Chevrolet

Venture

2004

Table of Contents

Product Information 1
Family-Friendly 2004 Chevrolet Venture Makes Traveling More Fun 1
Spacious interior adapts to people or cargo 1
Family fun 1
A safe environment 1
Enhanced handling and safety 2
New for 2004 2
Model Lineup 2
Specifications 3
Overview 3
Engine 3
Transmission 3
Chassis/Suspension 3
Brakes 4
Wheels/Tires 4
Dimensions 4
Exterior 4
Interior 4
Cargo volume (cu ft / L) 4
Capacities 5
Vehicle Identification 6
Vehicle Identification Number (VIN) 6
VIN Derivative 7
Vehicle Certification Label 8
Service Parts Identification Label (SPID) 9
Tire Placard 10
Engine ID and VIN Derivative Location 11
Transmission ID and VIN Derivative Location 12
Transmission ID and VIN Derivative Location 4T60-E/4T65-E(c) 12
Transmission VIN Location 4T65-E, M15/MN3/MN7(c) 13
Transaxle VIN Derivative Stamping(c) 13
Labeling - Anti-Theft 14
Notice 14
RPO Code List 15
Technical Information 19
Maintenance and Lubrication 19
Capacities - Approximate Fluid 19
Air Conditioning Refrigerant R134a 19
Automatic Transmission 19
AWD Automatic Transmission 19
Engine Cooling System 19
Engine Oil 19
Fuel Tank 19
Power Steering Capacities 19
Rear Axle Fluid 19
Transfer Case Fluid Capacity 19
Wheel Nut Torque 19
Windshield Washer Fluid 19
Maintenance Items 19
Tire Inflation Pressure Specifications 20
Fluid and Lubricant Recommendations 20

Descriptions and Operations 21
Power Steering System Description 21
Steering Wheel and Column 21
Vehicle Steering 21
Vehicle Security 22
Driver Convenience 22
Driver Safety 22
Suspension Description and Operation 22
Front Suspension 22
Rear Suspension 23
Wheels and Tires 24
General Description 24
Tread Wear Indicators Description 24
Metric Wheel Nuts and Bolts Description 24
Tire Inflation Description 24
P-Metric Sized Tires Description 26
Automatic Level Control General Description 27
Driveline System Description and Operation 28
Propeller Shaft Description and Operation 28
Wheel Drive Shafts 29
Boots (Seals) And Clamps 29
Front Wheel Drive Shaft Tri-pot Joint (Inner Joint) 30
Front Wheel Drive Shaft Constant Velocity Joint (Outer Joint) 30
Differential Carrier Assembly Description 30
Transfer Case 31
Propeller Shaft 32
Rear Differential 32
Differential Lock System Description and Operation 33
AWD Disable indicator 33
Differential Clutch Pump Actuator Check Valve 33
Powertrain Control Module 34
Braking System Description and Operation 34
Hydraulic Brake System Description and Operation 34
System Component Description 34
Hydraulic Brake Master Cylinder Fluid Reservoir 34
Hydraulic Brake Master Cylinder 34
Hydraulic Brake Pressure Balance Control System 34
Hydraulic Brake Pipes and Flexible Brake Hoses 34
Hydraulic Brake Wheel Apply Components 34
System Operation 34
Brake Assist System Description and Operation 34
System Component Description 34
Brake Pedal 34
Brake Pedal Pushrod 34
Vacuum Brake Booster 35
Vacuum Source 35
Vacuum Source Delivery System 35
System Operation 35
Disc Brake System Description and Operation 35
System Component Description 35
Disc Brake Pads 35
Disc Brake Rotors 35
Disc Brake Pad Hardware 35

Disc Brake Caliper Hardware 35
System Operation 35
Drum Brake System Description and Operation 35
System Component Description 35
Drum Brake Shoes 35
Brake Drums 36
Drum Brake Hardware 36
Drum Brake Adjusting Hardware 36
System Operation 36
Park Brake System Description and Operation 36
System Component Description 36
Park Brake Lever Assembly 36
Park Brake Cables 36
Park Brake Cable Equalizer 36
Park Brake Apply Lever 36
Park Brake Actuator/Adjuster 36
Drum Brake Shoes 36
System Operation 36
ABS Description and Operation 37
Antilock Brake System 37
Engine Description and Operation 38
Engine Mechanical – 3.4L 38
Mechanical Specifications 38
General Data 38
Block 38
Camshaft 38
Cooling System 38
Connecting Rod 38
Crankshaft 39
Cylinder Head 39
Lubrication System 39
Oil Pump 39
Piston Ring End Gap 39
Piston Ring to Groove Clearance 39
Piston Ring Thickness 39
Piston 40
Pin 40
Valves 40
Valve Lifters/Push Rods 40
Valve Springs 40
Fastener Tightening Specifications 41
Engine Component Description 43
Lubrication 44
Drive Belt System Description 45
Engine Cooling 46
Fastener Tightening Specifications 46
Cooling System Description and Operation 46
Cooling Fan Control 46
Engine Coolant Indicators 46
Hot Coolant Temp 46
Coolant Level Control 47
Coolant Heater 47
Cooling System 47
Cooling Cycle 47
Coolant 47

Radiator 47
Pressure Cap 48
Coolant Recovery System 48
Air Baffles and Seals 48
Water Pump 48
Thermostat 49
Engine Oil Cooler 49
Transmission Oil Cooler 49
Engine Electrical 50
Fastener Tightening Specifications 50
Battery Usage 50
Starter Motor Usage 50
Generator Usage 50
RPO K68 50
RPO KG9 50
Battery Description and Operation 51
Reserve Capacity 52
Cold Cranking Amperage 52
Circuit Description 52
Starting System Description and Operation 52
Charging System Description and Operation 53
Generator 53
Regulator 53
Circuit Description 53
Engine Controls 54
Engine Controls – 3.4L 54
Ignition System Specifications 54
Fastener Tightening Specifications 54
Fuel System Specifications 55
Exhaust System 56
Fastener Tightening Specifications 56
Exhaust System Description 56
Resonator 56
Catalytic Converter 56
Muffler 57
Transmission/Transaxle Description and Operation 57
Automatic Transmission – 4T65E 57
Transmission General Specifications 57
Fastener Tightening Specifications 58
Fluid Capacity Specifications 58
Transmission Component and System Description 59
Transmission General Description 59
Mechanical Componants 59
Adapt Function 60
Upshift Adapts (1-2, 2-3 and 3-4) 60
Steady State Adapts 60
Automatic Transmission Shift Lock Control Description 60
Abbreviations and Meanings i
Conversion - English/Metric i
Equivalents - Decimal and Metric ii
Fasteners i
Metric Fasteners i

Fastener Strength Identification i
Prevailing Torque Fasteners ii
All Metal Prevailing Torque Fasteners ii
Nylon Interface Prevailing Torque Fasteners ii
Adhesive Coated Fasteners ii
Metric Prevailing Torque Fastener Minimum Torque Development iii
All Metal Prevailing Torque Fasteners iii
Nylon Interface Prevailing Torque Fasteners iii
English Prevailing Torque Fastener Minimum Torque Development iv
All Metal Prevailing Torque Fasteners iv
Nylon Interface Prevailing Torque Fasteners iv

Product Information

Family-Friendly 2004 Chevrolet Venture Makes Traveling More Fun

Chevy Venture's outstanding family-friendly interior environment makes it the minivan that parents depend on to make traveling together more fun.

"For families constantly on the go, Venture's wide range of choices helps them get the most out of their minivan," said Pete Langenhorst, Venture marketing director, "with features like the third row stowable seat, standard dual sliding rear doors, available OnStar and the Versatrak all-wheel-drive system."

Spacious interior adapts to people or cargo

Venture's low step-in height through its standard dual sliding rear doors and available dual power sliding doors offers easy access to a spacious interior - with seating for up to eight people in some extended wheelbase models. Available separate front and rear HVAC controls add to its custom comfort.

The stowable third-row seat and flat-folding captain's chairs offer up to 140.7 cubic feet (3,984L) of cargo space in the extended wheelbase, enough room for 4-by-8-foot (1.2-by-2.4-meter) sheets of plywood with the liftgate closed. The third row stows to create a flat load surface.

Nestled behind the third row is a convenience center with three compartments for easy organizing. The middle compartment has a sealed bottom and sides for wet bathing suits, muddy boots or even garden plants. Conveniently located power outlets, and up to 17 cupholders, round out the usefulness of the vehicle.

Family fun

Getting there is half the fun with the Chevy Venture. "Take the versatile Venture, add our DVD player and you have the ultimate vehicle for family entertainment," said Langenhorst.

The available in-vehicle DVD-based entertainment system plays DVD video, DVD audio and CDs, and includes a flat, flip-down, 7-inch (178-mm) video screen, two wireless headphones and a wireless remote control. It's standard on all-wheel-drive LT models. The DVD-format screen provides superior picture quality, and the system has a 1.5-second "video memory" which prevents potholes, railroad tracks and other rough road surfaces from interfering with the sound and picture. Simple controls - Power, Play and Eject buttons - make the DVD player easy to use.

Adding to the variety of entertainment possibilities, the 2004 Venture offers XM Satellite Radio (continental U.S. only). XM Satellite Radio 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. An available CD/MP3 radio adds even further to the entertainment choices.

Three auxiliary jacks for devices such as video games and camcorders offer additional versatility. In fact, passengers can use the DVD player, the radio and the CD player all at the same time.

A safe environment

The family-friendly Venture offers four-wheel anti-lock brakes, driver and front-passenger air bags, driver and passenger side-impact air bags and child security rear door locks. Integrated child safety seats are standard on all vans except for those with captain's chairs. The LATCH (Lower Anchorages and Tethers for CHildren) system is standard and independent of the vehicle safety belts. LATCH enables parents to securely attach child safety seats without even using the vehicle's seat belts.

Venture's Rear Parking Aid alerts the drivers of objects or people behind the vehicle with both audio and visual signals while the van is in reverse. Venture is the only product in the industry to offer both types of indicators. Traction control is available and helps limit wheel spin on most slippery surfaces. Power comes from the standard 3400 V-6 engine with a four-speed electronically controlled automatic transmission.

Enhanced handling and safety

For extra confidence in all weather and all road conditions, Venture offers an optional AWD package with Versatrak all-wheel drive, 16-inch aluminum wheels and tires, four-wheel disc brakes and a fully independent rear touring suspension - which provides a more refined ride.

GM's exclusive Versatrak all-wheel-drive system gives Venture distinct performance and safety advantages. Versatrak is lightweight, quiet and efficient, and is one of the most advanced approaches to all-wheel drive on the market today. If one or both front wheels lose grip, the Versatrak system comes into action progressively, with no buttons to push or levers to throw. The Versatrak system is always poised to help the driver make use of the traction available by not only transferring torque from front to rear, but also from side to side between the rear wheels - an ability not found in many competitive systems.

New for 2004

- XM Satellite Radio available (continental U.S. only)
- CD/MP3 radio available
- Captain's chairs available on LS
- DVD standard on LT with AWD
- Three new exterior colors: Silverstone, Blue Granite and Sport Red Metallic (replacing Galaxy Silver, Black and Redfire)
- LS Easy Order Package includes:
  - RH power door
  - Power seat
  - Cargo net
  - Illuminated visor mirrors
  - Rear HVAC
  - Aluminum wheels
  - Luggage rack rails

Model Lineup

	Engine 3.4-liter 3400 V6	**Transmission 4T65-E 4-speed auto**
Plus (Reg. & Ext.)	S	S
LS (Reg. & Ext.)	S	S
LT (Ext.)	S	S

Standard S

Specifications

Overview	
Models:	Chevy Venture regular-length wheelbase, extended-length wheelbase
Body style / driveline:	minivan, front-engine, front- or all-wheel-drive
Construction:	unibody
EPA vehicle class:	minivan
Manufacturing location:	Doraville, Georgia
Key competitors:	Dodge Caravan and Grand Caravan, Chrysler Voyager and Grand Voyager, Ford Windstar, Honda Odyssey, Toyota Sienna, Mazda MPV
Engine	
Type:	3400 3.4L V-6 (LA1)
Displacement (cu in / cc):	207 / 3400
Bore & stroke (in / mm):	3.62 x 3.31 / 92 x 84
Block material:	cast iron
Cylinder head material:	aluminum
Valvetrain:	OHV, 2 valves per cylinder
Ignition system:	direct
Fuel delivery:	sequential fuel injection
Compression ratio:	9.5:1
Horsepower (hp / kw @ rpm)	185 / 134 @ 5200
Torque (lb-ft / Nm @ rpm):	210 / 278 @ 4000
Recommended fuel:	87 octane
Maximum engine speed (rpm)	6000
Emissions controls:	3-way catalytic converter, exhaust gas recirculation, positive crankcase ventilation, evaporative collection system
Estimated fuel economy (mpg city / hwy / combined):	19 / 26 / 22 (18 / 24 / 21 all-wheel drive)
Transmission	
Type:	Hydra-Matic 4T65-E4-speed electronic automatic with overdrive
Gear ratios (:1):	
First:	2.92
Second:	1.57
Third:	1.00
Fourth:	0.71
Reverse:	2.39
Final drive ratio:	3.29:1
Chassis/Suspension	
Front:	independent MacPherson struts with standard front stabilizer bar
Rear:	semi-independent, twist axle/coil spring (AWD: independent rear susp.)
Steering type:	power rack-and-pinion
Steering ratio:	16.8:1
Steering wheel turns, lock-to-lock:	3.05
Turning circle, curb-to-curb (ft / m)	Regular wheelbase models: 37.4 / 11.4 Extended wheelase: 39.7 / 12.1

Brakes	
Type:	front disc, rear drum (front disc, rear disc on AWD)
Rotor diameter x thickness (in / mm):	front: 10.94 x 1.27 / 278 x 32; rear: 8.86 x 1.77 / 225 x 45
Swept area (sq in / sq cm):	front: 240.6 / 1550; rear: 98.6 / 636
Wheels/Tires	
Wheel size & type:	15-inch x 6-inch steel (std) 15-inch x 6-inch cast aluminum wheels (LT, Warner Bros. Edition) 16-inch aluminum wheels (all-wheel-drive models)
Tires:	P212/70R15 std on all models P225/60R16 AL2 (all-wheel-drive models)

