Chevrolet

Cavalier

2004

Table of Contents

Product Information

2004 Cavalier Debuts A Fresh New Look, New Safety Features

With standard features and options that customers expect with luxury vehicles, the 2004 Cavalier continues appealing to young people who want to make a statement and appreciate its dollar-for-dollar performance.

Now with a sport appearance package available to all buyers and two new sporty exterior colors, the Cavalier is positioned as an affordable car that can be customized to fit every driver's personality.

The value equation continues with OnStar and XM Satellite Ratio (continental U.S. only) - options familiar to luxury-car owners. The Ecotec 2.2L I-4 continues to deliver an economical 140 hp (100 kw) to all models.

Audiophile options

Young people like their tunes, and the 2004 Cavalier offers even more ways for buyers to indulge their tastes. New for 2004 is an optional CD/MP3 player that plays whatever music is thrown at it.

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.

Fresh, stylish exterior

An exterior that had ground effects, front fascia with fog lamps, rear fascia, headlamps, taillamps and hood freshened just a year ago keeps the Cavalier contemporary. The new design sports Chevy's new gold bowtie in front and now for 2004, the gold bowtie graces the rear end, too, replacing a silver bowtie.

Cavalier also offers chrome aluminum wheels, specific body-color door handles, body-color exterior mirror housings for power mirrors, leather-wrapped transmission shift knob, steering wheel and high profile rear spoiler. The sportier, more customizable appearance that results complements the rest of the Chevy car lineup.

Cavalier for 2004 also features two new colors: Rally Yellow and Sunburst Orange Metallic. Yellow is discontinued.

Safety features

Cavalier now offers a center rear three-point seat belt, and optional front driver and passenger seat-mounted torso air bags with thorax protection (side impact air bags). OnStar continues as an option for the LS and LS Sport models.

OnStar is the leading provider of in-vehicle safety, security and information services in the U.S. and Canada. Using the Global Positioning System (GPS) satellite network and wireless technology, OnStar services include automatic notification of air bag deployment, stolen vehicle location, remote door unlock, emergency services dispatch, roadside assistance, remote diagnostics, route support, convenience services and OnStar Concierge. OnStar Personal Calling allows drivers to make and receive hands-free, voice-activated phone calls through a nationwide network in cooperation with Verizon Wireless. Virtual Advisor (U.S. only) gives subscribers access to personalized information in a hands-free, voice-activated manner with no screens or displays.

Cavalier also features GM's LATCH (Lower Anchors and Tethers for CHildren) system, which can be combined with a top shelf tether to enable adults to securely install LATCH-compatible child seats without using a seatbelt. Rear child seat anchors are located in the floorpan with an attachment at the juncture of seat cushion and seat back, taking the worry and guesswork out of child safety seat installation.

Ecotec 2.2L standard

The sporty and economical Ecotec 2.2L I-4 aluminum engine is the only engine available across the Cavalier line. It is mated with a standard five-speed manual or the optional Hydra-Matic 4T40-E four-

speed automatic transmission. The Ecotec engine features dual overhead camshafts with four valves per cylinder for excellent response in city driving and confident passing and merging on the highway.

Quiet operation is one of the engine's chief features. Twin balance shafts located in the cylinder block cancel the shaking forces inherent in an inline four-cylinder engine, resulting in an engine that is smooth from idle to maximum engine speed. The Ecotec 2.2L generates 140 hp (100 kw) at 5600 rpm. Other features that help make the twin cam smooth and quiet include a die-cast lower crankcase and a structural cast-aluminum oil pan, which stiffen the block and reduce radiated engine noise. The engine also features an isolated cam cover that reduces the transmission of valvetrain noise.

FE2 sport suspension

The FE2 sport suspension system offers excellent handling and road feel for both LS models. The sport suspension provides flatter, more precise cornering, more driver feedback, and better communication between car and driver. Front and rear sway bars stiffen the ride. The suspension system is mated to performance tires for better control and a five-speed manual transmission is standard. The stainless steel exhaust system, with a polished chrome exhaust outlet, offers high corrosion resistance - and good looks.

New For 2004

- Rear gold bowtie appliqué replaces silver crossbar appliqué
- Exterior colors: Rally Yellow, Sunburst Orange Metallic; Yellow dropped
- Optional CD/MP3 radio
- Optional smokers package
- Optional engine block heater
- Optional Sport Appearance Package available on base model

Model Lineup

	Engine	Transmissions	
	Ecotec 2.2L L4	**5-spd man (M86 / M94)**	**4-spd auto (Hydra-Matic 4T40-E)**
Base Coupe / Sedan	S	S	O
LS Coupe / Sedan	S	S	O
LS Sport Coupe / Sedan	S	S	O

Standard S
Optional O
Not available –

Specifications

Overview		
Models:	Cavalier, Cavalier LS, Cavalier LS Sport	
Body style / driveline:	5-passenger coupe and sedan, unitized frame, front engine, front-wheel drive, 5 passengers	
Construction:	steel body material	
EPA vehicle class:	compact car	
Manufacturing location:	Lordstown, Ohio	
Key competitors:	Ford Focus, Honda Civic, Dodge Neon	
Engine	**Ecotec 2.2L I-4 (L61)**	
Type:	2.2L DOHC I-4	
Displacement (cu in / cc):	134 / 2189	
Bore & stroke (in / mm):	3.38 x 3.72 / 86 x 94.60	
Block material:	aluminum	
Cylinder head material:	cast aluminum	
Valvetrain:	DOHC, 4 valves per cylinder	
Fuel delivery:	sequential fuel injection	
Compression ratio:	10.0:1	
Horsepower (hp / kw @ rpm):	140 / 100 @ 5600	
Torque (lb-ft / Nm @ rpm):	150 / 203 @ 4000	
Recommended fuel:	87 octane	
Maximum engine speed (rpm):	6500	
Estimated fuel economy (mpg city / hwy / combined):	automatic: 24 / 32 / 28 manual 25 / 33 / 29	
Transmissions	**M86 / M94**	**Hydra-Matic 4T40-E**
Type:	5-speed manual, front-wheel drive	4-speed automatic with overdrive, front-wheel drive
Gear ratios (:1):		
First:	3.58	2.96
Second:	2.02	1.62
Third:	1.35	1.00
Fourth:	0.98	0.68
Fifth:	0.69	-
Reverse:	3.31	2.14
Final drive ratio: 3	.94:1	3.63:1
Chassis/Suspension		
Front:	MacPherson strut suspension with coil spring with 19-mm stabilizer bar. Level II Sport Suspension LS Sport models includes shaped inner-metal bushings on front lower control arms, high-rate front and rear springs, and 24-mm stabilizer bar	
Rear:	training tubular control arms with twist-beam axle, coil-over-shock, 19-mm solid stabilizer bar for LS Sport models	
Steering type:	power rack-and-pinion	
Steering ratio:	coupe or sedan: 14.7:1; LS Sport models: 15.7:1	
Steering wheel turns, lock-to-lock:	coupe or sedan: 2.6; LS Sport models: 2.8	
Turning circle, curb-to-curb (ft / m):	35.6 / 10.9	

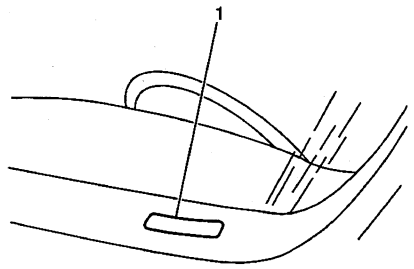
Brakes	
Type:	power-assisted front and rear disc, 4-wheel ABS optional
Rotor diameter x thickness (in / mm):	front: 10.2 x .79 / 260 x 20 rear: 9.06 x 1.57 / 230 x 40
Total swept area (sq in / sq cm):	front: 182.2 / 1176; rear: 86.2 / 556
Wheels/Tires	
Wheel size and type:	• 14-inch x 6-inch full wheel cover (standard on coupe and sedan) • 15-inch x 6-inch full wheel cover (stnd on LS coupe and sedan) • 15-inch x 6-inch aluminum wheel (opt on LS coupe and sedan) • 16-inch x 6-inch chrome finish aluminum wheels (standard on LS Sport models)
Tires:	• P195/70R14 all-season (standard on coupe and sedan) • P195/65R15 all-season touring (stnd on LS coupe and sedan) • P205/55R16 performance (standard on LS Sport models)

Dimensions

Exterior	**Coupe**	**Sedan**
Wheelbase (in / mm):	104.1 / 2644	104.1 / 2644
Overall length (in / mm):	182.7 / 4640	182.7 / 4640
Overall width (in / mm):	68.7 / 1745	67.9 / 1724
Overall height (in / mm):	53 / 1346	54.7 / 1389
Track (in / mm):	front: 57.6 / 1463; rear: 56.4 / 1432	front: 57.6 / 1463; rear: 56.7 / 1440
Curb weight (lb / kg):	2617 / 1188	2676 / 1214
Interior	**Coupe**	**Sedan**
Seating capacity (front / rear):	2 / 3	2 / 3
Head room (in / mm):	front: 37.6 / 956; rear: 36.6 / 929	front: 38.9 / 976; rear: 37.2 / 940
Leg room (in / mm):	front: 41.9 / 1066; rear: 32.7 / 831	front: 41.9 / 1066; rear: 34.4 / 872
Shoulder room (in / mm):	front: 53.9 / 1364; rear: 54.9 / 1394	front: 54.6 / 1388; rear: 53.9 / 1370
Hip room (in / mm):	front: 50 / 1280; rear: 49.5 / 1260	front: 50.8 / 1298; rear: 50.6 / 1278
Capacities	**Coupe**	**Sedan**
EPA interior volume (cu ft / L):	100 / 2840	105 / 2973
Cargo volume (cu ft / L):	13.2 / 375	13.6 / 386
Trailer towing maximum (lb / kg):	1000 / 454	1000 / 454
Fuel tank (gal / L):	14.1 / 53.4	14.1 / 53.4
Engine oil (qt / L):	4 / 3.8	4 / 3.8
Cooling system (qt / L):	9.6 / 9.1	10 / 9.4

