X 2.00
- M16 X 2.00

Prevailing Torque Fasteners

Prevailing torque fasteners create a thread interface between the fastener and the fastener counterpart in order to prevent the fastener from loosening.

All Metal Prevailing Torque Fasteners

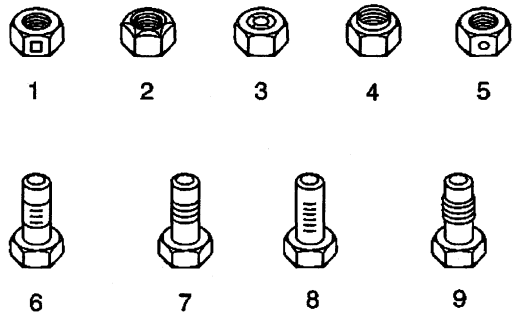
These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

Nylon Interface Prevailing Torque Fasteners

These fasteners accomplish the thread interface by the presence of a nylon material on the fastener threads.

Adhesive Coated Fasteners

These fasteners accomplish the thread interface by the presence of a thread-locking compound on the fastener threads. Refer to the appropriate repair procedure in order to determine if the fastener may be reused and the applicable thread-locking compound to apply to the fastener.



1. Prevailing Torque Nut, Center Lock Type
2. Prevailing Torque Nut, Top Lock Type
3. Prevailing Torque Nut, Nylon Patch Type
4. Prevailing Torque Nut, Nylon Washer Insert Type
5. Prevailing Torque Nut, Nylon Insert Type

6. Prevailing Torque Bolt, Dry Adhesive Coating Type
7. Prevailing Torque Bolt, Thread Profile Deformed Type
8. Prevailing Torque Bolt, Nylon Strip Type
9. Prevailing Torque Bolt, Out-of-Round Thread Area Type

A prevailing torque fastener may be reused ONLY if:

- The fastener and the fastener counterpart are clean and not damaged
- There is no rust on the fastener
- The fastener develops the specified minimum torque against its counterpart prior to the fastener seating

Metric Prevailing Torque Fastener Minimum Torque Development

Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		
6 mm	0.4 N·m	4 lb in
8 mm	0.8 N·m	7 lb in
10 mm	1.4 N·m	12 lb in
12 mm	2.1 N·m	19 lb in
14 mm	3 N·m	27 lb in
16 mm	4.2 N·m	37 lb in
20 mm	7 N·m	62 lb in
24 mm	10.5 N·m	93 lb in
Nylon Interface Prevailing Torque Fasteners		
6 mm	0.3 N·m	3 lb in
8 mm	0.6 N·m	5 lb in
10 mm	1.1 N·m	10 lb in
12 mm	1.5 N·m	13 lb in
14 mm	2.3 N·m	20 lb in
16 mm	3.4 N·m	30 lb in
20 mm	5.5 N·m	49 lb in
24 mm	8.5 N·m	75 lb in

English Prevailing Torque Fastener Minimum Torque Development

Application	Specification	
	Metric	English
All Metal Prevailing Torque Fasteners		
1/4 in	0.5 N·m	4.5 lb in
5/16 in	0.8 N·m	7.5 lb in
3/8 in	1.3 N·m	11.5 lb in
7/16 in	1.8 N·m	16 lb in
1/2 in	2.3 N·m	20 lb in
9/16 in	3.2 N·m	28 lb in
5/8 in	4 N·m	36 lb in
3/4 in	7 N·m	54 lb in
Nylon Interface Prevailing Torque Fasteners		
1/4 in	0.3 N·m	3 lb in
5/16 in	0.6 N·m	5 lb in
3/8 in	1 N·m	9 lb in
7/16 in	1.3 N·m	12 lb in
1/2 in	1.8 N·m	16 lb in
9/16 in	2.5 N·m	22 lb in
5/8 in	3.4 N·m	30 lb in
3/4 in	5 N·m	45 lb in