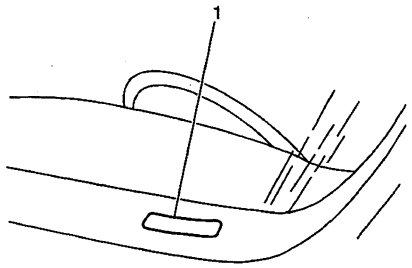
Dimensions

Exterior	**Reg. wheelbase**	**Ext. wheelbase**
Wheelbase (in / mm):	112 / 2845	121 / 3048
Overall length (in / mm):	186.9 / 4747	200.9 / 5103
Overall width (in / mm):	72 / 1829	72 / 1829
Overall height (in / mm):	67.4 / 1712	68.1 / 1730
Track (in / mm):		
Front:	61.5 / 1562	61.5 / 1562
Rear:	63.3 / 1607	63.3 / 1607
Minimum ground clearance (in / mm):	front: 8.3 / 211; rear: 10.4 / 264	front: 8.5 / 216; rear: 11 / 279
Ground to top of load floor (in / mm):	24 / 610	25 / 635
Curb weight (lb / kg):	3699 / 1678	3838 / 1741
Interior	**Reg. wheelbase**	**Ext. wheelbase**
Seating capacity (front / middle / rear):	2 / 2 / 3; 2 / 3 / 3	2 / 2 / 3; 2 / 3 / 3
Head room (in / mm):	front: 39.9 / 1014	front: 39.9 / 1014
	middle: 39.3 / 998	middle: 39.3 / 998
	rear: 38.8 / 986	rear: 38.9 / 988
Leg room (in / mm):	front: 39.9 / 1014	front: 39.9 / 1014
	middle: 36.9 / 937	middle: 39 / 991
	rear: 34 / 864	rear: 36.7 / 932
Shoulder room (in / mm):	front: 59.8 / 1519	front: 59.8 / 1519
	middle: 61.9 / 1572	middle: 61.9 / 1572
	rear: 60.1 / 1527	rear: 59.6 / 1514
Hip room (in / mm):	front: 55.5 / 1410	front: 55.5 / 1410
	middle: 60.4 / 1534	middle: 64.3 / 1633
	rear: 48.3 / 1227	rear: 48.3 / 1227
Cargo volume (cu ft / L)		
with front seat:	126.6 / 3584	-
with front seat and left-side sliding door:	119.8 / 3392	140.7 / 3984
with front / middle seats (max):	67.5 / 1911	84.5 / 2393
with front / middle / rear seats (max):	19.9 / 564	31.5 / 892

Capacities	Reg. wheelbase	Ext. wheelbase
GVWR, maximum (lb / kg):	5357 / 2430	5357 / 2430
Payload, base (lb / kg):	1612 / 601	1457 / 661
Trailer towing maximum (lb / kg):	3500 / 1588	3500 / 1588
Fuel tank (gal / L):	20 / 75.7	25 / 94.6
Cooling system (qt / L):	11.3 / 10.7	11.3 / 10.7

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	World Identifier	1	USA
2	Manufacturer	G	General Motors
3	Nameplate	N	Chevrolet
4	GVWR/Brake System	D	GVWR 5001- 6000/Brake System - Hydraulic
5	Line and Chassis Type	U/0 U/1 U/2 V/O V/1 V/2 XO X1 X2	CHEV-Venture APV 4x2 CHEV-Venture APV 4X2 Luxury CHEV-Venture APV 4X2 Economy CHEV-Venture APV 4X4 CHEV-Venture APV 4X4 Luxury CHEV-Venture APV 4X4 Economy CHEV-Venture APV 4X2 EXT W/B CHEV-Venture APV 4X2 EXT W/B Luxury EXT W/B CHEV-Venture APV 4X2 EXT W/B
6	Series	0 1 2	Base Luxury Economy
7	Body Type	3	Four-Door All Purpose Vehicle
8	Engine Type	E	RPO LA1, Engine Gas, 3.4L, V6, MFI, HO
9	Check Digit	--	Check Digit
10	Model Year	4	2004
11	Assembly Plant	D	Doraville, GA
12-17	Production Sequence Number	--	100001

VIN Derivative

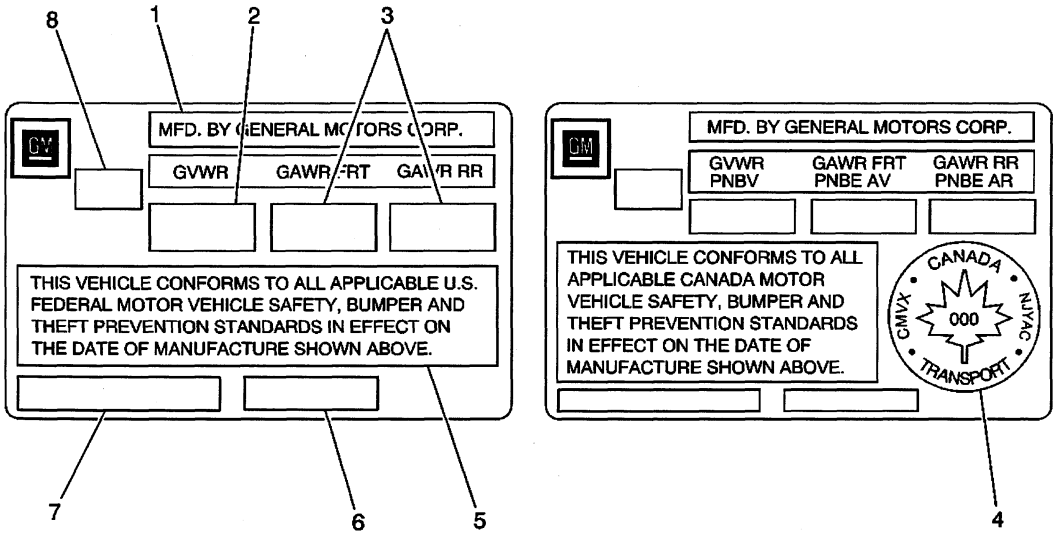
All engines and transmissions are stamped or laser etched with a partial vehicle identification number (VIN), which was derived from the complete VIN. A VIN derivative contains the following nine positions:

VIN Derivative Position	Definition	Character	Description
1	GM Division Identifier	N	Chevrolet
2	Model Year	4	2004
3	Assembly Plant	D	Doraville
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

Vehicle Certification Label



(1) Name of Manufacturer
(2) Gross Vehicle Weight-Rating
(3) Gross Axle Weight-Rating, Front, Rear
(4) Canadian Safety Mark (w/RPO Z49)
(5) Certification Statement
(6) Vehicle Class Type (Pass Car, etc.)
(7) Vehicle Identification Number
(8) Date of Manufacture (Mo/Yr)

The vehicle certification label is permanently located on the edge of the driver's door. Refer to this label in order to obtain the following information:

- The Gross Vehicle Weight Rating (GVWR)
- The Gross Axle Weight Rating (GAWR), front and rear

The Gross Vehicle Weight (GVW) must not exceed the Gross Vehicle Weight Rating (GVWR).

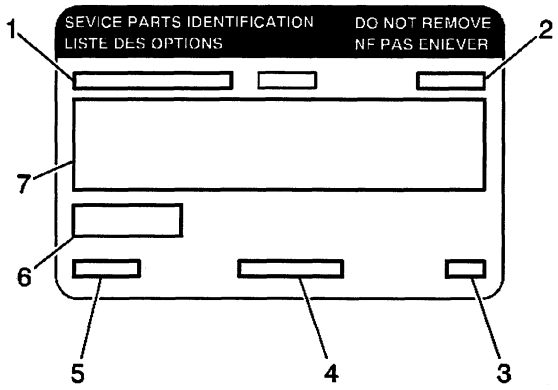
The GVW is the weight of the vehicle and everything the vehicle carries. Include the following items when figuring the GVW:

- The base vehicle weight (factory weight)
- The weight of any added vehicle accessories
- The weight of the driver and the passenger
- The weight of any cargo being carried

The front and rear Gross Axle Weights (GAW) must not exceed the Gross Axle Weight Ratings (GAWR), front and rear .

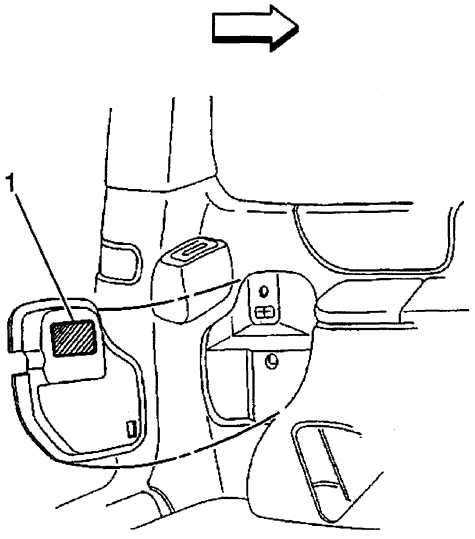
The GAW is the weight exerted on one of the axles (front or rear).

Service Parts Identification Label (SPID)



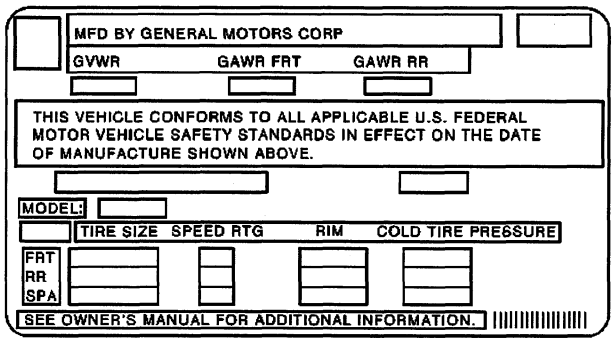
(1) Vehicle Identification Number
(2) Engineering Model Number (Vehicle Division, Vehicle Line and Body Style)
(3) Interior Trim and Decor Level
(4) Exterior (Paint Color) WA Number
(5) Paint Technology
(6) Special Order Paint Colors and Numbers
(7) Vehicle Option Content

The service parts identification label is used to identify the original equipment options built into the specific vehicle being serviced. The option content of a vehicle is very important information to properly service the vehicle.



The service parts identification label is located on the inside of the left quarter trim access panel (1). Refer to RPO Code List below for a definition of the codes that are printed on the service parts identification label or referred to in this service information.

Tire Placard

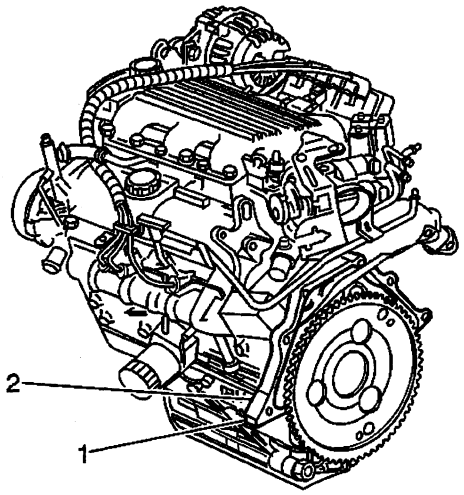


The tire placard is located on the inside edge of the driver's door. Refer to the tire placard to obtain the following information:

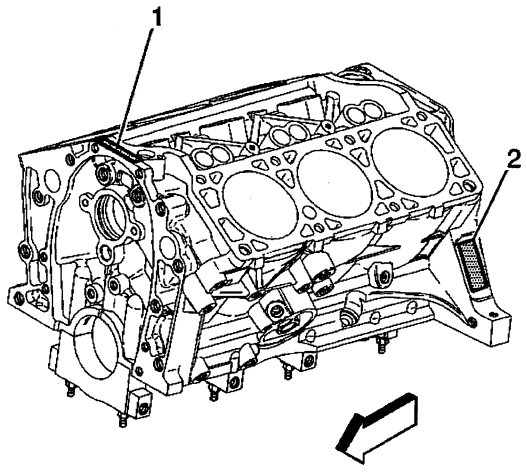
- Maximum vehicle capacity weight
- Cold tire inflation pressures
- Original equipment tire sizes
- Original equipment tire speed ratings

Engine ID and VIN Derivative Location

The eighth character in the Vehicle Identification Number (VIN) identifies the engine. Adhesive-backed labels attached to the engine, laser etching or stampings on the engine block indicate the engine unit number/date code. All engines are stamped with a VIN derivative. For more information on the VIN derivative, refer to VIN Derivative above.



The primary (1) and optional (2) location of the VIN derivative for the 3400 LA1 engine is on the lower left front transaxle mounting surface.

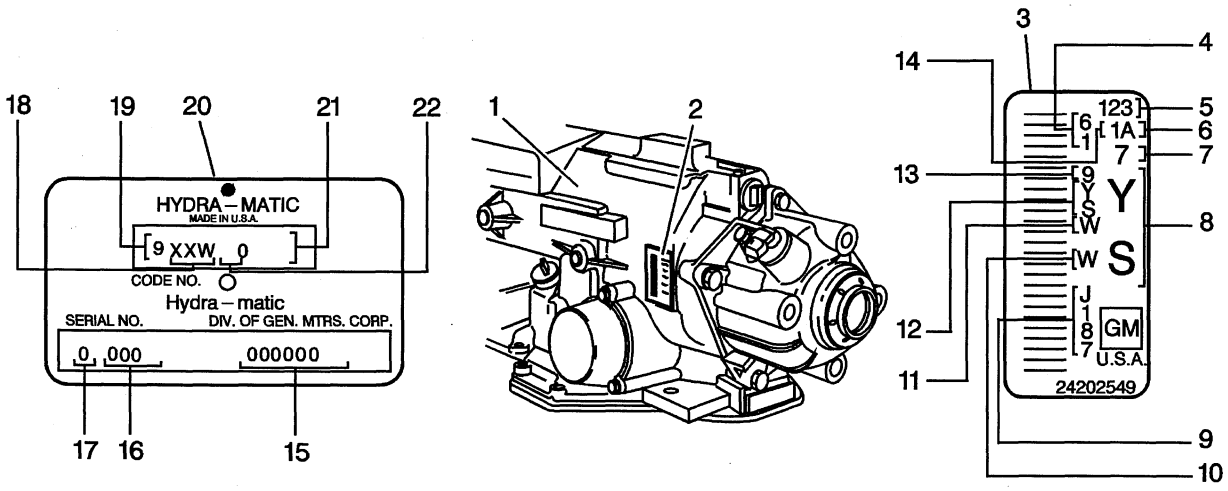


The eighth digit of the Vehicle Identification Number (VIN) identifies the engine. The adhesive-backed labels attached to the engine, laser etching or stampings on the engine block indicate the engine unit number/date code. All engines are stamped with a VIN derivative.

The primary location (1) of the Engine ID for the 3400 (LA1) engine on top of the RH rocker arm cover or front of RH oil pan rail. The secondary location (2) of the VIN derivative for the 3400 (LA1) engine is above the starter motor on the engine block. For additional information, refer to VIN Derivative above.

Transmission ID and VIN Derivative Location

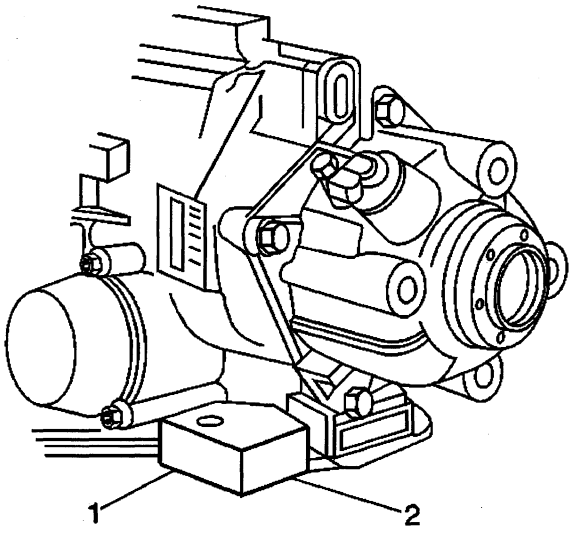
Transmission ID and VIN Derivative Location 4T60-E/4T65-E(c)



(1) Goodwrench® Tag Location
(2) Year
(3) Not Used
(4) Remanufacturing Site Code
(5) Serial Number
(6) Julian Date
(7) Year Remanufactured
(8) Model
(9) Transmission Identification Plate Location
(10) Model Year
(11) Line Build
(12) GM Production Code
(13) Julian Date
(14) Shift
(15) Model
(16) Serial Number in Base Code 31
(17) W = Warren Assembly Plant
(18) 4T65-E
(19) Model
(20) Vehicle Identification Number (VIN) Derivative Stamping Location

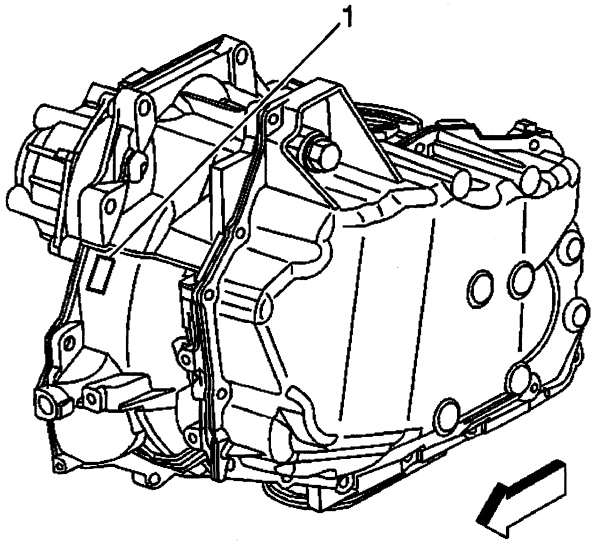
All automatic transmissions have a metal identification (ID) nameplate (9) attached to the case exterior.