Vehicle Identification

Vehicle Identification Number (VIN)



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

Position	Definition	Character	Description
1	Country of Origin	1	U.S.A.
2	Manufacturer	G	General Motors
3	Make	1 2	Chevrolet Pontiac
4-5	Carline/Series	J/C J/F J/H J/B	Cavalier Cavalier, Cavalier Sedan Cavalier, Z24 Sunfire Sedan
6	Body Style	1 5	Two-Door Coupe 37 Four-Door Sedan 69
7	Restraint System	2	Active Manual Belts w/Driver and Passenger Inflatable Restraint System Frontal
8	Engine Type	F	RPO L61, 2.2L, L4, MFI
9	Check Digit	--	Check Digit
10	Model Year	4	2004
11	Plant Location	7	Lordstown, OH
12-17	Plant Sequence Number	--	Plant Sequence Number

VIN Derivative

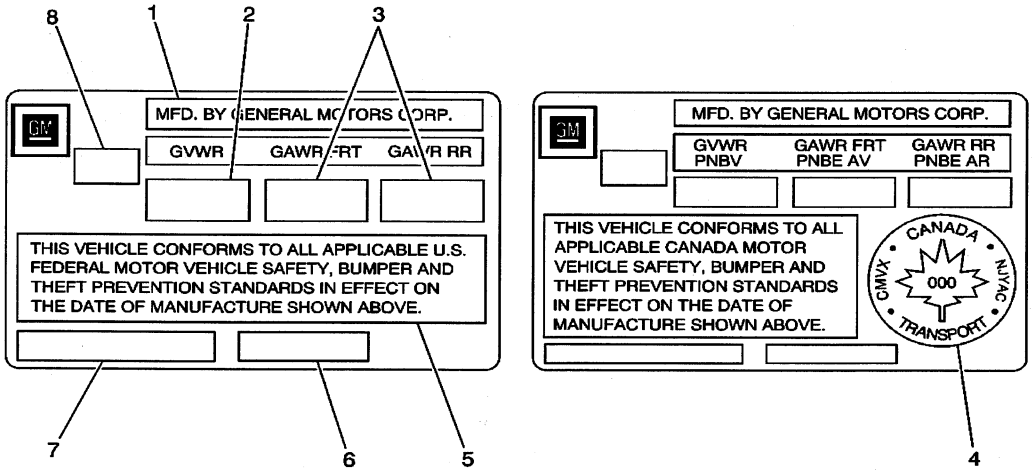
All engines and transmissions are stamped or laser etched with a partial vehicle identification number (VIN), which was derived from the complete VIN. A VIN derivative contains the following nine positions:

Position	Definition	Character	Description
1	GM Division Identifier	1	Chevrolet
		2	Pontiac
2	Model Year	4	2004
3	Assembly Plant	7	Lordstown, OH
4-9	Plant Sequence Number	--	--

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

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

Label Certification



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).

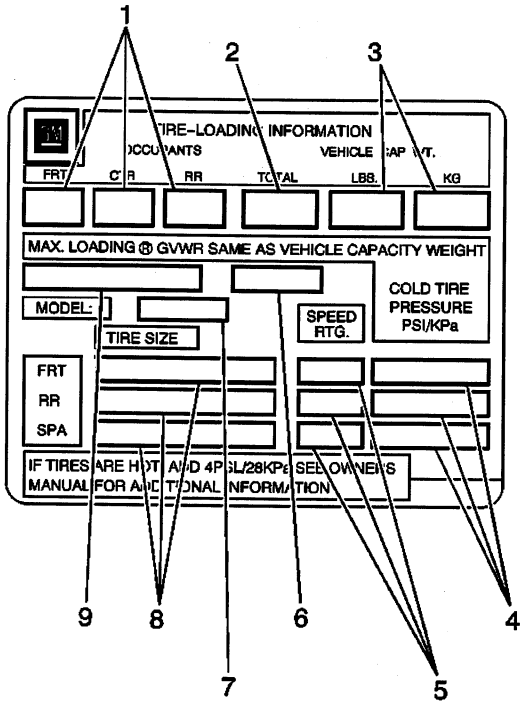
The GVW is the weight of the vehicle and everything the vehicle carries. Include the following items when figuring the GVW:

- 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).

Tire Placard

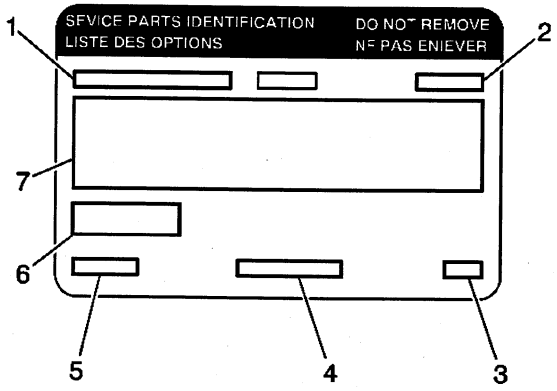


1. Specified Occupant Seating Positions
2. Total Occupant Seating
3. Maximum Vehicle Capacity Weight
4. Tire Pressures, Front, Rear, and Spare
5. Tire Speed Rating, Front, Rear, and Spare
6. Tire Label Code
7. Engineering Model Minus First Character
8. Tire Sizes, Front, Rear, and Spare
9. Vehicle Identification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

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

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

Service Parts Identification Label (SPID)

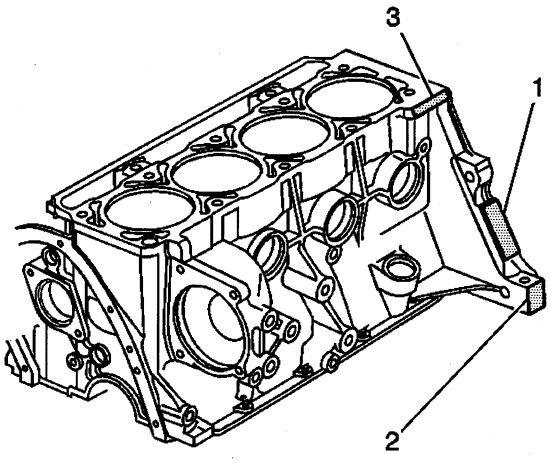


1. Vehicle Identification Number
2. Wheel Base
3. Part Number Location
4. Model Designation
5. Order Number
6. Exterior Color
7. Paint Technology

The service parts identification label is placed on the spare tire cover panel in order to help service and parts personnel identify the vehicle's original parts and the vehicle's original options.

Engine ID and VIN Derivative Location

2.2 L VIN 4 Engine ID Location



The engine code letter is the eight digit of the VIN, which identifies the engine.

Stick-on labels attached to the engine, laser etching, or stamping in the engine block indicate the engine unit number/build code date.

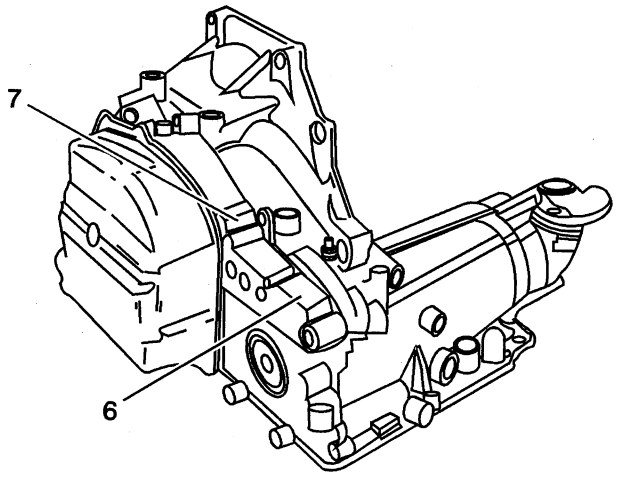
The primary location for the engine ID is on front of the rocker cover (1) for the 2.2 L (L61) engine.

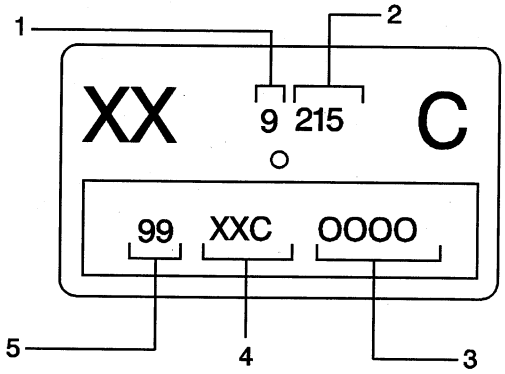
The primary location for the engine ID is on top of the rocker cover (1) for the 2.2 L (LN2) engine.

The primary (2) and secondary (3) hand stamp locations for the Vehicle Identification Number (VIN).

Transmission ID and VIN Derivative Location

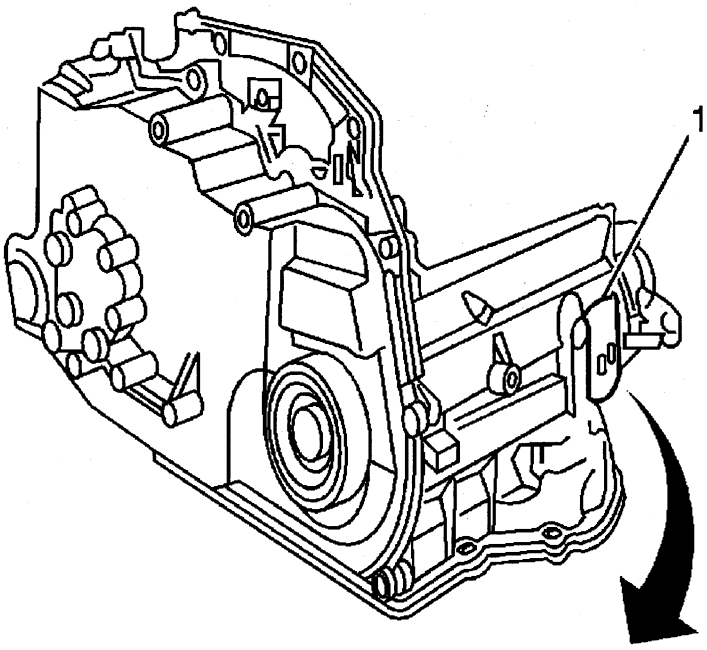
3T40 Transmission ID Location

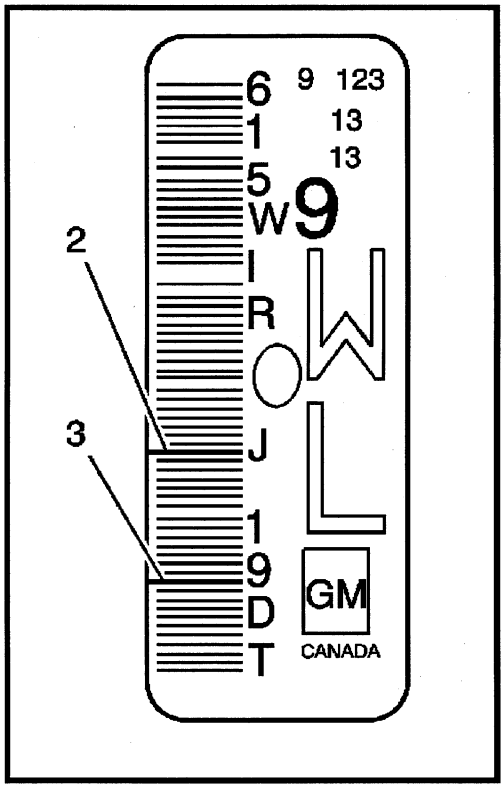




1. Calendar Year
2. Julian Date
3. Serial Number
4. Model
5. Model Year
6. Transmission ID Location
7. VIN Location

4T40E Transmission ID Location

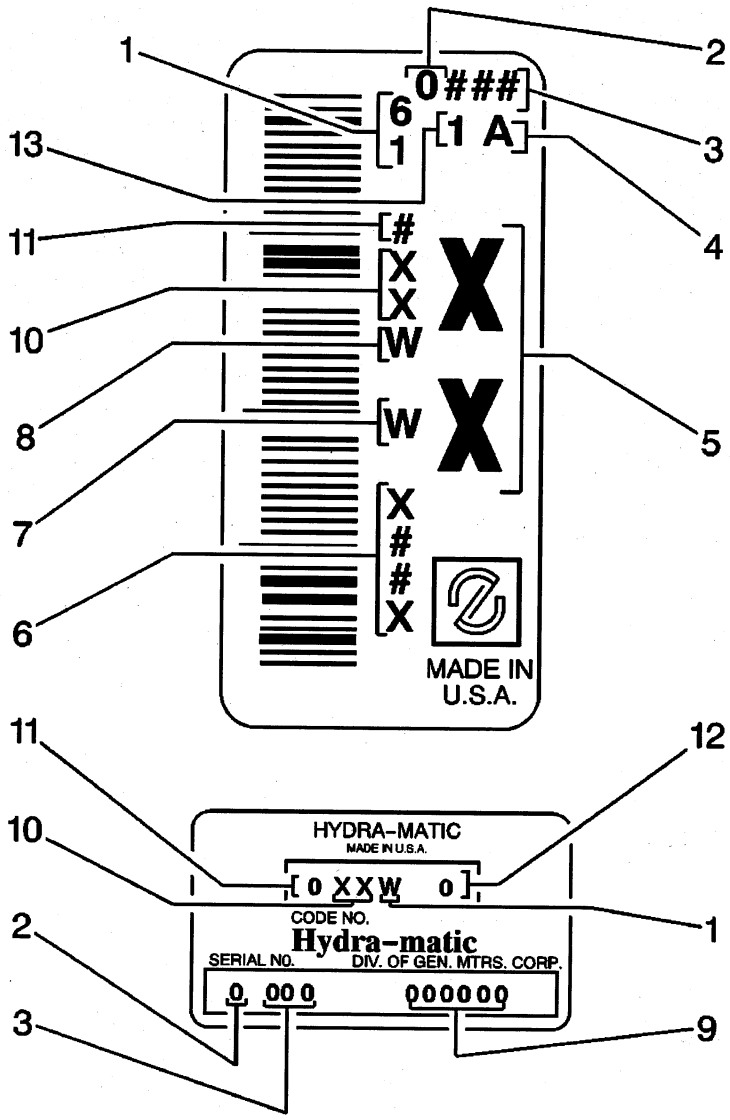




1. Goodwrech Tag Location
2. Remanufacturing Site Code
3. Serial Number

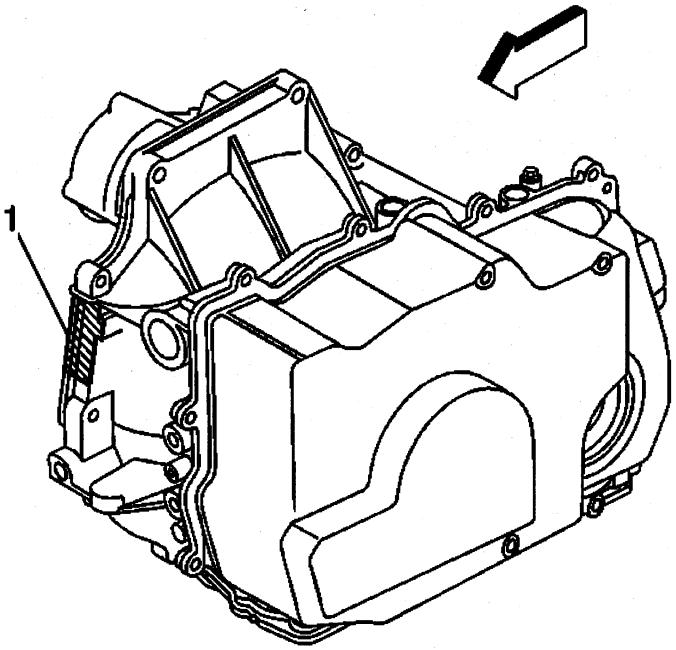
Automatic Transmission ID Nameplate

All automatic transmissions have a metal identification (ID) nameplate (1) attached to the case exterior.



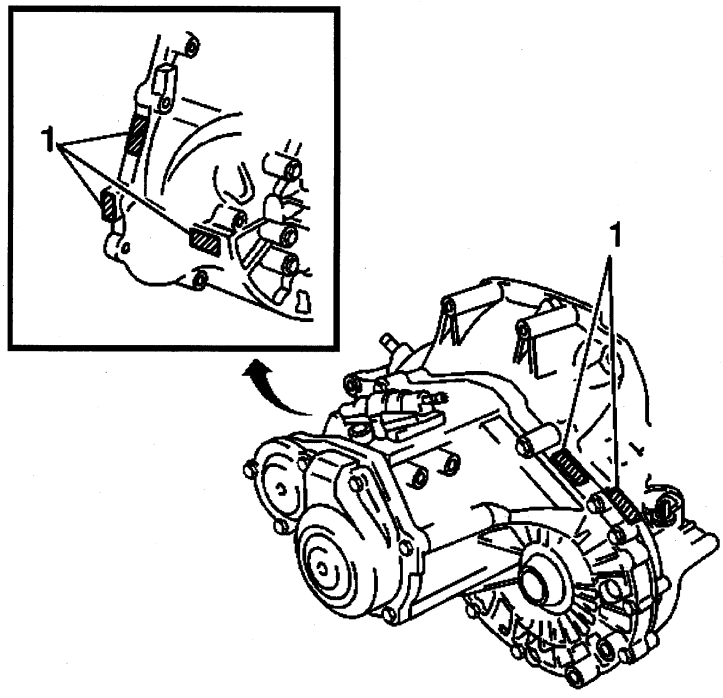
1. Transaxle
2. Calendar Year
3. Julian Date or Day of the Year
4. Shift (A=First Shift, B=Second Shift, C=Third Shift)
5. Model
6. Serial Number in Base Code 31
7. Plant
8. Hydramatic 4T40 E
9. Serial Number
10. Model
11. Model Year
12. Control Number
13. Line Built (1=Line 1, 2=Line 2, 3=Line 3, 4=Line 4)

VIN Derivative Location 4T40/4T45-E



The Location of the Vehicle Identification Number (VIN) Derivative (1).