Transmission VIN Location 4T65-E, M15/MN3/MN7(c)



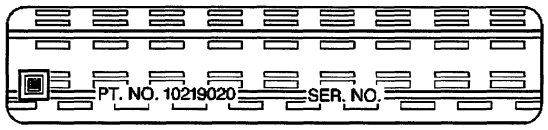
The primary (1) and secondary (2) Manual Tooling VIN Derivative Locations are on the casting of the transmission housing.

Transaxle VIN Derivative Stamping(c)



The location for the Semi-Automatic VIN derivative (1) is on the transmission housing.

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
AB7	Window Tinted Deep, Tail Gate
ACG	Filler Opaque Glass, SI RR WDO
AG1	Adjuster, Front Seat Poser, Multi-directional, Driver
AG2	Adjuster, Passenger Seat Power, Multi-directional
AJ1	Window Tinted Deep, All except W/S and DRS
AJ2	Seat, Rear Folding Jumpseat
AK5	Restraint System Seat, Inflatable, Driver and PASS
AJ7	Restraint System FRT Seat, Inflatable, DR/PASS, Front and Side
AL4	Seat RR Bucket w/RECLIN, HDREST
AM9	Seat RR Split Back, Folding, 50/50 Split Bench 3-Paw
AN2	Seat Child Integral Single RH 2ND Row
AP9	Restraint Cargo
AQ4	Seat RR
AR9	Seat FRT Bucket, Deluxe
AT5	Seat RR Center, Folding 2-PASS 40/60 Bench
AU0	Lock Control Remote Entry (RFA), INT Lights - On/Fade Off
AV5	Seat, Front Bucket, Highback
AV6	Seat RR Crew
AX4	Restraint Conversion Seat, MAN, European
A20	Window, Rear Quarter Vent Swing-Out - Power-Operated
A26	Window European Glazing, All
A31	Window Power-Operated Side; Domestic Inc.: Express Down; GME Inc. Auto Down/Auto Up/Anti-jam
BAG	Parts PKG Export
BG9	Covering Floor Rubber
BS1	Insulation Acoustical Package
B18	Ornamentation Interior, Deluxe
B37	Covering Floor Mat, FRT & RR, AUX
B4U	Performance Package Sport
B57	Ornamentation Exterior, Deluxe
CJ3	HVAC System Air conditioner Front, Manual Temperature Control, Auxiliary Temperature Control
C25	Wiper System RR Window, Intermittent
C3L	GVW Rating 5357 Lbs.
C49	Defogger RR Window, Electric
C60	HVAC System Air Conditioner Front Manual Controls
C69	HVAC System RR Air Conditioner
DH6	Mirror, I/S Sunshade ILLUM and Map HLDR - LH/R
DK6	Console, Interior Roof
DK7	Consolette, Overhead Base
DL5	Decal Roadside Service Information
DL6	Mirror O/S LH and RH, Remote Control, Electric, Manual Folding Color
DNR	Equipment Dealer Installed
DOE	Plant Code Doraville, GA, USA
DR1	Mirror O/S LH & RH, Manual Control, Color
DR5	Mirror O/S LH & RH, Remote Control, Electric, Heated Manual Folding, Color
D84	Paint, Custom Two-Tone

RPO	Description
E28	Assist Grips, B-Pillar-Mounted
E58	Door, Electric Sliding Side
E59	LH Power Sliding Door
FE1	Suspension System Soft Ride
FE2	Suspension System Ride, Handling
FE3	Suspension System Sport
FE4	Suspension System Special Ride and Handling
FR3	Ratio Transaxle Final Drive 6.69
FR9	Ratio Transaxle Final Drive 3.29
GEG	GVW Rating 2, 360 kg
GQ1	Axle Rear Standard Ratio
G50	Spring, Rear Heavy Duty, VAR 1
G67	Level Control Auto, Air
H4T	Merchandised PKG Thunder Special Edition
JL9	Brake System Power, FRT and RR Disc, Antilock, FRT and RR Wheel
JM4	Brake System Power, FRT Disc, RR Drum, Cast Iron, Antilock, FRT/RR Wheel
JS6	GVW Rating 5, 666 lbs
KA1	Heater Seat, FRT
KC4	Cooling System Engine Oil
KG7	Generator 125 AMP
KNB	Air Cleaner, Dry
K05	Engine Block Heater
K12	Filter, Air, Pollutant
K34	Cruise Control Automatic Electronic
K45	Air Cleaner, Heavy Duty
K68	Generator, 105AMP
LA1	Engine, Gas, 6 CYL, 3.4L, SFI, HO
MTF	Provisions Fire Extinguisher Mounting
MX0	Merchandises TRANS AUTO Provisions, O/D
M15	Trans, Auto 4-SPD, HMD, 4T65-E Enhanced Electronic
M76	Trans, Auto 4-SPD, HMD, 4T65-E PTU, O/D
NF4	Emission System Clean Fuel Fleet
NF9	Emission System General, Unleaded
NK4	Steering Wheel, Sport Leather
NP7	Steering Column EEG Approved
NT3	Emission System EEC 00
NT9	Emission Sstem Federal, Tier 2 Phase-Out
NU4	Emission System California LEV2 Plus
NV6	Steering Power, Reduced Effort
NW9	Traction Control Electronic
NY8	Shield Exhaust
N05	Lock Control Fuel Filler Cap
N30	Steering Wheel, Deluxe, Urethane
PB4	Lock, Wheel
PG1	Wheels 15 x 6, Steel
PH3	Wheels 15 x 6, Aluminum Cast 115 mm Bolt Circle
PY0	Wheels 16 x 6.5, Aluminum
PY1	Wheels 16 x 6.5, Aluminum Chrome
RPA	Rear Parking Assist
QD1	Wheels 16 x 6.5, Aluminum Styled
TL4	Grille Painted
TT5	Headlamps Halogen, 2

RPO	Description
T2H	Ornamentation EXTR, Export Unique Requirement
T2J	Ornamentation INTR, Export Unique Requirement
T65	Lamps System Daytime Running, Export
T84	Headlamps RH Rule of the Road, E Mark
T89	Lamps Tail and Stop. Export
T90	Lamps Signaling and Marker, Export
UA6	Theft Deterrent System
UC6	Radio AM/FM Stereo, Seek/Scan, RDS, Multiple Compact Disc, Auto Tone Control, Clock, ETR
UD4	Alarm Vehicle Speed, 120 K/H
UD7	Rear Parking Aid
UE1	Communication System Vehicle, G.P.S. 1
UG1	Garage Door Opener, Universal
UH8	Cluster Instrument, Coolant Temperature, Trip Odometer, Tachometer
UK3	Electronic System Steering Wheel Accessory Controls
UK6	Radio Control, RR Seat, and Earphone Jacks
UL2	Frequencies, European Radio
UL8	Frequencies, Saudi Arabian
UM7	Radio AM/FM Stereo, Seek/Scan, Clock, ETR
UN0	Radio AM/FM Stereo, Seek/Scan, Compact Disc, Auto Tone, Clock, ETR
UP0	Radio AM/FM Stereo, Seek/Scan, Compact Disc, Equalizer, Clock, ETR
US6	Antenna Fixed, Painted, Radio
UZ4	Speaker System, Four Dual Front Door Extended Range, Dual Rear Liftgate Extended Range
UZ5	Speaker System, Four Dual Front Door Coaxial, Dual Rear Liftgate Coaxial
U1P	Radio AM/FM Stereo, Seek/Scan, CD, Clock, Equalizer, RDS, ETR
U1Q	Radio AM/FM Stereo, Seek/Scan, Auto Rev Music Search CASS, CD, Clock, EQLZR, RDS, ETR
U18	Speedometer-Instrument Kilo/Miles
U19	Speedometer-Instrument Kilo/Miles; Kilo Odometer
U2E	Cluster Instrument, Coolant Temperature, Trip Odometer
U32	Entertainment PKG Rear Seat; Player, DVD
U68	Display Driver Info Center
VBX	Language Label Arabic
VG9	Protector Wax, Exterior Body
VH5	Plate Vehicle Identification
VH7	Bumper Custom
VH9	Envelope Owner Information Manual
VJ4	Label, Export Child Seat Location
VL2	Label, Spare Caution, Compact Spare
V08	Cooling System Heavy Duty
V41	Kit Accessory
V73	Vehicle Statement USA/Canada
V76	Hook Tow
V92	Trailer Provisions
XCK	Tire FRT P215/70R15-97S WOL PE ST TL AL2
XNI	Tire Front 225/60R16-98W BW R/PE ST TL HW4
XNX	Tire Front P225/60R16-97S BL R/PE ST TL AL2
XPA	Tire P215/70R15-97S WOL PE/ ST TL AL2, Rear YPA
XPK	Tire FRT P215/70R15-97S BW R/PE ST TL ALS
XPU	Tire FRT P215/70R15 BW R/PE ST TL AL2 97S
XUC	Tire Front 225/60R16-98S WOL TL ALS
XUF	Tire Front 225/60R16-98S BW TL ALS
X88	Market Brand Chevrolet

RPO	Description
YCK	Tire Rear P215/70R15 WOL PE ST TL AL2 97S Self Sealing
YNA	Tire Rear 205/65R15 BW R/PE ST TL HWY 94H
YNI	Tire Rear 225/60R16-98W BW R/PE ST TL HW4
YNX	Tire Rear P225/60R16-97S BL R/PE ST TL AL2
YPA	Tire Rear P215/70R15 WOL PE ST TL AL2 97S
YPK	Tire Rear P215/70R15 BW R/PE ST TL ALS 97S
YPU	Tire Rear P215/70R15 BW R/PE ST TL AL2 97S
YUC	Tire Rear 2255/60R16-98S WOL TL ALS
YUF	Tire Rear 225/60R16-98S BW

Technical Information

Maintenance and Lubrication

Capacities - Approximate Fluid

Application	Specification	
	Metric	English
Air Conditioning Refrigerant R134a		
Front A/C	0.8 kg	1.7 lbs
Front and Rear A/C	1.0 kg	2.2 lbs
Automatic Transmission		
Bottom Pan Removal	7.0 L	7.4 qts
Complete Overhaul	9.5 L	10.0 qts
Dry	12.0 L	13.0 qts
AWD Automatic Transmission		
Bottom Pan Removal	8.3 L	8.7 qts
Complete Overhaul	10.30 L	10.8 qts
Engine Cooling System		
With A/C	9.1 L	9.6 qts
With Rear Climate Control	11.3 L	11.9 qts
Engine Oil	3.8 L	4.0 qts
Fuel Tank		
Extended	95.0 L	25.1 gals
Regular	75.0 L	20.0 gals
Power Steering Capacities	0.75 L	1.5 pints
Rear Axle Fluid	1.9 L	2.1 qts
Transfer Case Fluid Capacity	290.0 ml	0.6 pints
Wheel Nut Torque	140 N·m	100 lb ft
Windshield Washer Fluid	0.37 L	1.0 qt

Maintenance Items

Item	Type/Part Number
Engine Air Cleaner Filter	AC Type A-1208C
Engine Oil Filter	AC Type PF-47
Fuel Filter	AC Type GF-819
Passenger Compartment Air Filter	(2) GM P/N 52482929
Radiator Cap	RC27
Spark Plugs	AC Type 41-101 Gap: 1.5 mm (0.060 in)
Windshield Wiper Blades	
• Back Glass Wiper Blade	GM P/N 22143295--Hook Type 40.6 mm (16 in)
• Left Wiper Blade	GM P/N 10293948--Hook Type 60.0 mm (24 in)
• Right Wiper Blade	GM P/N 10293947--Hook Type 60.0 mm (24 in)

Tire Inflation Pressure Specifications

Application	Specification	
	Metric	English
Compact Spare	414 kPa	60 psi
Front and Rear Tires	241 kPa	35 psi
Front and Rear Tires (w/ Entertainment Center U42)	220 kPa	32 psi

Fluid and Lubricant Recommendations

Usage	Fluid/Lubricant
Automatic Transmission	DEXRON®-III, Automatic Transmission Fluid
Engine Coolant	50/50 mixture of clean, drinkable water and use only GM Goodwrench® DEX-COOL® or Havoline® DEX-COOL® Coolant
Engine Oil	Engine oil with the American Petroleum Institute Certified For Gasoline Engines Starburst symbol of the proper viscosity
Hood and Door Hinges	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241 or equivalent)
Hood Latch Assembly, Secondary Latch, Pivots, Spring Anchor and Release Pawl	Lubriplate® Lubricant Aerosol (GM P/N 12346293 or equivalent) or lubricant meeting requirements of NLGI # 2, Category LB or GC-LB
Hydraulic Brake System	Delco Supreme 11® Brake Fluid (GM P/N 12377967 or equivalent DOT-3 Brake Fluid)
Key Lock Cylinders	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241 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, or equivalent)
Rear Folding Seat, Fuel Door Hinge, Liftgate Hinges, Power Sliding Door Cable	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241 or equivalent)
Sliding Door Track	Lubriplate® Lubricant Aerosol (GM P/N 12346293 or equivalent) or lubricant meeting requirements of NLGI # 2, Category LB or GC-LB
Weatherstrips	Dielectric Silicone Grease (GM P/N 12345579 or equivalent)
Windshield Washer Solvent	GM Optikleen® Washer Solvent (GM P/N 1051515) or equivalent

Descriptions and Operations

Power Steering System Description

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.

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 allows each wheel to compensate for changes in the road surface without affecting the opposite wheel. Each wheel independently connects to the frame with a steering knuckle, ball joint assemblies, and upper and lower control arms.

The control specifically allow the steering knuckles to move in a three-dimensional arc. Two tie rods connect to steering arms on the knuckles and an intermediate rod. These operate the front wheels.

The rear wheel drive vehicles have coil chassis springs. These springs are mounted between the spring housings on the frame and the lower control arms. Shock absorbers are mounted inside the coil springs. The coil springs attach to the lower control arms with bolts and nuts.