Getrag 5T45-E Transmission VIN Location, M86



The various possible locations for the Getrag Vehicle Identification Number (VIN) Derivative.(1)

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
AF5	Easy Entry Seat Adjuster; Passenger Side
AJ7	Restraint System Seat, Inflatable, Driver and Passenger, Front and Side
AK5	Restraint System Front Seat, Inflatable, Driver and Passenger
AM7	Seat, Right Rear, Folding
AP9	Net, Convenience
AR9	Seats; Bucket, Reclining
AS5	Seats; Deluxe Bucket, Reclining, with Driver Lumbar Adjust, Seat Back Pocket, Firmer Side Bolsters
AU0	Remote Keyless Entry
AU3	Power Door Locks
A31	Window Power Operated, Side
BW2	Molding B/S Deluxe
BW8	Ornamentation Exterior, Emblem, Body, Rear
B20	Ornamentation Interior, Luxury
B25	Trim Equipment Luggage Compartment, Deluxe
B37	Covering Floor Mats, FRT & RR AUX
CD4	Wiper System Windshield, Pulse
CF5	Roof Sun, Glass, Sliding, ELEC
C41	HVAC, Heater System Outside Air, With Fan
C49	Defogger, Rear Window Electric
C60	HVAC, Air Conditioner Front Manual Controls
C95	Lamp Interior, Roof, Courtesy and Dual Reading
DC4	Mirror, Inside Rearview, Tilt, Dual Reading Lamps
DG7	Mirror, Outside, Remote Control, Electric, Color
DL5	Decal Roadside Service Information
DT3	Box Rear Storage Compartment
DT4	Ashtray Cigarette Lighter
D34	Mirror I/S FRT Van LH and RH, Sunshade, No Illumination
D35	Mirror, Outside Remote Control, Color
E02	Equipment, Additional, Caribbean Countries
FE1	Suspension System, Soft Ride
FE2	Suspension System, Ride Handling
FX1	Ratio Transaxle Final Drive, 3.94
FX2	Ratio Transaxle Final Drive, 3.91
JM4	Brake System Power, Front Disc, Rear Drum, Cast Iron, Antilock, Front and Rear Wheel
J41	Brake System PWR, FRT Disc, RR Drum, Cast Iron
KL6	Provision Natural Gas
KO5	Engine Block Heater
K34	Cruise Control Automatic, Electronic
K62	Generator, CS 130-D, 105 Amp, Dual Internal Fan
LOD	Plant Code Lordstown, OH, BOC
L42	Engine Flexible Fuel, 2.2L, Gas CNG, MFI, DOHC, ALUM
L61	Engine Gas, 4 CYL, 2.2L, MFI, ALUM, DOHC
MM5	Merchandised TRANS MAN 5 SPD Provisions
MN4	Transmission, Automatic 4 Speed, 4T40E
MX0	Merchandised TRANS AUTO Provisions, O/D
M86	Transmission, 5 SPD. OPEL, F23, 5T45MI

NB5	Exhaust System Single
NC1	Emission System California, LEV
NF9	Emission System General, Unleaded
NN5	Emission Override California System, Federal Offset Vehicle
NP5	Steering Wheel Leather Wrapped
NT9	Emission System Federal, Tier 2 Phase-Out
NU4	Emission System California LEV2 Plus
NW7	Traction Control; Powertrain MGMT Only
N10	Exhaust System Dual
N33	Steering Column Tilt Type
N46	Steering Wheel; Deluxe Urethane, w/SIR
PA5	Hubcaps Wheel
PB1	Wheel Cover, 15 Inch
PB7	Wheel, 14 X 6, Painted
PC1	Wheel, 14 x 6, Steel
PFC	Wheel, 16 x 6, Aluminum, Chrome
PFD	Wheel, 16 X 6, Aluminum, Machined Face
PF7	Wheel, 15 x 6, Aluminum Cast, Styled
PGO	Wheel, 16 x 6, Aluminum, Styled
PG1	Wheel, 14 x 6, Steel
P96	Equipment Mexican Modification Mandatory Base Equipment
QFB	P195/70 R14 All Season, Black Wall Tires
QJN	Tire All P205/60R15-90H BW R/ST TL ALS
QLG	P205/55 R16 Performance; Black Wall Tire
QPD	P195/65 R15 Touring; Black Wall Tires
RPA	Rear Parking Assist
SAL	Plant Code Ramos Arizpe, Mexico, GM DE Mexico
SVA	Holder Cup
TR2	Lamp Turn Signal, Enlarged
TW4	Package Cavalier Low-Priced
T43	Spoiler Rear
T7N	Parts PKG Miscellaneous Parts For Police PKG
T7P	Equipment MISC EQUIP Chile
T7V	Fire Extinguisher 2 KG Dry Chemical
T79	Fog Lamp, Rear
T84	Headlamps Right Hand Rule of the Road, E Mark
UA6	Theft Deterrent System
UD4	Alarm Vehicle Speed, 120 K/H
UE1	Communication System Vehicle, G.P.S. 1
UH8	Cluster Instrument, Cool Temp, Trip ODOM, Tach
UL2	European Frequencies
UM6	Radio, AM/FM Stereo Seek/Scan, Auto Reverse, Cassette, Clock
UM7	Radio, AM/FM Stereo, Seek/Scan, Clock, ETR
UN0	Radio, AM/FM Stereo, Seek/Scan, CD, Auto Tone, Clock, ETR
UQ3	Speaker System Performance Enhanced Audio
US6	Antenna Fixed, Painted, Radio
US8	Radio, AM/FM Stereo, Seek/Scan, CD, Auto Tone, Clock ETR, MP3, RDS
UW6	6 Speaker System, Dual F/D Tweet and Woof, Dual Extended Range Shelf
UX7	Speaker System 4, Dual Front Door Mounted, Dual Extended Range Package Shelf
U05	Horn Dual
U1C	Radio, AM/FM Stereo, Seek/Scan, Compact DISC, Clock, ETR
U19	Speedometer INST, KILO and Miles, KILO Odometer
U2E	Cluster INST, Cool TEMP, Trip ODOM

U2K	Digital Audio System S-Band
U25	Lamp Interior, Rear Compartment, Courtesy
U79	Speakers (4), 2 Rear Shelf, 1 Coaxial Per Door
U85	Speakers System 8, QUAD FRT DR MTD, Shelf QUAD, Amplifier
VBX	Language Label, Arabic
VB1	Label Shipping, Japan
VC4	Label Price/Fuel Economy Puerto Rico and Virgin Islands
VC5	Label Shipping, Except US, US Possessions, or Japan
VC7	Label Price/Fuel Economy, Guam
VG8	Vehicle Label, Notice to Buyer
VG9	Protector Wax, Exterior Body
VH4	Front Mud Guards
VH5	Plate Vehicle Identification
VH9	Envelope Owner Information Manual
VK3	License Plate Front FRT Mounting PKG
VK4	License Plate Front FRT Fascia Cover
VP6	Noise Control
VR6	Hook Tie Down
VT7	Owners Manual, English Language
VY7	Leather Shift Knob
V1A	Plant Operation Painted Exported Brake Rotors
V1G	Plant Operation Chevy Decklid Nameplate
V1H	Plant Operation Hood Blanket
V3C	Plant Operation Non-Asbestos Brake Linings
WE4	Door, Dynamic, Side Impact
Y73	Parts PKG Deluxe Headliner
WL9	Model Conversion Police Vehicle
Z49	Export Canadian MODIF Mandatory Base EQUIP
Z5X	Mirror Provisions, Arabic Language

Technical Information

Maintenance and Lubrication

Capacities - Approximate Fluid

Application	Specification	
	Metric	English
Air Conditioning Refrigerant R13a	0.68 kg	1.5 lb
Cooling System	8.2 L	8.6 qt
Engine Oil With Filter	4.8 L	5.0 qt
Fuel Tank	53.4 L	14.1 gal
Power Steering System	0.70 L	1.5 pt
Transaxle		
• Bottom Pan Removal	6.5 L	6.9 qt
• Complete Overhaul	9.0 L	9.5 qt
• Dry	12.2 L	12.9 qt
• Manual Transaxle Complete Drain and Refill	1.7 L	1.8 qt
Wheel Nut Torque	140 N·m	100 lb ft

Tire Inflation Pressure Specifications

Application	Specification	
	Metric	English
Tire Inflation; Compact Spare	420 kPa	60 psi
Tire Inflation; Front Tires	210 kPa	30 psi
Tire Inflation; Rear Tires	210 kPa	30 psi

Maintenance Items

Application	Specification
Air Cleaner Filter, 2.2L L4, L61	AC Type A-1172C
Engine Oil Filter, 2.2L L4, L61	AC Type PF2244G
Spark Plug and Gap, 2.2L L4, L61	AC Type 41-981, 1.06 mm (0.042 in) Gap
Windshield Wiper Blades	
• Driver Side	Shepherd's Hook Type 56 cm (22 in)
• Passengers Side	Shepherd's Hook Type 43 cm (17 in)

Fluid and Lubricant Recommendations

Application	Fluid/Lubricant
Automatic Transaxle	DEXRON®-III Automatic Transaxle Fluid
Chassis Lubrication	Chassis Lubrication GM P/N 12377985 or equivalent or lubricant meeting requirements of NLGI # 2, Category LB or GC-LB
Clutch Linkage Pivot Points	Engine oil
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. To determine the preferred viscosity for your vehicle's engine, refer to Engine Oil Viscosity in your owner's manual.
Hinges, Hood and Door	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
Hydraulic Clutch System	Hydraulic Clutch Fluid GM P/N 12345347 or equivalent DOT-3 Brake Fluid
Key Lock Cylinders	Multi-Purpose Lubricant, Superlube ® GM P/N 12346241
Manual Transaxle	Dexron® III-Automatic Transaxle Fluid
Manual Transaxle Shift Linkage	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 or 1050017 - 1 quart, or equivalent
Weatherstrip Conditioning	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

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

This requires that the steering knuckle be suspended between a lower control arm and a strut assembly. The lower control arm attaches from the steering knuckle at the outermost point of the control arm. The attachment is through a ball and socket type joint. The innermost end of the control arm attached at 2 points to the vehicle frame through semi-rigid bushings. The upper portion of the steering knuckle is attached to a strut assembly. The strut assembly then connects to the vehicle body by way of an upper bearing. The steering knuckle is allowed to travel up and down independent of the vehicle body structure and frame.