The upper part of each shock absorber extends through the upper control arm frame bracket, and the shock absorber secures with two grommets, two retainers, and a nut.

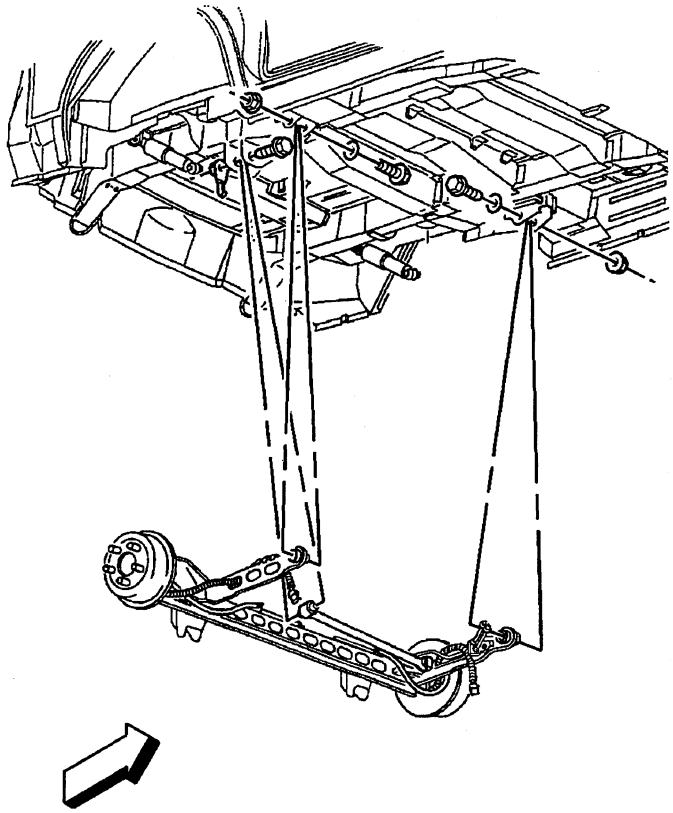
A spring stabilizer shaft controls the side roll of the front suspension. This shaft is mounted in rubber insulators that are held by brackets to the frame side rails. The ends of the stabilizer shaft connect to the lower control arms with link bolts. Rubber insulators isolate these link bolts.

A ball joint assembly is riveted and bolted to the outer end of the upper control arm. A castellated nut and a cotter pin join the steering knuckle to the upper ball joint.

The inner ends of the lower control arm have pressed-in bushings. The bolts pass through the bushings and join the arm to the frame. The lower ball joint assembly is a press fit in the lower control arm and attaches to the steering knuckle with a castellated nut and a cotter pin.

Ball socket assemblies have rubber grease seals. These seals prevent entry of moisture and dirt, and these seals prevent damage to the bearing surfaces.

Rear Suspension



The rear suspension system on this vehicle is the trailing-arm axle type. Two control arms (trailing arms) mount the axle to the vehicle body. The rear suspension system performs the following functions:

- Maintains the relationship of the rear axle to the body
- Opposes the torque reaction on acceleration and braking

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

- The rear axle
- Two coil springs
- Two shock absorbers
- The rear axle tie rod

The rear axle contains a stabilizer shaft which is an integral part of the rear axle. A wheel bearing/hub is secured at each end of the rear axle. The wheel bearing/hub also contains an integral wheel speed sensor.

The rear coil springs are retained between the spring seat in the underbody and the spring seat on the top of the rear axle. Rubber insulators isolate the coil spring at the top and at the bottom.

The shock absorbers mount at the bottom with a bolt and nut to brackets which are welded to the axle housing and at the top with a bolt and nut beneath the body.

The rear tie rod attaches to the axle and to the underbody. The rear axle tie rod controls the lateral movement of the rear axle in relation to the vehicle body. The rear axle tie rod bushings are an integral part of the rear axle tie rod.

Wheels and Tires

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.

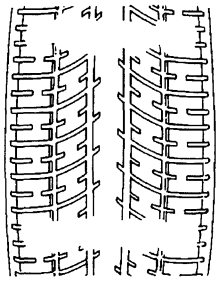
The following factors have an important influence on tire life:

- 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

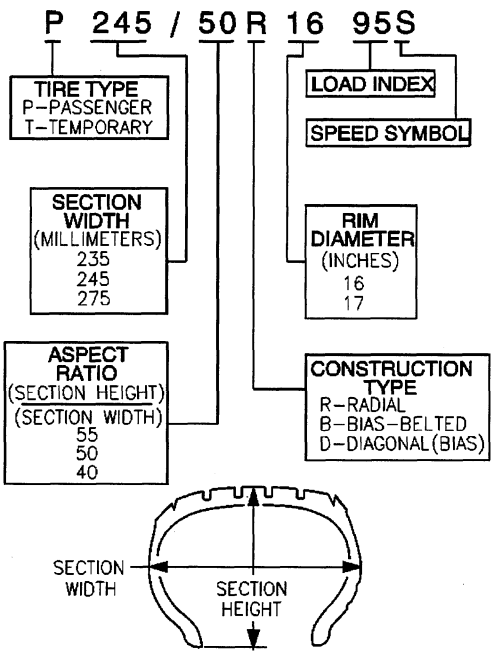
Tires with a lower than recommended pressure can cause the following conditions:

- 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.

Automatic Level Control General Description

The function of the Automatic Level Control (ALC) system is maintaining a constant trim height at the rear suspension when the vehicle is loaded beyond a predetermined amount. The ALC system is active ONLY when the vehicle ignition is ON. The system consists of the following components:

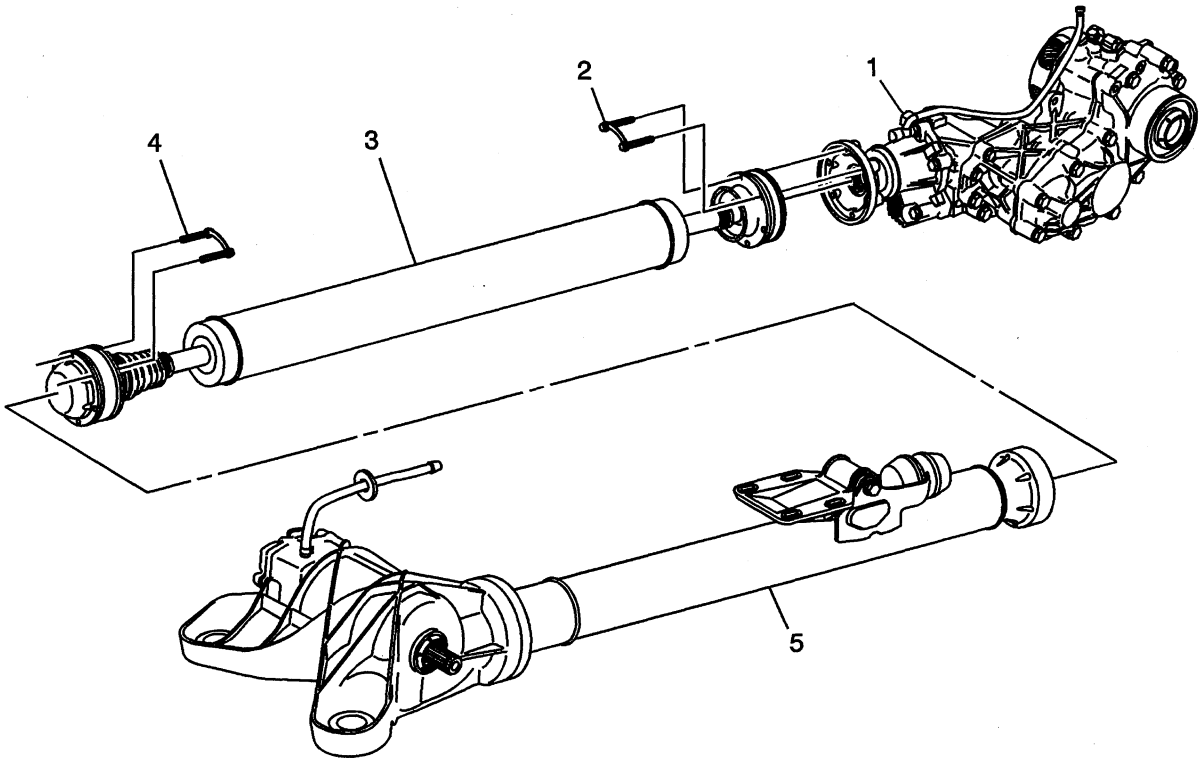
- An automatic level control sensor
- Air shocks
- Air lines
- An automatic level control air compressor assembly, consisting of the following components:
  - Automatic level control air compressor motor and head
  - Automatic level control air compressor air compressor bracket
  - Air drier
  - Exhaust solenoid
  - Automatic level control relay
  - Automatic level control air compressor filter

An inflator system is included as part of the overall ALC system. The function of the inflator system is to provide air under pressure up to 482 kPa (70 psi) to an inflator solenoid fill valve for the purpose of inflating items other than the vehicle air shocks, such as sports balls, bicycle tires, automobile tires, etc. The inflator solenoid fill valve and the inflator on/off switch are located behind an access door in the rear left-hand side of the passenger compartment. The inflator system is active ONLY when the vehicle ignition is ON.

- An inflator solenoid fill valve
- An inflator solenoid
- An inflator switch
- An inflation timer relay
- An accessory kit

Driveline System Description and Operation

Propeller Shaft Description and Operation



The propeller shaft (3) is of a tubular design with constant velocity joints at both the transfer case and the torque tube flanges. The forward and rearward ends of the propeller shaft mate to the transfer case and the torque tube flanges with 6 bolts each (2, 4) utilizing special crescent-shaped washers to pair the bolts together in order to evenly distribute the clamping force.

The front constant velocity (CV) joint receives the rotational forces from the transfer case output flange. The front CV joint is of a ball-and-groove design using 6 ball bearings set in a race. The CV joint allows axial, but not lateral movement of the joint in order to compensate for the driveline inclination changes imposed by the powertrain during acceleration and deceleration. The CV joint is lubricated with a special grease that is protected from foreign material contamination by a seal similar in design to the seal on a front wheel drive shaft. The mating surface of the CV joint is protected by a metal cap which is crimped on to the CV joint, and captured between the CV joint and the transfer case output flange.

The rear CV joint receives the rotational forces transmitted through the propeller shaft from the front CV joint. These forces are then transferred to the torque tube input flange. The rear CV joint is similar in design to the front CV joint, although the rear CV joint allows lateral as well as axial movement. The lateral and axial movement of the CV joint compensates for driveline inclination changes as well as the lateral movement of the driveline during acceleration and deceleration. The CV joint is lubricated with a special grease that is protected from foreign material contamination by a bellows-type seal. The mating surface of the CV joint is protected by a metal cap which is crimped on to the CV joint, and captured between the CV joint and the torque tube input flange.

The propeller shaft and the constant velocity joints are not serviceable. The CV joints and seals should be inspected periodically, whenever the vehicle is raised for service.

Wheel Drive Shafts

Front wheel drive axles are flexible assemblies.

Front wheel drive axles consist of the following components:

- A front wheel drive shaft tri-pot joint (inner joint)
- A front wheel drive shaft constant velocity joint (outer joint)
- A front wheel drive shaft 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. The front wheel drive shaft tri-pot joint can move in and out.

The front wheel drive shaft constant velocity joint is flexible, but the front wheel drive shaft constant velocity joint cannot move in and out.

Boots (Seals) And Clamps

The front wheel drive shaft constant velocity joint and the front wheel drive shaft tri-pot joint boots (seals) in the front wheel drive axle are made of a thermoplastic material.

The clamps in front wheel drive axle are made of stainless steel.

The boot (seal) provides the following functions:

- Protection of the internal parts of the front wheel drive shaft constant velocity joint and the front wheel drive shaft tri-pot joint. The boot (seal) protects the grease from the following sources of damage:
  - Harmful atmospheric conditions (such as extreme temperatures or ozone gas)
  - Foreign material (such as dirt or water)
- Allows angular movement and the axial movement of the front wheel drive shaft tri-pot joint.
- Allows angular movement of the front wheel drive shaft constant velocity joint.

Important

Protect the boots (seals) from sharp tools and from the sharp edges of the surrounding components.

Any damage to the boots (seals) or the clamps will result in leakage. Leakage will allow water to leak into the front wheel drive shaft tri-pot joint and the front wheel drive shaft constant velocity joints. Leakage will also allow grease to leak out of the front wheel drive shaft tri-pot joints and the front wheel drive shaft constant velocity joints.

Leakage may cause noisy front wheel drive axle operation and eventual failure of the internal components.

The clamps provide a leak proof connection for the front wheel drive shaft tri-pot joint and the front wheel drive shaft constant velocity joint at the following locations:

- The housing
- The front wheel drive shaft

The thermoplastic material performs well under normal conditions and normal operation. However, the material is not strong enough to withstand the following conditions:

- Abusive handling
- Damage from sharp objects (such as sharp tools or any sharp edges of the surrounding components in the vehicle).

Front Wheel Drive Shaft Tri-pot Joint (Inner Joint)

The front wheel drive shaft tri-pot joint is made with the tri-pot design without an over-extension limitation retainer.

The joint is constructed as follows for vehicles that are equipped with an automatic transmission:

- The left front wheel drive axle has a female spline. The female spline installs over a stub shaft that protrudes from the transaxle.
- The right front wheel drive axle has a male spline. The right front wheel drive axle uses barrel type snap rings in order to interlock with the transaxle gears.

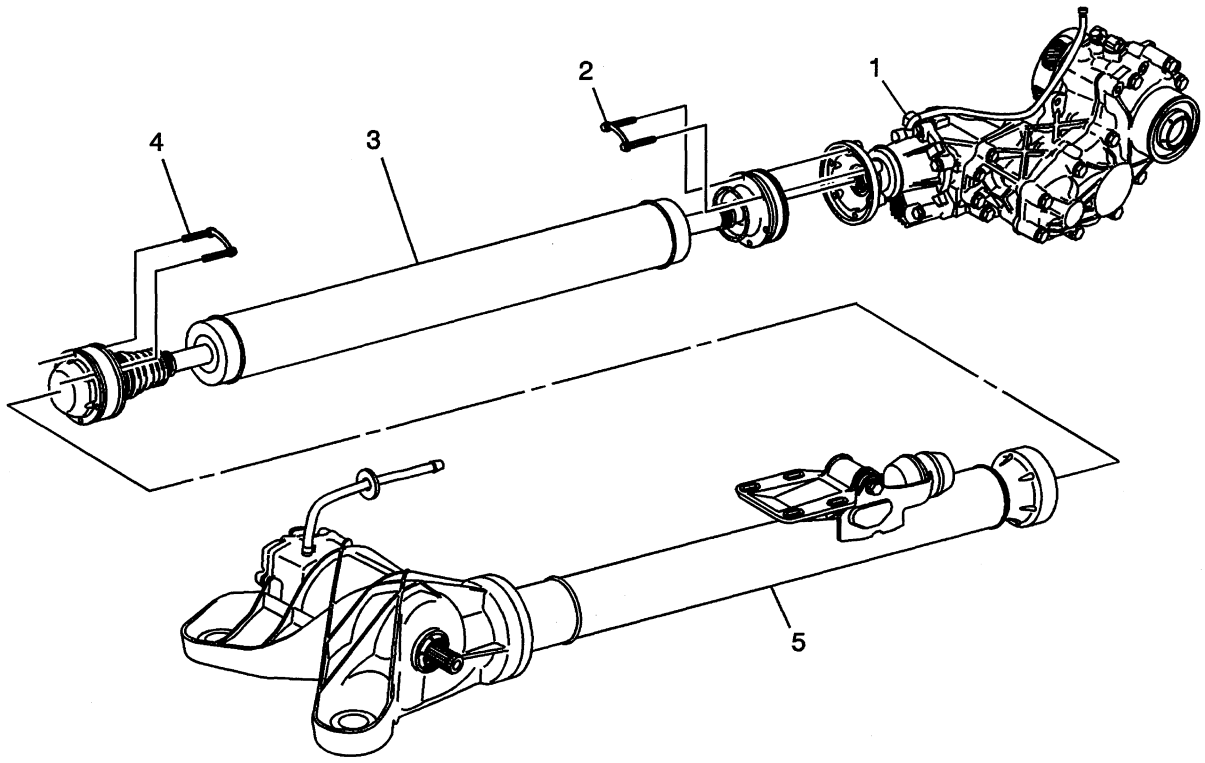
Front Wheel Drive Shaft Constant Velocity Joint (Outer Joint)

The front wheel drive shaft constant velocity joint is made with the Rzeppa joint design.