This up and down motion of the steering knuckle as the vehicle travels over bumps is absorbed predominantly by the coil spring. This spring is retained under tension over the strut assembly. A strut is used in conjunction with this system in order to dampen out the oscillations of the coil spring. A strut is a basic hydraulic cylinder. The strut is filled with oil and has a moveable shaft that connects to a piston inside the strut. Valves inside the shock absorber offer resistance to oil flow and consequently inhibit rapid movement of the piston and shaft. Each end of the shock absorber is connected in such a fashion to

utilize this recoil action of a spring alone. Each end of the strut is designed as the connection point of the suspension system to the vehicle and acts as the coil spring seat. This allows the strut to utilize the dampening action to reduce the recoil of a spring alone. The lower control arm is allowed to pivot at the vehicle frame in a vertical fashion. The ball joint allows the steering knuckle to maintain the perpendicular relationship to the road surface.

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

Rear Suspension

This vehicle has a semi-independent rear suspension which consists of the following components:

- An axle with trailing arms
- A twisting cross beam
- 2 coil shocks

The axle assembly attaches to the underbody through a rubber bushing located at the front of each control arm. The brackets are integral with the underbody side rails. The axle structure itself maintains the geometrical relationship of the wheels relative to the inside of the body. The stabilizer shaft is attached to the inside of the axle beam.

The coil springs support the weight of the vehicle in the rear. A rubber insulator isolates the coil spring upper spring seat.

The lower ends of the coil-over shocks are attached to the axle assembly, by a bracket which has a stud that is fastened to the axle using a nut. The upper ends are attached to the body of the car. The top of the coil-over shock has an insulator which is bolted to the body near the wheel-house area. The coil-over shock absorbers are non-adjustable and non-refillable. Service of the coil-over shocks require replacement of the inner shock assembly. This is when they have lost their resistance, are damaged or are leaking.

A single hub and bearing assembly is bolted to both ends of the rear axle assembly or the rear knuckle assembly. This hub and bearing assembly is a sealed unit which eliminated the need for wheel bearing adjustments and does not require periodic maintenance.

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

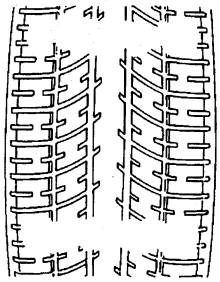
The following factors increase tire wear:

- 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:

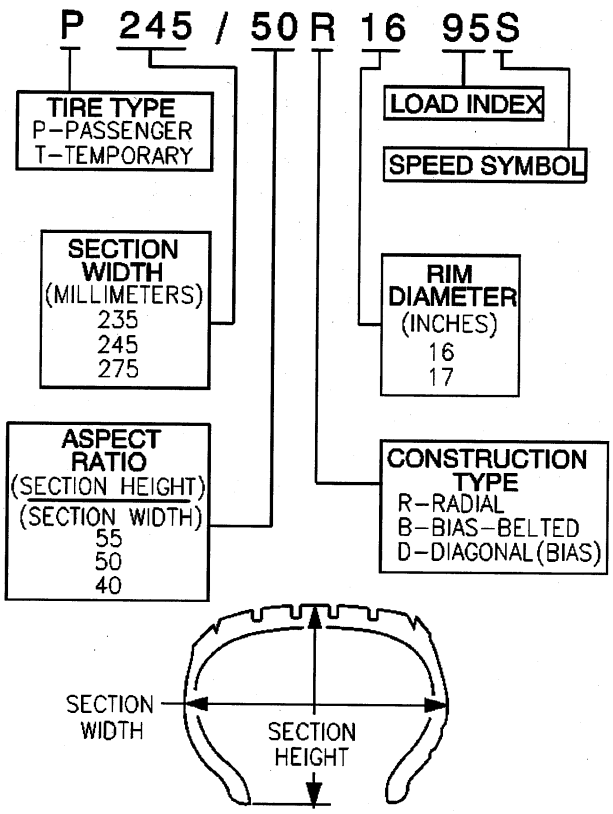
- A tire squeal on turns
- Hard steering
- Rapid wear and uneven wear on the edge of the tread
- Tire rim bruises and tire rim rupture
- Tire cord breakage
- High tire temperatures
- Reduced vehicle handling
- High fuel consumption
- Soft riding

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

- Uneven braking
- Steering lead
- Reduced vehicle handling

Refer to the Tire Placard for specific tire and wheel applications and tire pressures.

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.

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 – 2.2L – L61

General Specifications

Application	Specification	
	Metric	English
General Data		
• Engine Type	Inline 4 Cylinder	
• Displacement	2.2 L	134 CID
• RPO	L61	
• Liter (VIN)	F	
• Bore	85.992-86.008 mm	3.3855-3.3861 in
• Stroke	94.6 mm	3.727 in
• Compression Ratio	10:01	
Balance Shaft		
• Bearing Clearance	0.030-0.063 mm	0.0012-0.0025 in
• Bearing Diameter - Inside - Carrier	20.050-20.063 mm	0.7894-0.7899 in
• Bearing Diameter - Outside - Carrier	41.975-41.995 mm	1.6526-1.6534 in
• Bearing Journal Diameter	20.000-20.020 mm	0.7874-0.7882 in
• Bushing Clearance	0.033-0.102 mm	0.0013-0.0040 in
• Bushing Diameter - Inside	36.776-36.825 mm	1.4479-1.4498 in
• Bushing Journal Diameter	36.723-36.743 mm	1.4458-1.4466 in
• End Play	0.100-0.300 mm	0.0020-0.0118 in
Block		
• Balance Shaft Bearing Bore Diameter - Carrier	42.000-42.016 mm	1.6535-1.6542 in
• Balance Shaft Bushing Bore Diameter	40.763-40.776 mm	1.6048-1.6054 in
• Crankshaft Main Bearing Bore Diameter	64.068-64.082 mm	2.5224-2.5229 in
• Cylinder Bore Diameter	85.992-86.008 mm	3.3855-3.3861 in
• Cylinder Bore Out-of-Round - Maximum	0.010 mm	0.0004 in
• Cylinder Bore Taper - Maximum	0.010 mm	0.0004 in
• Cylinder Head Deck Surface Flatness - Transverse	0.030 mm	0.0012 in
• Cylinder Head Deck Surface Flatness - Longitude	0.050 mm	0.002 in
• Cylinder Head Deck Surface Flatness - Overall	0.08 mm	0.0031 in
Camshaft		
• Camshaft End Play	0.040-0.144 mm	0.0016-0.0057 in
• Camshaft Journal Diameter	26.935-26.960 mm	1.0604-1.0614 in
• Camshaft Thrust Surface	21.000-21.052 mm	0.8268-0.8252 in
Connecting Rod		
• Connecting Rod Bearing Clearance	0.029-0.069 mm	0.0011-0.0027 in
• Connecting Rod Bore Diameter - Bearing End	52.118-52.134 mm	2.0519-2.05252 in
• Connecting Rod Bore Diameter - Pin End	20.007-20.021 mm	0.7877-0.7882 in
• Connecting Rod Side Clearance	0.070-0.370 mm	0.0028-0.0146 in
• Connecting Rod Straightness - Bend - Maximum	0.021 mm	0.0083 in
• Connecting Rod Straightness - Twist - Maximum	0.04 mm	0.0157 in
Crankshaft		
• Connecting Rod Journal Diameter	49.000-49.014 mm	1.9291-1.9297 in
• Crankshaft End Play	0.050-0.380 mm	0.0012-0.0150 in