The shaft end (which mates with the knuckle/hub) has a helical spline. The helical spline ensures a tight, press-type fit.

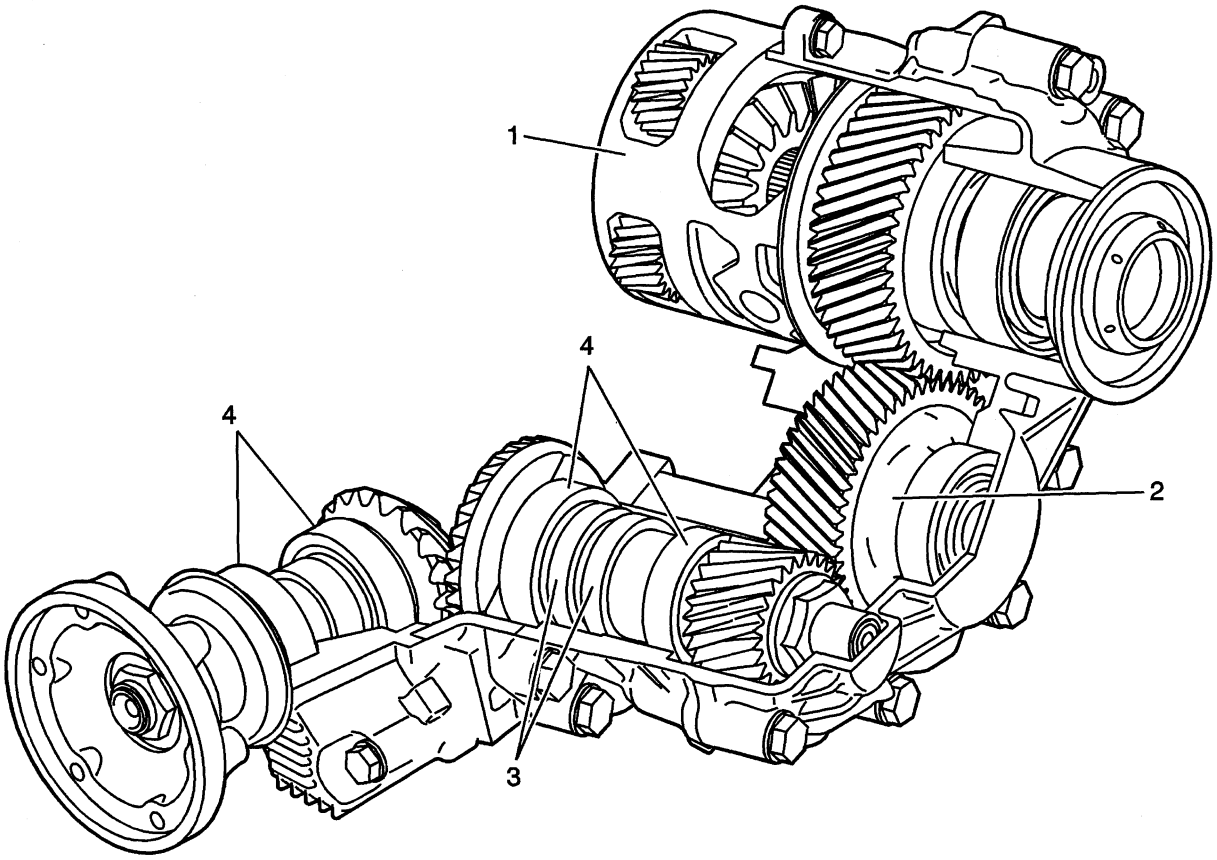
This design prevents end play between the hub bearing and the front wheel drive axle.

Differential Carrier Assembly Description



The vehicle is powered by the LA1 3400 V 6 engine, VIN E. Motion/power is transferred from the engine crankshaft/flywheel through the 4T65-E automatic transaxle. A three gear transfer case (1), mated to the right side of the transaxle assembly, transfers torque/power to the rear differential (5) via a propeller shaft assembly (3). The front-to-rear gear ratio is 1.013 to 1.

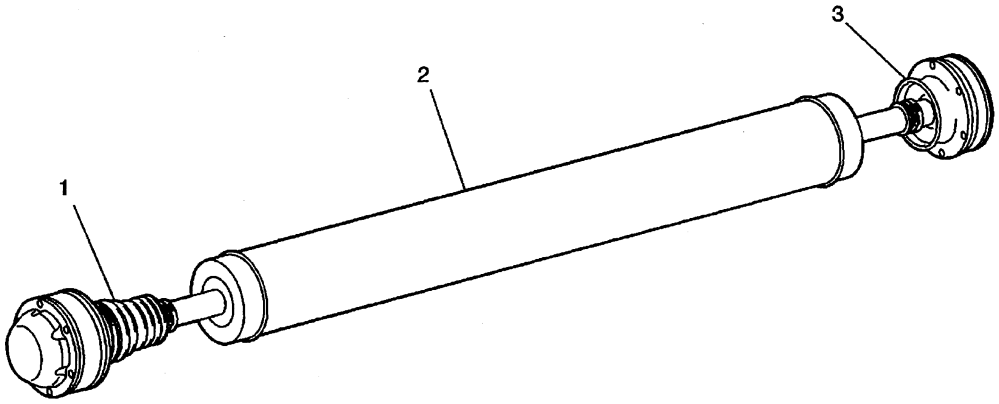
Transfer Case



The transfer case assembly consists of a four-piece aluminum housing, an input helical gear assembly or carrier (1), an idler helical gear (2), and a hypoid bevel gear set which consists of two shaft assemblies supported by tapered roller bearings (4). The design of this component changes power output from transverse to longitudinal and also positions the propeller shaft assembly near the centerline of the vehicle. The propeller shaft assembly, mated to the output flange of the transfer case, is constantly rotating and spins at a rate equal to an average of the two front wheels.

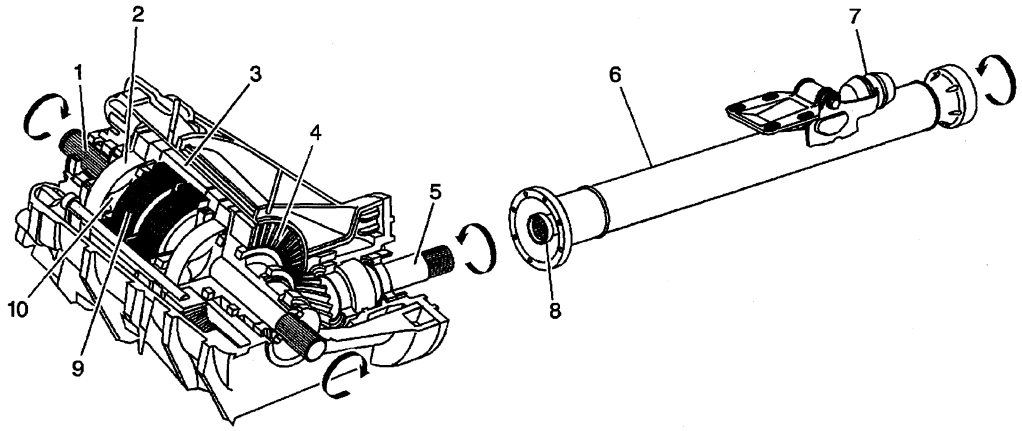
The transfer case is mated to the right side of the 4T65-E automatic transmission. Two types of lubricant are used within the transfer case: automatic transmission fluid for the three helical gear set and a unique hypoid gear oil for the bevel gears. Two oil seals, internal to the case (3) separate the two types of fluid.

Propeller Shaft



The propeller shaft assembly consists of a one-piece aluminum tube (2) and front and rear constant velocity type joints (1 and 3). The rear constant velocity joint (3) is a plunging type design and will plunge forward and rearward as required. Dust boots, at each joint, contain the joint lubricating grease and protect the components from dirt and debris. The propeller shaft assembly is retained to the transfer case output flange and the rear differential input flange by retaining bolts. The propeller shaft is serviced as an assembly.

Rear Differential



The rear differential assembly consists of a torque tube assembly (6), three-piece differential housing, ring and pinion (4 and 5), and a differential carrier assembly (3).

The aluminum torque tube housing (6) contains an internal drive shaft (8) that is supported by roller bearings at each end. The internal drive shaft is retained to the front propeller shaft assembly by bolts and splined to the differential pinion shaft. External to the tube are a vehicle mounting bracket and a noise and vibration dampner (7).

The pinion shaft (5) is positioned in an aluminum pinion housing and is supported by tapered roller bearings. A shim between the pinion and differential housings provides the proper backlash for the ring and pinion. The ring gear (4) is retained externally to the differential carrier assembly (3) by bolts. Both the transfer case hypoid gears and the rear differential assembly use unique type synthetic gear oil.

The differential carrier assembly (3) consists of left and right side clutch pack drum, separate left and right axle sub shafts (1), left and right gerotor pump components (2 and 10), left and right clutch packs (9), left and right pistons, and internal valves.

The Versatrak® on-demand system operates as follows: The propeller shaft assembly, mated to the output flange of the transfer case, is constantly rotating and spins at a rate equal to an average of the two front wheels. Under normal straight-ahead non-slip driving conditions, the external (2) and internal (10) gears of the differential gerotor pumps are rotating at an equal rate of speed. Under those conditions, there is no speed differential between the pump gears, no pump pressure created, no clutch pack activation, and no torque transfer. During a front-wheel slip condition, the external gears (2) of the gerotor pumps rotate at a faster rate of speed than the rear-wheel driven internal gears (10). The gerotor pumps pull oil from the sump through the clutch pump check valve sending pressurized oil to each individual piston to activate the separate clutch packs. On-demand torque/drive is provided to each of the rear wheels as required. A valve internal to each piston housing controls maximum clutch pack pressure. A second valve within each housing is temperature compensating and controls fluid flow based on ambient temperature. The system operates in both forward and rearward vehicle directions.

In the event a spare wheel of a smaller diameter is used on any of the four positions, the wheel rotational speed difference is detected by the wheel speed sensors of the anti-lock brake system (ABS) system. The powertrain control module (PCM) directs the clutch pump check valve to close and block oil flow to the gerotor pumps. The clutch pump check valve also monitors the sump oil for an over-temperature condition. If differential oil temperature exceeds 110°C (230°F), the valve will close and block oil flow to the gerotor pumps. In both spare wheel usage and over-temperature conditions, a "closed" valve will alert the PCM to illuminate the control panel "AWD Disable" light.

Differential Lock System Description and Operation

The All Wheel Drive (AWD) system provides On-Demand all wheel drive, distributing variable torque/power to the rear wheels via individual axle shaft assemblies. On-Demand drive is provided to each of the rear wheels only when slippage is detected at the front wheels. As long as there is no slippage at the front wheels, there is no front-to-rear speed differential and no need for rear wheel drive torque. In the event there is front-to-rear wheel speed differential/slippage, a rotational speed difference between the gerotor pump components (rotor and housing) occurs. In those instances, the rotor draws fluid from the sump and through the internal passages of the differential carrier, sending pressurized fluid to a piston (actuating the specific rear wheel clutch pack). In the event of a spare wheel (of smaller diameter) is used on any of the four positions, the wheel rotational speed difference is detected by the wheel speed sensors of the ABS system. The powertrain module directs the differential inlet valve to close and block oil flow to the gerotor pumps. The inlet valve also monitors the sump oil for an "overtemperature" condition. If differential oil temperature exceeds 110°C (230°F), the valve will close and block oil flow to the gerotor pumps. In both spare wheel usage and overtemperature conditions, an activated inlet valve will illuminate the control panel AWD Disable indicator.

View the list of major components that make up the AWD system below.

AWD Disable indicator

The AWD Disable indicator is located in the instrument panel cluster. This lamp is used to inform the driver that the AWD system has been disabled and no torque will be applied to the rear wheels during a slip condition. The AWD Disable indicator is controlled by the powertrain control module via a class 2 message.

Differential Clutch Pump Actuator Check Valve

The differential clutch pump actuator check valve controls the oil flow to the gerotor pumps. Without fluid pressure the pistons cannot apply the clutchpacks for rear wheel engagement. The actuator check valve

will open upon engine startup and remain open unless commanded closed by the powertrain control module. The actuator check valve also monitors the sump oil for an overtemperature condition. If differential oil temperature exceeds 110°C (230°F), the valve will close and block oil flow to the gerotor pumps.

Powertrain Control Module

The powertrain control module monitors the data from the ABS controller and Rear Drive Module (RDM) for proper operating conditions. If inappropriate conditions are present the PCM commands the differential clutch pump actuator check valve closed, disabling the AWD system. The PCM also commands the AWD Disable indicator on.

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.

Drum Brake System Description and Operation

System Component Description

The drum brake system consists of the following:

Drum Brake Shoes

Applies mechanical output force (from hydraulic brake wheel cylinders) to friction surface of brake drums.

Brake Drums

Uses mechanical output force applied to friction surface from drum brake shoes to slow speed of tire and wheel assembly rotation.

Drum Brake Hardware

Secures drum brake shoes firmly in proper relationship to hydraulic brake wheel cylinders. Enables sliding motion of brake shoes needed to expand toward friction surface of drums when mechanical output force is applied; provides return of brake shoes when mechanical output force is relieved.

Drum Brake Adjusting Hardware

Provides automatic adjustment of brake shoes to brake drum friction surface whenever brake apply occurs during rearward motion of the vehicle.

System Operation

Mechanical output force is applied from the hydraulic brake wheel cylinder pistons to the top of the drum brake shoes. The output force is then distributed between the primary and secondary brake shoes as the shoes expand toward the friction surface of the brake drums. The brake shoes apply the output force to the friction surface of the brake drums, which slows the rotation of the tire and wheel assemblies. The proper function of both the drum brake hardware and adjusting hardware is essential to the proper 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 drum brake shoes toward the friction surface of the brake drum.

Threaded park brake actuators/adjusters are also used to control clearance between the drum brake shoes and the friction surface of the brake drum.

Drum Brake Shoes

Applies mechanical output force from park brake actuator/adjuster to friction surface of the brake drum.