• Crankshaft Main Bearing Clearance	0.031-0.067 mm	0.0012-0.0026 in
• Crankshaft Main Journal Diameter	55.994-56.008 mm	2.2045-2.2050 in
Cylinder Head		
• Surface Flatness - Block Deck - Transverse	0.030 mm	0.0012 in
• Surface Flatness - Block Deck - Longitude	0.050 mm	0.002 in
• Surface Flatness - Block Deck - Overall	0.1 mm	0.004 in
• Valve Guide Bore - Exhaust	6.000-6.012 mm	0.2362-0.2367 in
• Valve Guide Bore - Intake	6.000-6.012 mm	0.2362-0.2367 in
• Valve Lifter Bore Diameter - Stationary Lash Adjusters	12.013-12.037 mm	0.4730-0.4739 in
Lubrication System		
• Oil Pressure - Minimum - [commat]1000 RPM	344.75-551.60 kPa	50-80 psi
• Oil Capacity	4.8L	5.0 quarts
Piston Rings		
• Piston Ring End Gap - First Compression Ring	0.20-0.40 mm	0.008-0.016 in
• Piston Ring End Gap - Second Compression Ring	0.35-0.55 mm	0.014-0.022 in
• Piston Ring End Gap - Oil Control Ring - Rails	0.25-0.76 mm	0.010-0.030 in
• Piston Ring to Groove Clearance - First Compression Ring	0.04-0.08 mm	0.0015-0.0031 in
• Piston Ring to Groove Clearance - Second Compression Ring	0.030-0.069 mm	0.0012-0.0027 in
• Piston Ring to Groove Clearance - Oil Control Ring	0.090-0.106 mm	0.0035-0.0042 in
• Piston Ring Thickness - First Compression Ring	1.170-1.190 mm	0.0461-0.0469 in
• Piston Ring Thickness - Second Compression Ring	1.471-1.490 mm	0.0579-0.0587 in
• Piston Ring Thickness - Oil Control Ring - Rail - Maximum	0.43 mm	0.0169 in
• Piston Ring Thickness - Oil Control Ring - Spacer	1.574-1.651 mm	0.0620-0.0650 in
Pistons and Pins		
• Piston - Piston Diameter - [commat]14.5 mm up	85.967-85.982 mm	3.3845-3.3851 in
• Piston - Piston Pin Bore Diameter	20.002-20.007 mm	0.07875-0.7877 in
• Piston - Piston Ring Grove Width - Top	1.23-1.25 mm	0.0484-0.0492 in
• Piston - Piston Ring Grove Width - Second	1.52-1.54 mm	0.0598-0.0606 in
• Piston - Piston Ring Grove Width - Oil Control	2.52-2.54 mm	0.0992-0.1000 in
• Piston - Piston To Bore Clearance	0.010-0.041 mm	0.0004-0.0016 in
• Pin - Piston Pin Clearance to Connecting Rod Bore	0.007-0.026 mm	0.0003-0.0010 in
• Pin - Piston Pin Clearance to Piston Pin Bore	0.002-0.012 mm	0.0001-0.0005 in
• Pin - Piston Pin Diameter	19.995-20.000 mm	0.7872-0.7874 in
• Pin - Piston Pin End Play	0.19-1.16 mm	0.0075-0.0461 in
Valve System		
• Valves - Valve Face Runout - Maximum	0.04 mm	0.0016 in
• Valves - Valve Seat Runout - Maximum	0.05 mm	0.0020 in
• Valves - Valve Stem Diameter - Intake	5.955-5.970 mm	0.2344-0.2355 in
• Valves - Valve Stem Diameter - Exhaust	5.935-5.950 mm	0.2337-0.2343 in
• Valves - Valve Stem to Guide Clearance - Intake	0.030-0.057 mm	0.0012-0.0022 in
• Valves - Valve Stem to Guide Clearance - Exhaust	0.050-0.077 mm	0.0020-0.0026 in
• Valve Lifters - Valve Lifter Diameter - Stationary Lash Adjuster	11.986-12.000 mm	0.0005-0.0020 in
• Valve Lifters - Valve Lifter-to-Bore Clearance - Stationary Lash Adjuster	0.013-0.051 mm	3.2210-3.2299 in

• Valve Springs - Valve Spring Load - Closed - [commat]22.5 mm	245.0-271.0 N. - Eng Spec.
• Valve Springs - Valve Spring Load - Open - [commat]32.5 mm	525.0-575.0 N. - Eng Spec.

Fastener Tightening Specifications

Application	Specification	
	Metric	English
A/C Compressor to Block Bolt	20 N·m	15 lb ft
Balance Shaft Adjustable Chain Guide Bolt	10 N·m	89 lb in
Balance Shaft Bearing Carrier to Block Bolt	10 N·m	89 lb in
Balance Shaft Fixed Chain Guide Bolt	10 N·m	89 lb in
Balance Shaft Sprocket Bolt	50 N·m	37 lb ft
Block Heater Bolt	10 N·m	89 lb in
Cam Cover to Cylinder Head Bolt	10 N·m	89 lb in
Cam Cover to Ground Cable Bolt	10 N·m	89 lb in
Cam Cover to Ground Cable Stud	10 N·m	89 lb in
Camshaft Bearing Cap Bolt	10 N·m	89 lb in
Camshaft Sprocket Bolt		
• First Pass	85 N·m	63 lb ft
• Final Pass	30 degrees	
Camshaft Timing Chain Tensioner	75 N·m	55 lb ft
Chain Guide Plug	90 N·m	59 lb ft
Connecting Rod Bolt		
• First Pass	25 N·m	18 lb ft
• Final Pass	100 degrees	
Crankshaft Bearings - Lower Crankcase to Block		
• First Pass	20 N·m	15 lb ft
• Final Pass	70 degrees	
Crankshaft Pulley Bolt		
• First Pass	100 N·m	74 lb ft
• Final Pass	75 degrees	
Crankshaft Position Sensor Bolt	10 N·m	89 lb in
Cylinder Head Bolt		
• First Pass	30 N·m	22 lb ft
• Final Pass	155 degrees	
Cylinder Head Front Chaincase Bolt	35 N·m	26 lb ft
Cylinder Head Oil Gallery Plug	35 N·m	26 lb ft
Dipstick Guide to Intake Manifold Bolt	10 N·m	89 lb in
Drive Belt Tensioner Bolt	45 N·m	33 lb ft
EGR Cover Bolt	25 N·m	18 lb ft
Elek. ICM Cover Bolt	10 N·m	89 lb in
Engine Coolant Temperature Sensor	22 N·m	16 lb ft
Engine Lift Bracket Front Bolt	25 N·m	18 lb ft
Engine Lift Bracket Rear Bolt	25 N·m	18 lb ft
Exhaust Manifold to Cylinder Head Nut	12 N·m	9 lb ft
Exhaust Manifold to Cylinder Head Stud	10 N·m	89 lb in
Exhaust Manifold Pipe Flange Stud	16 N·m	12 lb ft
Flexplate (AMT) Bolt		
• First Pass	53 N·m	39 lb ft
• Final Pass	25 degrees	

Flywheel (SMT) Bolt		
• First Pass	53 N·m	39 lb ft
• Final Pass	25 degrees	
Front Cover to Block Bolt	25 N·m	18 lb ft
Front Lift Bracket Bolt	25 N·m	18 lb ft
Fuel Pipe Bracket Bolt	10 N·m	89 lb in
Fuel Rail Bracket Stud	10 N·m	89 lb in
Generator to Block Bolt	20 N·m	15 lb ft
Heat Shield to Exhaust Manifold Bolt	23 N·m	17 lb ft
Ignition Coil Bolt	10 N·m	89 lb in
Intake Camshaft Rear Cap Bolt	25 N·m	18 lb ft
Intake Manifold to Cylinder Head Bolt	10 N·m	89 lb in
Intake Manifold to Cylinder Head Nut	10 N·m	89 lb in
Intake Manifold to Cylinder Head Stud	6 N·m	53 lb in
Knock Sensor Bolt	25 N·m	18 lb ft
Lower Crankcase to Block Peripheral Bolt	25 N·m	18 lb ft
Oil Filter Housing Cover	25 N·m	18 lb ft
Oil Gallery Gerotor Cover - Rear Bolt	6 N·m	53 lb in
Oil Gallery Plug	35 N·m	26 lb ft
Oil Gallery Plug -Rear	60 N·m	44 lb ft
Oil Pan Drain Plug	25 N·m	18 lb ft
Oil Pan to Block Bolts	25 N·m	18 lb ft
Oil Pressure Switch	22 N·m	16 lb ft
Oil Pump Cover Bolt	6 N·m	53 lb in
Oil Pump Pressure Relief Valve Plug	40 N·m	30 lb ft
Oxygen Sensor	42 N·m	31 lb ft
Power Steering Pump Bolt	25 N·m	18 lb ft
Spark plug	20 N·m	15 lb ft
Starter Motor to Block Bolt	40 N·m	30 lb ft
Thermostat Housing to Block Bolts	10 N·m	89 lb in
Throttle Body Bolt	10 N·m	89 lb in
Throttle Body Nut	10 N·m	89 lb in
Throttle Body Stud	6 N·m	53 lb in
Timing Adjustable Chain Guide Bolt	10 N·m	89 lb in
Timing Chain Oil Nozzle Bolt	10 N·m	89 lb in
Timing Fixed Chain Guide Bolt	10 N·m	89 lb in
Timing Upper Chain Guide Bolt	10 N·m	89 lb in
Vent Tube to Cylinder Head	15 N·m	11 lb ft
Water Jacket Drain Plug	20 N·m	15 lb ft
Water Pipe Support Bracket Bolt	10 N·m	89 lb in
Water Pump Access Cover Bolt	7 N·m	62 lb in
Water Pump/Balance Shaft Chain Tensioner Bolt	10 N·m	89 lb in
Water Pump Bolts	25 N·m	18 lb ft
Water Pump Sprocket Bolt	10 N·m	89 lb in

Engine Component Description

Cylinder Block

The cylinder block is lost foam cast aluminum with four cylinders arranged in-line. The cylinders have pressed in place iron liners. The block has five crankshaft bearings with the thrust bearing located on the second bearing from the front of the engine. The cylinder block incorporates a bedplate design that forms an upper and lower crankcase. This design promotes cylinder block rigidity and reduced noise and vibration.

Crankshaft

The crankshaft is cast nodular iron with eight counterweights. The number eight counterweight is also the ignition system reluctor wheel. The main bearing journals are cross-drilled, and the upper bearings are grooved. The crankshaft has a slip fit balance shaft drove sprocket. Number two main bearing is the thrust bearing. A harmonic damper is used to control torsional vibration.

Connecting Rod and Piston

The connecting rods are powdered metal. The connecting rod incorporates the floating piston pin. The pistons are cast aluminum. The piston rings are of a low tension type to reduce friction. The top compression ring is ductile iron with a molybdenum facing and phosphate coated sides. The second compression ring is gray iron. The oil ring is a 3-piece spring construction with chromium plating.

Oil Pan

The oil pan is die cast aluminum. The oil pan includes an attachment to the transmission to provide additional structural support.

Balance Shaft Assembly

There are two block mounted balance shafts located on each side of the crankcase at the bottom of the cylinder bores. The balance shafts are driven by a single roller chain that also drives the water pump. The chain is tensioned by a hydraulic tensioner that is supplied pressure by the engine oil pump. This design promotes the maximum effectiveness of the balance shaft system and reduces noise and vibration.

Cylinder Head

The cylinder head is a lost foam aluminum casting. Pressed-in powdered metal valve guides and valve seat insets are used. The fuel injection nozzle is located in the intake port. The cylinder head incorporates camshaft bearing journals and camshaft bearing caps.

Valves

There are two intake and two exhaust valves per cylinder. Rotators are used on all of the intake valves. The rotators are located at the bottom of the valve spring to reduce valve train reciprocating mass. Positive valve stem seals are used on all valves.

Camshaft

Two camshafts are used, one for all intake valves, the other for all exhaust valves. The camshafts are cast iron. The intake camshaft had a pressed-in hex insert. The hex inset is used to drive the direct drive power steering pump.

Valve Lifters

The valve train uses a roller finger follower acted on by a hydraulic element adjuster. The roller finger follower reduces friction and noise.

Camshaft Cover

The camshaft cover is cast aluminum with steel crankcase ventilation baffling incorporated. The camshaft cover has mounting locations for the ignition system.

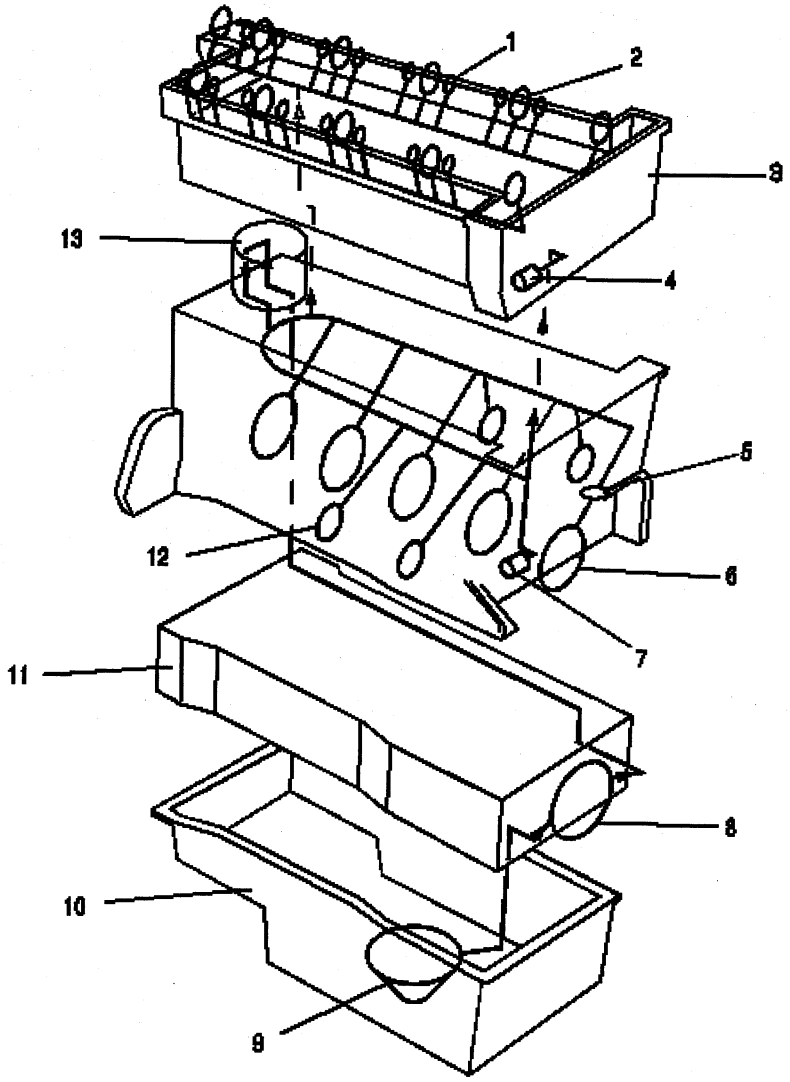
Camshaft Drive

A single row roller chain is used for camshaft drive. There is a tensioner and active guide used on the slack side of the chain to control chain motion and noise. The chain drive promotes long valve train life and low maintenance.

Intake and Exhaust Manifold

The intake manifold is made of composite plastic. The exhaust manifold is cast iron. The intake manifold incorporates a distribution and control system for PCV gases. The exhaust manifold is a dual plane design that promotes good low end torque and performance.

Lubrication Description



(1) Hydraulic Lifter
(2) Cam Bearing
(3) Cylinder Head
(4) Timing Chain Tensioner
(5) Cam Drive Chain Oil Nozzle
(6) Crankshaft Bearing
(7) Balance Shaft Chain Tensioner
(8) Oil Pump
(9) Oil Pick Up
(10) Oil Pan
(11) Bedplate
(12) Balance Shaft Bearings
(13) Oil Filter

Oil is applied under pressure to the crankshaft, connecting rods, balance shaft assembly, camshaft bearing surfaces, valve lifters and timing chain hydraulic tensioner. All other moving parts are lubricated by gravity flow or splash. Oil enters the gerotor type oil pump thorough a fixed inlet screen. The oil pump is driven by the crankshaft. The oil pump body is within the engine front cover. The pressurized oil from the pump passes through the oil filter. The oil filter is located on the right (front) side of the engine block.

The oil filter is housed in a casting that is integrated with the engine block. The oil filter is a disposable cartridge type. A by-pass valve in the filter cap allows continuous oil flow in case the oil filter should become restricted. Oil then enters the gallery where it is distributed to the balance shafts, crankshaft, camshafts and camshaft timing chain oiler nozzle. The connecting rod bearings are oiled by constant oil flow passages through the crankshaft connecting the main journals to the rod journals. A groove around each upper main bearing furnishes oil to the drilled crankshaft passages. The pressurized oil passes through the cylinder head restrictor orifice into the cylinder head and then into each camshaft feed gallery. Cast passages feed each hydraulic element adjuster and drilled passages feed each camshaft bearing surface. An engine oil pressure switch or sensor is installed at the end. Oil returns to the oil pan through passages cast into the cylinder head. The timing chain lubrication drains directly into the oil pan.

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.

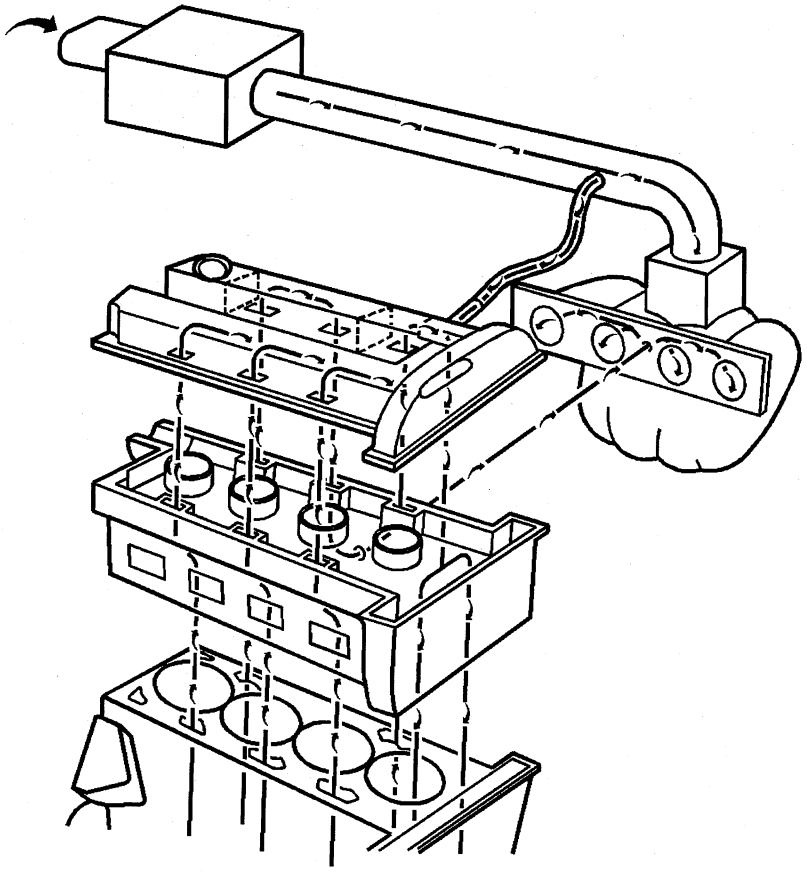
The drive belt system may have an idler pulley, which is used to add wrap to the adjacent pulleys. Some systems use an idler pulley in place of an accessory drive component when the vehicle is not equipped with the accessory.

Crankcase Ventilation System Description

General Description

A crankcase ventilation system is used to consume crankcase vapors in the combustion process instead of venting them to atmosphere. Fresh air from the intake system is supplied to the crankcase, mixed with blow by gases and then passed through a calibrated orifice into the intake manifold.

Operation



The primary control is through the positive crankcase ventilation (PCV) orifice which meters the flow at a rate depending on inlet vacuum. The PCV orifice is an integral part of the camshaft cover. If abnormal operating conditions occur, the system is designed to allow excessive amounts of blow by gases to back flow through the crankcase vent into the intake system to be consumed by normal combustion.