System Operation

Park brake apply input force is received by the park brake lever assembly being applied. The input force is multiplied by the lever assembly, 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 drum brake shoes toward the friction surface of the brake drum in order to prevent the rotation of the rear tire and wheel assemblies. The park brake lever assembly releases an applied park brake system when it is returned to the at-rest, lowered, position.

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 Mechanical – 3.4L

Mechanical Specifications

Application	Specification	
	Metric	English
General Data		
• Engine Type	60 degree V-6	
• Displacement	3.4L	204 cu in
• RPO	LA1	
• VIN	E	
• Bore	92 mm	3.62 in
• Stroke	84 mm	3.31 in
• Compression Ratio	9.6:1	
• Firing Order	1-2-3-4-5-6	
• Spark Plug Gap	1.52 mm	0.60 in
Block		
• Camshaft Bearing Bore Diameter - Front and Rear	51.03-51.08 mm	2.009-2.011 in
• Camshaft Bearing Bore Diameter - Middle #2, #3	50.77-50.82 mm	1.999-2.001 in
• Crankshaft Main Bearing Bore Diameter	72.1535-72.0695 mm	2.840-2.841 in
• Crankshaft Main Bearing Bore Out-of-Round	0.008 mm	0.00031 in
• Cylinder Bore Diameter - Production	92.020-92.038 mm	3.622-3.623 in
• Cylinder Bore Diameter - Service	92.020-92.038 mm	3.622-3.623 in
• Cylinder Bore Out-of-Round - Diametral - Production	0.020 mm	0.0008 in
• Cylinder Bore Out-of-Round - Diametral - Service	0.025 mm	0.001 in
• Cylinder Bore Taper - Production	0.020 mm	0.0008 in
• Cylinder Bore Taper - Service	0.025 mm	0.001 in
• Cylinder Head Deck Height	224 mm	8.818 in
• Cylinder Head Deck Surface Flatness	0.05 mm per 152 mm	0.0019 in per 6 in
• Valve Lifter Bore Diameter	21.417-21.455 mm	0.843-0.844 in
Camshaft		
• Camshaft Bearing Inside Diameter	47.523-47.549 mm	1.871-1.872 in
• Camshaft Journal Diameter	47.45-47.48 mm	1.868-1.869 in
• Camshaft Journal Out-of-Round	0.025 mm	0.001 in
• Camshaft Lobe Lift - Exhaust	6.9263 mm	0.2727 in
• Camshaft Lobe Lift - Intake	6.9263 mm	0.2727 in
Cooling System		
• Capacity	12.4 liters	13.1 quarts
• Thermostat Full Open Temperature	195 degrees	
Connecting Rod		
• Connecting Rod Bearing Clearance	0.18-0.062 mm	0.0007-0.017 in
• Connecting Rod Bore Diameter	53.962-53.978 mm	2.124-2.125 in
• Connecting Rod Bore Out-of-Round	0.008 mm	0.0002 in
• Connecting Rod Length - Center to Center	144.75-144.81 mm	5.69-5.70 in
• Connecting Rod Side Clearance	0.25-0.37 mm	0.010-0.015 in

Application	Specification	
	Metric	English
Crankshaft		
• Connecting Rod Journal Diameter	50.768-50.784 mm	1.9987-1.9994 in
• Connecting Rod Journal Out-of-Round	0.005 mm	0.0002 in
• Connecting Rod Journal Taper	0.005 mm	0.0002 in
• Connecting Rod Journal Width	21.92-22.08 mm	0.863-0.869 in
• Crankshaft End Play	0.060-0.210 mm	0.0024-0.0083 in
• Crankshaft Main Bearing Journal Width	23.9-24.1 mm	0.941-0.949 in
• Crankshaft Main Bearing Clearance - Except #3	0.019-0.064 mm	0.0008-0.0025 in
• Crankshaft Main Bearing Clearance - #3 Thrust Bearing	0.032-0.077 mm	0.0012-0.0030 in
• Crankshaft Main Journal Diameter	67.239-67.257 mm	2.6473-2.6483 in
• Crankshaft Main Journal Out-of-Round	0.005 mm	0.0002 in
• Crankshaft Main Journal Taper	0.005 mm	0.0002 in
• Crankshaft Rear Flange Runout	0.04 mm	0.0016 in
Cylinder Head		
• Combustion Chamber Depth - at Measurement Point	2.2 mm	0.087 in
• Surface Finish - Maximum	2.8 RA	
• Surface Flatness - Block Deck	0.08 mm per 152 mm	0.003 in per 6 in
• Surface Flatness - Exhaust Manifold Deck	0.1 mm	0.004 in
• Surface Flatness - Intake Manifold Deck	0.1 mm	0.004 in
• Valve Guide Bore - Exhaust	8.01 mm	0.315 in
• Valve Guide Bore - Intake	8.01 mm	0.315 in
• Valve Guide Installed Height	16.6 mm	0.654 in
Lubrication System		
• Oil Capacity - with Filter	4.3 liters	4.5 quarts
• Oil Capacity - without Filter	3.8 liters	4.0 quarts
• Oil Pressure - @ 1850 RPM	414 kPa	60 psi
Oil Pump		
• Gear Diameter	38.05-38.10 mm	1.498-1.500 in
• Gear Pocket - Depth	30.52-30.58 mm	1.202-1.204 in
• Gear Pocket - Diameter	38.176-38.226 mm	1.503-1.505 in
• Gears Lash	0.094-0.195 mm	0.0037-0.0077 mm
• Relief Valve-to-Bore Clearance	0.038-0.089 mm	0.0015-0.0035 in
Piston Ring End Gap		
• First Compression Ring	0.15-0.36 mm	0.006-0.014 in
• Second Compression Ring	0.48-0.74 mm	0.0188-0.0291 in
• Oil Control Ring	0.25-0.77 mm	0.0098-0.0303 in
Piston Ring to Groove Clearance		
• First Compression Ring	0.04-0.086 mm	0.002-0.0033 in
• Second Compression Ring	0.04-0.08 mm	0.002-0.0031 in
• Oil Control Ring	0.07-0.095 mm	0.0028-0.0037 in
Piston Ring Thickness		
• First Compression Ring	1.164-1.190 mm	0.046-0.047 in
• Second Compression Ring	1.460-1.490 mm	0.0574-0.0586 in
• Oil Control Ring - Maximum	2.960 mm	0.116 in

Application	Specification	
	Metric	English
Piston		
• Piston Diameter - production - cylinder 1-4	91.985-92.003 mm	3.621-3.622 in
• Piston Diameter - service limit - cylinder 1-4	91.945 mm	3.619 in
• Piston Diameter - production - cylinder 5-6	91.99-92.028 mm	3.621-3.623 in
• Piston Diameter - service limit - cylinder 5-6	91.945 mm	3.619 in
• Piston Pin Bore Diameter	23.005-23.010 mm	0.9057-0.9059 in
• Piston Ring Groove Width - First	1.23-1.25 mm	0.048-0.049 in
• Piston Ring Groove Width - Second	1.53-1.55 mm	0.060-0.061 in
• Piston Ring Groove Width - Oil Control	3.03-3.055 mm	0.119-0.120 in
• Piston to Bore Clearance - production - 1-4	0.17-0.053 mm	0.0006-0.0020 in
• Piston to Bore Clearance - service limit- 1-4	0.093 mm	0.0036 in
• Piston to Bore Clearance - production - 5-6	-0.008-0.048 mm	-0.0003-0.0018 in
• Piston to Bore Clearance - service limit- 5-6	0.093 mm	0.0036 in
Pin		
• Piston Pin Clearance to Connecting Rod Bore - Press Fit	-0.047 to -0.019 mm	-0.0019 to -0.0007 in
• Piston Pin Clearance to Piston Pin Bore	0.008-0.016 mm	0.00031-0.00063 in
• Piston Pin Diameter	22.994-22.997 mm	0.9053-0.9054 in
Valves		
• Valve Face Angle	45 degrees	
• Valve Seat Angle	46 degrees	
• Valve Seat Depth - Intake - from deck face	7.9-8.1 mm	0.311-0.318 in
• Valve Seat Depth - Exhaust - from deck face	8.9-9.1 mm	0.350-0.358 in
• Valve Seat Runout	0.037 mm	0.0015 in
• Valve Seat Width - Intake	1.55-1.80 mm	0.061-0.071 in
• Valve Seat Width - Exhaust	1.70-2.0 mm	0.067-0.079 in
• Valve Stem-to-Guide Clearance	0.026-0.068 mm	0.0010-0.0027 in
Valve Lifters/Push Rods		
• Push Rod Length - Intake	146.0 mm	5.75 in
• Push Rod Length - Exhaust	152.5 mm	6.0 in
Valve Springs		
• Valve Spring Free Length	48.5 mm	1.89 in
• Valve Spring Installed Height	43.2 mm	1.701 in
• Valve Spring Load - Closed	320 N @ 43.2 mm	75 lb @ 1.701 in
• Valve Spring Load - Open	1036 N @ 32 mm	230 lb @ 1.260 in
• Valve Spring Total Number of Coils	6.55	

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Control Cable Bracket Bolt/Nut	10 N·m	89 lb in
Camshaft Position Sensor Bolt	10 N·m	89 lb in
Camshaft Sprocket Bolt	140 N·m	103 lb ft
Camshaft Thrust Plate Screw	10 N·m	89 lb in
Connecting Rod Bearing Cap Nut		
First Pass	20 N·m	15 lb ft
Final Pass	75 degrees	
Coolant Drain Plug	19 N·m	14 lb ft
Coolant Temperature Sensor	23 N·m	17 lb ft
Crankshaft Balancer Bolt		
First Pass	70 N·m	52 lb ft
Final Pass	72 degrees	
Crankshaft Main Bearing Cap Bolt/Stud		
First Pass	50 N·m	37 lb ft
Final Pass	77 degrees	
Crankshaft Oil Deflector Nut	25 N·m	18 lb ft
Crankshaft Position Sensor Bolt -- Front Cover	10 N·m	89 lb in
Crankshaft Position Sensor Stud -- Side of Engine Block	11 N·m	98 lb in
Crankshaft Position Sensor Shield Nut	11 N·m	98 lb in
Crankshaft Position Sensor Wiring Bracket Bolt	27 N·m	20 lb ft
Cylinder Head Bolt		
First Pass	60 N·m	44 lb ft
Final Pass	95 degrees	
Drive Belt Tensioner Bolt	50 N·m	37 lb ft
EGR Valve Pipe to Exhaust Manifold Nut	25 N·m	18 lb ft
EGR Valve Pipe to EGR Valve Bolt	25 N·m	18 lb ft
EGR Valve to Upper Intake Manifold Bolt	30 N·m	22 lb ft
Engine Front Cover Bolt		
Large Bolt	55 N·m	41 lb ft
Medium Bolt	55 N·m	41 lb ft
Small Bolt	27 N·m	20 lb ft
Engine Mount Bracket to Engine Block Bolt - AWD	85 N·m	63 lb ft
Engine Mount Bracket to Oil Pan	58 N·m	43 lb ft
Engine Mount to Engine Mount Bracket Nut	53 N·m	39 lb ft
Engine Mount to Engine Oil Pan Bolts	58 N·m	43 lb ft
Engine Mount to Frame Bolts	47 N·m	35 lb ft
Engine Mount to Lower Nut	47 N·m	35 lb ft
Engine Mount Strut and A/C Compressor Bracket Bolt	50 N·m	37 lb ft
Engine Mount Strut Bolt	48 N·m	35 lb ft
Engine Mount Strut Bracket Bolt, Left	70 N·m	52 lb ft
Engine Mount Strut Bracket Bolt, Right	50 N·m	37 lb ft
Engine Mount Strut Bracket Bolt to Radiator Support, Upper	26 N·m	19 lb ft
Engine Mount Strut and Generator Bracket Bolt	50 N·m	37 lb ft
Engine Mount Strut and Lift Bracket Bolt - Engine Lift Rear	70 N·m	52 lb ft
Engine Mount Strut Nut	48 N·m	35 lb ft
Engine Mount Strut and Support Bracket		
Large Bolt	55 N·m	41 lb ft
Medium Bolt	55 N·m	41 lb ft
Small Bolt	27 N·m	20 lb ft
Engine Mount Strut to Upper Bracket Bolt	48 N·m	36 lb ft

Application	Specification	
	Metric	English
Engine Mount Strut to Engine Mount Strut Bracket Nut	48 N·m	36 lb ft
Engine Mount Upper Nut	53 N·m	39 lb ft
Engine Oil Pressure Indicator Switch	16 N·m	12 lb ft
Engine Wiring Harness Bracket Bolt	13 N·m	110 lb in
Exhaust Manifold Heat Shield Bolt	10 N·m	89 lb in
Exhaust Manifold Nut	16 N·m	12 lb ft
Exhaust Manifold Stud	18 N·m	13 lb ft
Flywheel Bolt	71 N·m	52 lb ft
Fuel Feed and Return Pipe Bracket Stud	50 N·m	37 lb ft
Fuel Feed and Return Pipe Retaining Clip Bolt	8 N·m	71 lb in
Fuel Feed and Return Pipe Retaining Clip Nut	25 N·m	18 lb ft
Fuel Feed Pipe To Fuel Injector Rail Nut	17 N·m	13 lb ft
Fuel Injector Rail Bolt	10 N·m	89 lb in
Fuel Pipe Clip Bolt	8 N·m	71 lb in
Heated Oxygen Sensor	42 N·m	31 lb ft
Heater Inlet Pipe Nut	25 N·m	18 lb ft
Heater Inlet Pipe Stud	50 N·m	37 lb ft
Ignition Coil Bracket Bolt/Nut/Stud	25 N·m	18 lb ft
Intake Manifold Coolant Pipe Bolt	10 N·m	89 lb in
Knock Sensor	19 N·m	14 lb ft
Left Engine Mount Strut Bracket to Engine Bolts	50 N·m	37 lb ft
Lower Intake Manifold Bolt - Center		
First Pass	7 N·m	62 lb in
Final Pass	13 N·m	115 lb in
Lower Intake Manifold Bolt - Corner		
First Pass	13 N·m	115 lb in
Final Pass	25 N·m	18 lb ft
MAP Sensor Bolt	5 N·m	44 lb in
MAP Sensor Bracket Bolt	25 N·m	18 lb ft
Oil Filter	30 N·m	22 lb ft
Oil Filter Bypass Hole Plug	19 N·m	14 lb ft
Oil Filter Fitting	39 N·m	29 lb ft
Oil Gallery Plug -- 1/4 inch	19 N·m	14 lb ft
Oil Gallery Plug -- 3/8 inch	33 N·m	24 lb ft
Oil Level Indicator Tube Bolt	25 N·m	18 lb ft
Oil Level Sensor Bolt	10 N·m	89 lb in
Oil Pan Bolt	25 N·m	18 lb ft
Oil Pan Drain Plug	25 N·m	18 lb ft
Oil Pan Side Bolt	50 N·m	37 lb ft
Oil Pump Cover Bolt	10 N·m	89 lb in
Oil Pump Drive Clamp Bolt	36 N·m	27 lb ft
Oil Pump Mounting Bolt	41 N·m	30 lb ft
Right Engine Mount Strut Bracket to Engine Bolts	70 N·m	52 lb ft
Spark Plug - Initial Installation	20 N·m	15 lb ft
Spark Plug - After Initial Installation	15 N·m	13 lb ft
Thermostat Bypass Pipe to Engine Front Cover Bolt	12 N·m	106 lb in
Thermostat Bypass Pipe to Throttle Body Nut	25 N·m	18 lb ft
Throttle Body Bolt/Stud	25 N·m	18 lb ft
Timing Chain Dampener Bolt	21 N·m	15 lb ft
Upper Engine Mount Strut Bracket to Upper Raidiator Support Bolts	28 N·m	21 lb in
Upper Intake Manifold Bolt/Stud	25 N·m	18 lb ft

Application	Specification	
	Metric	English
Valve Lifter Guide Bolt	10 N·m	89 lb in
Valve Rocker Arm Bolt	32 N·m	24 lb ft
Valve Rocker Arm Cover Bolt	10 N·m	89 lb in
Water Outlet Bolt	25 N·m	18 lb ft
Water Pump Bolt	11 N·m	98 lb in
Water Pump Pulley Bolt	25 N·m	18 lb ft

Engine Component Description

The cylinder block is made of cast alloy iron. The cylinder block has 6 cylinders that are arranged in a V shape. There are 3 cylinders in each bank. The cylinder banks are set at a 60 degree angle from each other.

Starting from the front of the engine, the left bank cylinders are 1, 3, 5. The right bank cylinders are 2, 4, 6.

Four main bearings support the crankshaft. The crankshaft is retained by the bearing caps. The bearing caps are machined with the block for proper alignment and clearances. The main bearing caps are drilled and tapped for the structural oil pan side bolts.

The aluminum cylinder heads have individual intake and exhaust ports for each cylinder. The valve guides are pressed in. The roller rocker arms are located on a pedestal in a slot in the cylinder head. The roller rocker arms are retained on individual threaded bolts.

The crankshaft is cast nodular iron with deep rolled fillets on all 6 crankpins and all 4 main journals. Four steel-backed aluminum bearings are used. The #3 bearing is the end-thrust bearing.

The camshaft is made from a new metal composite design. The camshaft profile is a hydraulic roller design. The camshaft is supported by 4 journals. The camshaft includes an oil pump drive gear.

The pistons are cast aluminum using 2 compression rings and 1 oil control ring. The piston pin is offset 0.8 mm (0.031 in) towards the major thrust side. This placement allows for a gradual change in thrust pressure against the cylinder wall as the piston travels its path. The pins are chromium steel. The pins have a floating fit in the pistons. The pins are retained in the connecting rods by a press fit.

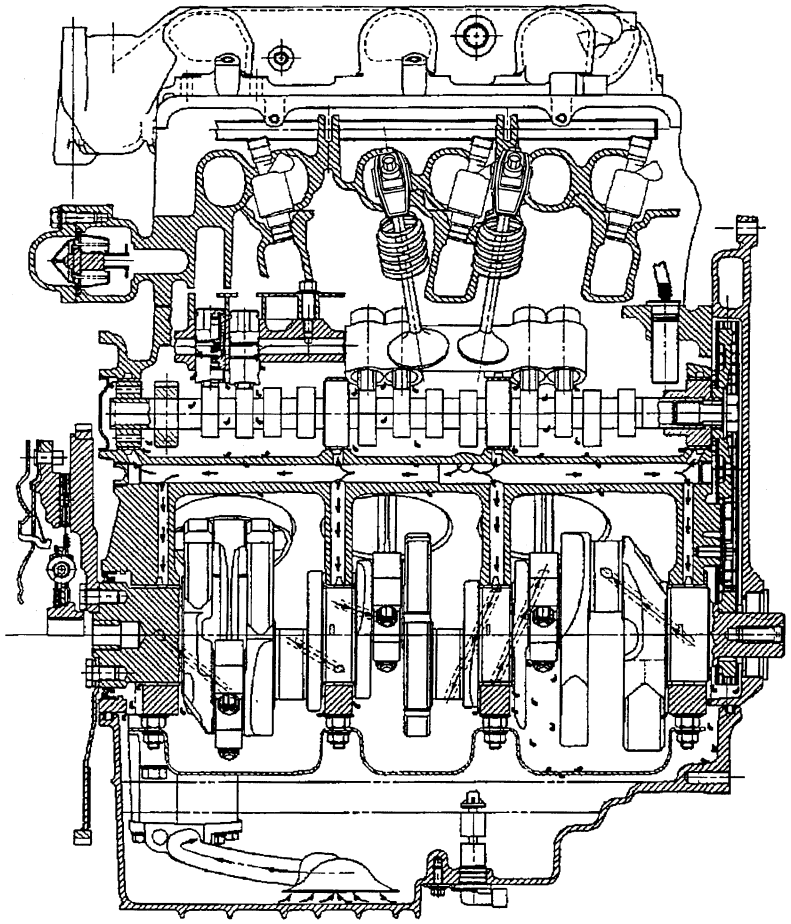
The connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal.

A roller rocker type valve train is used. Motion is transmitted from the camshaft through the hydraulic roller lifter and from the pushrod to the roller rocker arm. The rocker arm pivots on the needle roller bearings. The rocker arm transmits the camshaft motion to the valve. The rocker arm pedestal is located in a slot in the cylinder head. The rocker arm is retained in the cylinder head by a bolt. The pushrod is located by the rocker arm.

The intake manifold is a 2-piece cast aluminum unit. The intake manifold centrally supports a fuel rail with 6 fuel injectors.

The exhaust manifolds are cast nodular iron.

Lubrication



Full pressure lubrication, through a full flow oil filter, is furnished by a gear type oil pump. The oil is drawn up through the pickup screen and the tube. The oil passes through the pump to the oil filter.

The oil filter is a full flow paper element unit. An oil filter bypass is used in order to ensure oil supply during the following conditions:

- On a cold start
- If the filter is plugged
- If the filter develops excessive pressure drop

The bypass is designed to open at 69-83 kPa (10-12 psi).

A new priority oil delivery system supplies oil first to the crankshaft journals. The oil from the crankshaft main bearings is supplied to the connecting rod bearings by intersecting the passages drilled in the crankshaft. The passages supply the oil to the crankshaft main bearings and the camshaft bearings through the intersecting vertical drilled holes. The oil passages from the camshaft journals supply oil to the hydraulic lifters.

The hydraulic lifters pump oil up through the pushrods to the rocker arms. The cast dams in the crankcase casting direct the oil that drains back from the rocker arms in order to supply the camshaft lobes. The camshaft chain drive is lubricated by indirect oil splash.

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.

Engine Cooling

Fastener Tightening Specifications

Application	Specification	
	Metric	English
A/C Condenser Mounting Bolts	6 N·m	53 lb in
A/C Condenser Tube Clip Bolt	2.5 N·m	22 lb in
Coolant Heater Bolt/Screw	2 N·m	18 lb in
Coolant Fan Heat Shield Screws	4 N·m	53 lb in
Cooling Fan Motor Screws	6 N·m	53 lb in
Cooling Fan Nut	6 N·m	53 lb in
Cooling Fan Shroud Bolts	6 N·m	53 lb in
Discharge Hose to Condenser Nut	16 N·m	12 lb ft
Engine Mount Strut Nut	48 N·m	35 lb ft
Engine Mount Strut Bracket Bolt -- Upper Radiator Support	28 N·m	21 lb ft
Evaporator Inlet Tube to Condenser Bolt	16 N·m	12 lb ft
Primary Hood Latch at Support Bolts	25 N·m	18 lb ft
Radiator Bracket Bolts	24 N·m	18 lb ft
Radiator Lower Air Deflector Bolts	20 N·m	15 lb ft
Radiator Upper Mount Bolts	10 N·m	89 lb in
Thermostat Bypass Pipe Bolt	11 N·m	98 lb in
Thermostat Bypass Pipe Nut	25 N·m	18 lb ft
Thermostat Housing Bolts	25 N·m	18 lb ft
Water Pump Bolts	10 N·m	89 lb in
Water Pump Pulley Bolts	25 N·m	18 lb ft

Cooling System Description and Operation

Cooling Fan Control

The engine cooling fan system consists of 2 electrical cooling fans and 3 fan relays. The relays are arranged in a series/parallel configuration that allows the powertrain control module (PCM) to operate both fans together at low or high speeds. The cooling fans and fan relays receive battery positive voltage from the underhood junction block.

During low speed operation, the PCM supplies the ground path for the low speed fan relay through the low speed cooling fan relay control circuit. This energizes the cooling fan 1 relay coil, closes the relay contacts, and supplies battery positive voltage from the cool fan 1 maxifuse® through the cooling fan motor supply voltage circuit to the left cooling fan. The ground path for the left cooling fan is through the cooling fan relay and the right cooling fan. The result is a series circuit with both fans running at low speed.

During high speed operation the PCM supplies the ground path for the cooling fan 1 relay through the low speed cooling fan relay control circuit. After a 3-second delay, the PCM supplies a ground path for the cooling fan 2 relay and the cooling fan relay through the high speed cooling fan relay control circuit. This energizes the cooling fan relay coil, closes the relay contacts, and provides a ground path for the left cooling fan. At the same time the cooling fan 2 relay coil is energized closing the relay contacts and provides battery positive voltage from the cool fan 2 maxifuse® on the cooling fan motor supply voltage circuit to the right cooling fan. During high speed fan operation, both engine cooling fans have there own ground path. The result is a parallel circuit with both fans running at high speed.

Engine Coolant Indicators

Hot Coolant Temp

The IPC illuminates the hot coolant temperature indicator in the message center when the IPC determines that the coolant temperature is greater than 128°C (262°F).

Coolant Level Control

The engine cooling system contains an engine coolant level module which alerts the driver in the event of a coolant loss. The coolant level module sends out a coolant loss signal over the low coolant level indicator control circuit via the underhood accessory wiring junction block. If the coolant level module reads a low coolant level in the cooling system, the switch closes. The instrument cluster has a coolant level warning indicator.

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
Battery Hold Down Bolt	18 N·m	13 lb ft
Battery Negative Terminal Bolt	15 N·m	11 lb ft
Battery Negative Cable Bolt to Frame Rail	8 N·m	71 lb in
Battery (Positive) Cable Junction Block Lead Nut	15 N·m	11 lb ft
Battery Positive Terminal Bolt	15 N·m	11 lb ft
Battery Tray Bolts	5 N·m	44 lb in
Generator Pulley Shaft Nut	100 N·m	74 lb ft
Starter Bolt(s)	43 N·m	32 lb ft
Starter Solenoid BAT Terminal Nut	9.5 N·m	89 lb in
Starter Solenoid S Terminal Nut	2.3 N·m	20.5 lb in
Underhood Accessory Wiring Juntion Block Nuts	2 N·m	18 lb in
Transaxle Stud Nut	25 N·m	18 lb ft
Generator Bolt (Long)	50 N·m	37 lb ft
Generator Bolt (Short)	50 N·m	37 lb ft
Generator Output BAT Terminal Nut	20 N·m	15 lb ft
Generator Pivot Bolt	50 N·m	37 lb ft
Generator Rear Brace Nut	25 N·m	18 lb ft

Battery Usage

Application	Specification
3.4L LA1	
Cold Cranking Amperes	600 A
Reserve Capacity Rating	115 min
Replacement Battery Number	78-6YR

Starter Motor Usage

Application	Model
LA1	PG260 D

Generator Usage

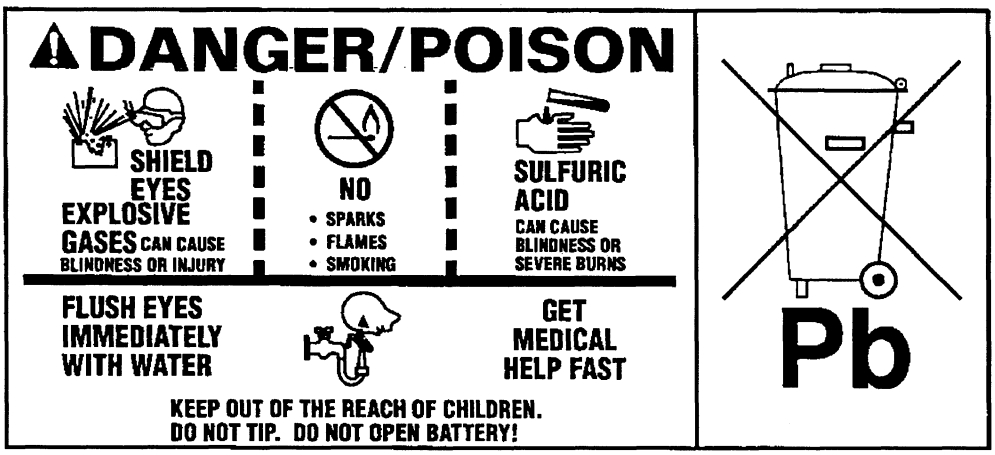
RPO K68	
Application	**Specification**
Generator Model	SG10
Rated Output	105 A
Load Test Output	70 A
RPO KG9	
Application	**Specification**
Generator Model	SG12
Rated Output	125 A
Load Test Output	87.5 A

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.**



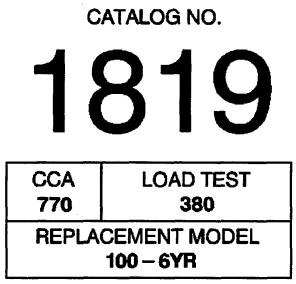
The maintenance free battery is standard. There are no vent plugs in the cover. The battery is completely sealed except for two small vent holes in the side. These vent holes allow the small amount of gas that is produced in the battery to escape.

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] starter motors are [non-]repairable starter motors. They have 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 protects the armature from excessive speed until the switch is opened.

When the ignition switch is released from the START position, crank 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 BOSCH generator is electrically similar to earlier models. 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

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 B+ voltage that is Hot At All Times through the DIM fuse in the rear fuse block. This voltage is used by the regulator as the reference for system voltage control.

When the ignition switch is turned to RUN, the charge indicator turns on for a few seconds (bulb check), then turns off. The powertrain control module (PCM) commands the bulb of the charge indicator on by

sending a Class 2 serial data line message to the instrument panel cluster when the PCM detects a charging system problem.

Engine Controls

Engine Controls – 3.4L

Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-2-3-4-5-6	
Spark Plug Wire Resistance	9868ohms per meter (3000ohms per ft)	
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Gap	1.52 mm	.060 in
Spark Plug Type	41-940	

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Cable Bracket Retaining Bolts	13 N·m	115 lb in
Accelerator Cable Bracket Retaining Nut	10 N·m	89 lb in
Accelerator Pedal Bolt	5 N·m	44 lb in
Air Cleaner Duct Clamps	2 N·m	18 lb in
Air Cleaner Housing Bolts	10 N·m	89 lb in
(AIR) Shut-Off Valve Pipe Adapter Fasteners	30 N·m	22 lb ft
Camshaft Position (CMP) Sensor Retaining Bolt	8 N·m	71 lb in
Crankshaft Position 7X (CKP) Sensor Bolts	11 N·m	97 lb in
Crankshaft Position 24X (CKP) Sensor Bolts	10 N·m	89 lb in
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
(EVAP) Canister Bracket Retaining Nut	9 N·m	80 lb in
EVAP Canister Purge Valve Bracket	10 N·m	89 lb in
Exhaust Gas Recirculation EGR Gasket Nut	25 N·m	18 lb ft
Exhaust Gas Recirculation Pipe Assembly to EGR Valve Bolt	25 N·m	18 lb ft
Exhaust Gas Recirculation Valve to Throttle Body Adapter Bolts	30 N·m	22 lb ft
Fuel Filler Pipe Attaching Nut	10 N·m	89 lb in
Fuel Filler Pipe Attaching Screw	25 N·m	18 lb ft
Fuel Filter Mounting Bracket Nut	10 N·m	89 lb ft
Fuel Pressure and Return Pipes	17 N·m	13 lb ft
Fuel Pressure Regulator Attaching Bolt	8.5 N·m	76 lb in
Fuel Rail Attaching Nuts or Bolts	10 N·m	89 lb in
Fuel Tank Filler Pipe Hose Clamp	2.5 N·m	22 lb in
Fuel Tank Retaining Strap Bolts	47.5 N·m	35 lb ft
Heated Oxygen Sensors HO2S	41 N·m	30 lb ft
Idle Air Control IAC Valve Attaching Screws	3 N·m	27 lb in
Ignition Coil to Ignition Control Module ICM Screws	4.5 N·m	40 lb in
Knock Sensor KS	19 N·m	14 lb in
Manifold Absolute Pressure (MAP) Sensor Retaining Bolt	3 N·m	27 lb in
Secondary AIR Injection Check Valve Bracket Nut	10 N·m	89 lb in
Secondary AIR Injection Check Valve Mounting Bolt	20 N·m	15 lb ft
Secondary AIR Injection Crossover Pipe Fastener	9 N·m	80 lb in
Secondary AIR Injection Pipe Nut	10 N·m	89 lb in
Secondary AIR Injection Pipe Adapter	30 N·m	22 lb ft
Secondary AIR Injection Pump Bracket Bolt	50 N·m	37 lb ft
Secondary AIR Injection Vacuum Bleed Valve Bracket Nut	10 N·m	89 lb in
Spark Plugs	15 N·m	11 lb ft

Application	Specification	
	Metric	English
Throttle Body Retaining Nuts or Bolts	28 N·m	21 lb ft
Throttle Position TP Sensor Screws	2 N·m	18 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 gasoline. 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 it is bad enough, it can damage your engine.

If you're using fuel rated at 87 octane or higher and you hear heavy knocking, your engine needs service. Don't worry if you hear a little pinging noise when you're accelerating or driving up a hill. That is normal and you don't have to buy a higher octane fuel to get rid of pinging. It is the 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 to meet California Emission Standards (indicated on the under hood emission control label), it 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 it is determined that the cause of the condition is the type of fuels used, repairs may not be covered by your warranty.

Some gasoline 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.

Exhaust System

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Catalytic Converter Bolt	34 N·m	25 lb ft
Catalytic Converter Hanger Bolt	35 N·m	26 lb ft
Exhaust Crossover Heat Shield Bolt	10 N·m	89 lb in
Exhaust Crossover Pipe Stud/Nut	25 N·m	18 lb ft
Exhaust Manifold Heat Shield Bolt	10 N·m	89 lb in
Exhaust Manifold Nut	16 N·m	12 lb ft
Exhaust Manifold Pipe Nut	35 N·m	26 lb ft

Exhaust System Description

Important

Use of non-OEM parts may cause driveability concerns.

The exhaust system design varies according to the model designation and the intended use of the vehicle.

In order to secure the exhaust pipe to the exhaust manifold, the exhaust system utilizes a flange and seal joint coupling. A flange and gasket coupling secures the catalytic converter assembly to the muffler assembly.

Hangers suspend the exhaust system from the underbody, allowing some movement of the exhaust system and disallowing the transfer of noise and vibration into the vehicle.

Heat shields protect the vehicle from the high temperatures generated by 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 – 4T65E

Transmission General Specifications

Name	Hydra-matic 4T65-E
RPO Codes	M15 / M76
Production Location	Warren, MI
Vehicle Platform (Engine/Transmission) Usage	U
Transaxle Drive	Transverse Mounted Front Wheel Drive
1st Gear Ratio	2.921:1
2nd Gear Ratio	1.568:1
3rd Gear Ratio	1.000:1
4th Gear Ratio	0.705:1
Reverse	2.385:1
Torque Converter Size (Diameter of Torque Converter Turbine)	245 mm (M15)
Pressure Taps	Line Pressure
Transaxle Fluid Type	DEXRON® III
Transaxle Fluid Capacity (Approximate)	Bottom Pan Removal: 7.0 L (7.4 qts) Complete Overhaul: 9.5 L (10.0 qts) Dry: 12.7 L (13.4 qts)
Transaxle Type: 4	Four Forward Gears
Transaxle Type: T	Transverse Mount
Transaxle Type: 65	Product Series
Transaxle Type: E	Electronic Controls
Chain Ratios (Designates Number of Teeth on the Drive/Driven Sprockets)	35/35
Final Drive Ratios	3.29
Overall Final Drive Ratios	3.29
Position Quadrant	P, R, N, D, 3, 2, 1
Case Material	Die Cast Aluminum
Transaxle Weight Dry	87.9 kg (194.2 lbs)
Transaxle Weight Wet	97.0 kg (214.4 lbs)
Maximum Trailer Towing Capacity	907 kg (2000 lbs)
Maximum Gross Vehicle Weight (GVW)	2903 kg (6,400 lbs)

Fastener Tightening Specifications

Description of Usage	Specification	
	Metric	English
2-1 Servo to Case	25 N·m	18 lb ft
Accumulator Cover to Case	12 N·m	106 lb in
Case Cover to Case	12 N·m	106 lb in
Case Cover to Case	12 N·m	106 lb in
Case Cover to Driven Sprocket Support	25 N·m	18 lb ft
Case Cover to Driven Sprocket Support (TORX®)	12 N·m	106 lb in
Case to Drive Sprocket Support	25 N·m	18 lb ft
Case Extension to Case	36 N·m	26 lb ft
Case Side Cover to Case	25 N·m	18 lb ft
Case Side Cover to Case (Stud)	25 N·m	18 lb ft
Case Side Cover to Case (TORX® Special)	25 N·m	18 lb ft
Detent Spring to Case Cover	12 N·m	106 lb in
Forward Band Servo Cover to Case	12 N·m	106 lb in
Manual Shaft/Detent Nut	32 N·m	23 lb ft
Oil Cooler Quick Connector	38 N·m	28 lb ft
Oil Cooler Quick Connector with Checkball	38 N·m	28 lb ft
Oil Pan to Case	14 N·m	10 lb ft
Oil Pressure Test Hole Plug	12 N·m	106 lb in
Pump Body to Case	16 N·m	11 lb ft
Pump Cover to Case Cover	12 N·m	106 lb in
Pump Cover to Pump Body	8 N·m	70 lb in
Speed Sensor to Case	12 N·m	106 lb in
TFP Switch to Case	16 N·m	11 lb ft
TFP Switch to Case Cover	12 N·m	106 lb in
TFP Switch to Valve Body	8 N·m	70 lb in
Transaxle Brace Bolts to Engine	43 N·m	32 lb ft
Transaxle Brace Bolts to Transaxle	43 N·m	32 lb ft
Transaxle Mount Bracket Bolts	95 N·m	70 lb ft
Transaxle Mount Lower Nuts to Transaxle Mount Frame Bracket	47 N·m	35 lb ft
Transaxle Mount Upper Nuts	47 N·m	35 lb ft
Valve Body to Case	12 N·m	106 lb in
Valve Body to Case	12 N·m	106 lb in
Valve Body to Case Cover	12 N·m	106 lb in
Valve Body to Case Cover	12 N·m	106 lb in
Valve Body to Case Cover (TORX®)	12 N·m	106 lb in
Valve Body to Driven Sprocket Support	25 N·m	18 lb ft

Fluid Capacity Specifications

Application	Specification	
	Metric	English
Bottom Pan Removal (2WD)	7.0 L	7.4 qt
Bottom Pan Removal (AWD)	7.4 L	7.8 qt
Complete Overhaul (2WD)	9.5 L	10.0 qt
Complete Overhaul (AWD)	9.9 L	10.4 qt
Dry (2WD)	12.7 L	13.4 qt
Dry (AWD)	13.1 L	13.8 qt

Transmission Component and System Description

Transmission General Description

The 4T65-E is a fully automatic front wheel drive electronically controlled transmission. The 4T65-E provides four forward ranges including overdrive. The PCM controls shift points by means of two shift solenoids. A vane-type oil pump supplies the oil pressure. The PCM regulates oil pressure by means of a pressure control solenoid valve.

All vehicles equipped with a 4T65-E transmission have an electronically controlled capacity clutch (ECCC) system. In the ECCC system, the pressure plate does not fully lock to the torque converter cover. It is instead, precisely controlled to maintain a small amount of slippage between the engine and the turbine, reducing driveline torsional disturbances.

You can operate the transmission in any one of the following seven modes:

- P -- Park position prevents the vehicle from rolling either forward or backward. For safety reasons, use the parking brake in addition to the park position.
- R -- Reverse allows the vehicle to be operated in a rearward direction.
- N -- Neutral allows the engine to be started and operated while driving the vehicle. If necessary, you may select this position in order to restart the engine with the vehicle moving.
- D -- Overdrive is used for all normal driving conditions. Overdrive provides four gear ratios plus a converter clutch operation. Depress the accelerator in order to downshift for safe passing.
- 3 -- Drive position is used for city traffic and hilly terrain. Drive provides three gear ranges and drive range prevents the transmission from operating in fourth gear. Depress the accelerator in order to downshift.
- 2 -- Manual Second provides two gear ratios under most operating conditions. Manual Second provides acceleration and engine braking. Select this range at any vehicle speed, but the transmission will not downshift into Second gear until the vehicle speed drops below approximately 100 km/h (62 mph)
- 1 -- Manual Lo provides maximum engine braking. You may also select this range at any vehicle speed, but the transmission will not downshift into First gear until the vehicle speed drops below approximately 60 km/h (37 mph).

Mechanical Componants

The mechanical components of this unit are as follows:

- A torque converter with an Electronically Controlled Capacity Clutch (ECCC)
- A drive link assembly
- 4 multiple disk clutch assemblies: Input, Second, Third and Fourth
- 3 friction bands: Forward band, 2/1 band and Reverse band
- 2 planetary gear sets: Input and Reaction
- 3 one-way clutches: a roller clutch (1-2 support) and 2 sprag clutches (Third and Input)
- A final drive and differential assembly
- A control valve assembly
- A vane type oil pump

The electrical components of this unit are as follows:

- 2 shift solenoid valves
- A torque converter clutch pulse width modulation (TCC PWM) solenoid valve
- A pressure control (PC) solenoid valve
- An automatic transmission fluid temperature (TFT) sensor
- 2 speed sensors: input shaft and vehicle speed sensors
- An automatic transmission fluid pressure (TFP) manual valve position switch
- Either an Internal Mode Switch or an exterior-mounted Transmission Range Switch.
- An automatic transmission (A/T) wiring harness assembly

Adapt Function

The 4T65-E transmission uses a line pressure control system, that has the ability to adapt line pressure to compensate for normal wear of the following parts:

- The clutch fiber plates
- The springs and seals
- The apply bands

The PCM maintains information for the following transmission adaptive systems:

Upshift Adapts (1-2, 2-3 and 3-4)

The PCM monitors the automatic transmission input shaft speed (AT ISS) sensor and the vehicle speed sensor (VSS) in order to determine when an upshift has started and completed. The PCM measures the time for the upshift. If the upshift time is longer than a calibrated value, then the PCM will adjust the current to the pressure control (PC) solenoid valve to increase the line pressure for the next shift in the same torque range. If the upshift time is shorter than the calibrated value, then the PCM will decrease the line pressure for the next shift in the same torque range.

Steady State Adapts

The PCM monitors the AT ISS sensor and the VSS after an upshift in order to determine the amount of clutch slippage. If excessive slippage is detected, then the PCM will adjust the current to the PC solenoid valve in order to increase the line pressure to maintain the proper gear ratio for the commanded gear.

The TAP information is divided into 13 units, called cells. The cells are numbered 4 through 16. Each cell represents a given torque range. TAP cell 4 is the lowest adaptable torque range and TAP cell 16 is the highest adaptable torque range. It is normal for TAP cell values to display zero or negative numbers. This indicates that the PCM has adjusted line pressure at or below the calibrated base pressure.

Automatic Transmission Shift Lock Control Description

The automatic transmission shift lock control system is a safety device that prevents an inadvertent shift out of PARK when the engine is running. 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 body control module (BCM).
- The powertrain control module (PCM).

With the ignition in the ON position, battery positive voltage is supplied 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 body control module (BCM) provides a ground for the automatic transmission shift lock control solenoid when the transmission is in the PARK position. The body control module (BCM) receives the transmission gear position information via class2 serial data from the powertrain control module (PCM). This causes the automatic transmission shift lock control solenoid to energize and lock the shift lever in the PARK position. When the driver presses the brake pedal, the contacts in the automatic transmission shift lock control switch open. This causes the automatic transmission shift lock control solenoid to release. This allows the shift lever to move from the PARK position. The body control module (BCM) turns off the automatic transmission shift lock control solenoid ground circuit when the transmission is out of the PARK position.

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

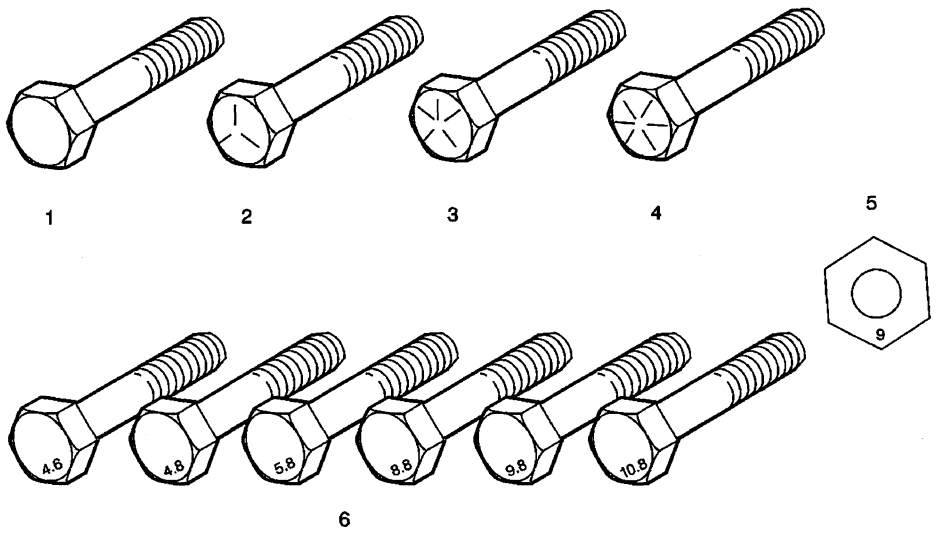
Metric Fasteners

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

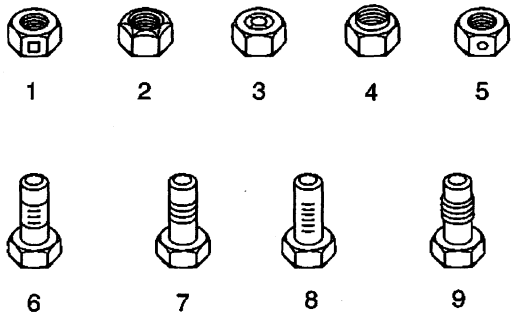
These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

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