Results of Incorrect Operation

A plugged orifice may cause the following conditions:

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

A leaking orifice may cause the following conditions:

- Rough idle
- Stalling
- High idle speed

Engine Cooling

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Cooling Fan Bolt	6 N·m	53 lb in
Engine Coolant Temperature Sensor	22 N·m	16 lb ft
Surge Tank Bolt	10 N·m	89 lb in
Thermostat Housing to Block Bolts	10 N·m	89 lb in
Transmission Oil Cooler Line Fitting	36 N·m	27 lb ft
Upper Radiator Mount Bolt	10 N·m	89 lb in
Water Pump Access Cover Bolts	7 N·m	62 lb in
Water Pump Bolts	25 N·m	18 lb ft
Water Pump Sprocket Bolts	10 N·m	89 lb in

Cooling System Description and Operation

Coolant Heater

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

Cooling System

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

Cooling Cycle

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

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

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

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

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

Coolant

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

Radiator

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

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

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

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

Pressure Cap

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

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

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

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

Coolant Recovery System

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

In effect, a cooling system with a coolant recovery reservoir is a closed system. When the pressure in the cooling system gets too high, it will open the pressure valve in the pressure cap. This allows the coolant, which has expanded due to being heated, is allowed to flow through the overflow tube and into the recovery reservoir. As the engine cools down, the temperature of the coolant drops and a vacuum is created in the cooling system. This vacuum opens the vacuum valve in the pressure cap, allowing some of the coolant in the reservoir to be siphoned back into the radiator. Under normal operating conditions, no coolant is lost. Although the coolant level in the recovery reservoir goes up and down, the radiator and cooling system are kept full. An advantage to using a coolant recovery reservoir is that it eliminates almost all air bubbles from the cooling system. Coolant without bubbles absorbs heat much better than coolant with bubbles.

Air Baffles and Seals

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

Water Pump

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

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

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

Thermostat

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

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

Engine Oil Cooler

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

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

Transmission Oil Cooler

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

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

Engine Electrical

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Battery Hold Down Retainer Bolt	18 N·m	13 lb ft
Battery Negative Cable Terminal Bolt	15 N·m	11 lb ft
Battery Positive Cable Terminal Bolt	15 N·m	11 lb ft
Generator Bolts	20 N·m	15 lb ft
Generator Electrical Connector	17 N·m	13 lb ft
Negative Battery Cable Ground Stud	25 N·m	18 lb ft
Positive Battery Cable to Starter Solenoid Nut	17 N·m	13 lb ft
Starter Motor Bolts	40 N·m	30 lb ft
Starter Motor Solenoid S Terminal Nut	3 N·m	27 lb in
Wire Harness Retainer Nut	18 N·m	13 lb ft

Battery Usage

Application	Specification
Cold Cranking Amperage (CCA)	525
Reserve Capacity	90 min.
Replacement Model Number	75-5YR

Starter Motor Usage

Application	Starter Model
L61	PG-260D

Generator Usage

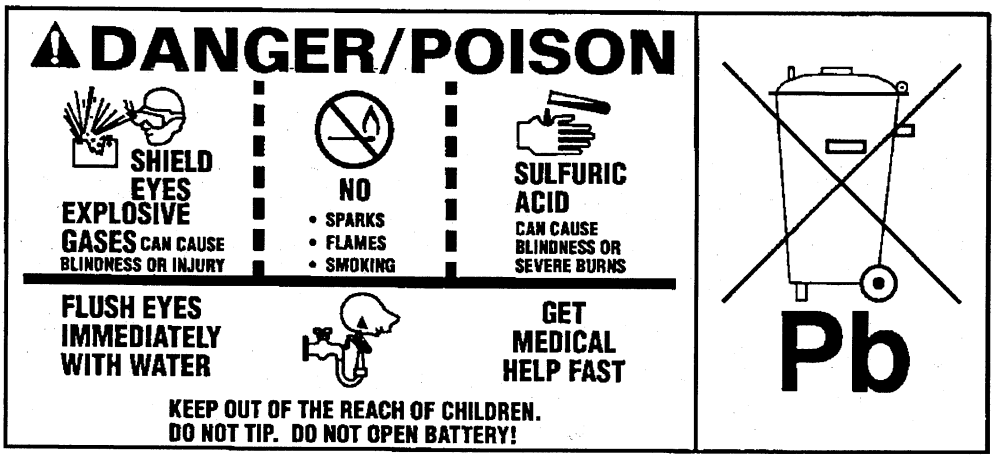
Application	Specification
L61	
Generator Model	Valeo SG 10
Rated Output	105 A
Load Test Output	73 A

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

CATALOG NO.

1819

CCA	LOAD TEST
770	380
REPLACEMENT MODEL 100 – 6YR	

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-260D is a non-repairable starter motor. It has pole pieces that are arranged around the armature. Both solenoid windings are energized. The pull-in winding circuit is completed to the ground through the starter motor. The windings work together magnetically to pull 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. Moving at the same time, the plunger also closes the solenoid switch contacts in the starter solenoid. Full battery voltage is 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 because battery voltage is 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, pinion overrun protects the armature from excessive speed until the switch is opened.

When the ignition switch is released from the START position, the START relay opens and battery voltage is removed from the starter solenoid S terminal. Current flows from the motor contacts through both windings to the ground at the end of the hold-in winding. However, the direction of the current flow through the pull-in winding is now opposite the 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, causes the starter drive assembly to disengage and the solenoid switch contacts to open simultaneously. As soon as the contacts open, the starter circuit is turned off.

Circuit Description

When the ignition switch is placed in the Start position 12 volts is supplied through the Park/Neutral Position Switch to the S terminal of the Starter Solenoid. Ground is found through the engine block.

Charging System Description and Operation

Generator

The generator features the following major components:

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

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

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

Regulator

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

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

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

Circuit Description

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

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

Engine Controls

Fuel System Specifications – All Engines

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

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

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

Notice

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

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

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

Engine Controls - 2.2L (L61)

Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-3-4-2	
Primary Coil Current Output	8.5-9.5 Amps	
Spark Plug Torque	20 N·m	15 lb ft
Spark Plug Gap	1.06 mm	0.042 in
Spark Plug Type	GM P/N 12569190 or 41-981--AC plug type	

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Cable Bracket Nuts	10 N·m	89 lb in
Accelerator Pedal Retaining Nuts	30 N·m	22 lb ft
Air Cleaner Intake Duct Clamp	5 N·m	44 lb in
Air Cleaner Intake Upper Attaching Bolt	7 N·m	62 lb in
Air Cleaner Outlet Resonator Clamp	5 N·m	44 lb in
CKP Sensor Bolts	8 N·m	71 lb in
Engine Coolant Temperature (ECT) Sensor	10 N·m	89 lb in
EVAP Canister Purge Valve Mounting Bracket Nut	8 N·m	71 lb in
EVAP Canister Retainer Bolt	10 N·m	89 lb in
Exhaust Heat Shield Bolt	2.0 N·m	18 lb in
Exhaust Heat Shield Nut	1.0 N·m	9 lb in
Fuel Bundle Fasteners	10 N·m	89 lb in
Filler Pipe Attaching Screw	10 N·m	89 lb in
Fuel Filler Hose Clamp	3 N·m	27 lb in
Fuel Filter Fitting	27 N·m	20 lb ft
Fuel Pipe Mounting Bolts	6 N·m	53 lb in
Fuel Pipe Retainer Bolts	10 N·m	89 lb in
Fuel Pressure Regulator Retaining Bolts	5 N·m	44 lb in
Fuel Rail Attaching Studs	10 N·m	89 lb in
Fuel Rail Pipe Fittings	10 N·m	89 lb in
Fuel Tank Retaining Strap Bolt	35 N·m	26 lb ft
Heated Oxygen Sensor (HO2S) 1	30 N·m	22 lb ft
Heated Oxygen Sensor (HO2S) 2	41 N·m	30 lb ft
Idle Air Control (IAC) Valve Screw	3 N·m	27 lb in
Ignition Coil Housing Retaining Bolts	10 N·m	89 lb in
Ignition Control Module (ICM) Screws	1.5 N·m	13 lb in
Knock Sensor (KS)	25 N·m	18 lb ft
Spark Plugs	20 N·m	15 lb in
Throttle Body Attaching Bolts and Studs	10 N·m	89 lb in
Throttle Body Clamp	5 N·m	44 lb in
Throttle Position (TP) Sensor Mounting Screw	2 N·m	18 lb in
Upper Air Cleaner Cover Screws	3 N·m	27 lb in

Exhaust System

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Exhaust Manifold Heat Shield Bolt	25 N·m	18 lb ft
Exhaust Manifold to Cylinder Head Nuts	13 N·m	115 lb in
Exhaust Manifold Pipe Nuts	30 N·m	22 lb ft
Intermediate Pipe Nuts	30 N·m	22 lb ft
Muffler Hanger Bolt	16 N·m	12 lb ft

Exhaust System Description

Important

Use of non-OEM parts may cause driveability concerns.

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

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

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

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

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

The exhaust system may be comprised of the following components:

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

Resonator

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

Catalytic Converter

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

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

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

The catalyst in the converter is not serviceable.

Muffler

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

Transmission/Transaxle Description and Operation

Manual Transmission - M86/M94 Getrag

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Drain/Fill Plugs	38 N·m	28 lb ft
Intermediate Shaft Bolts	100 N·m	74 lb ft
Front Transmission Mount	75 N·m	55 lb ft
Rear Cover Bolts	25 N·m	18 lb ft
Rear Transmission Mount	75 N·m	55 lb ft
Reverse Switch	18 N·m	13 lb ft
Ring Gear	90 N·m	66 lb ft
Shaft Bolts	100 N·m	74 lb ft
Shifter Guide Bolts	25 N·m	18 lb ft
Shifter Mounting Bolts	25 N·m	18 lb ft
Speed Sensor Bolt	12 N·m	8 lb ft
Transmission Housing Bolts	25 N·m	18 lb ft

Lubrication Specifications

Application	Specification	
	Metric	English
DEXRON®III	1.7 liters	1.8 quarts

Transmission General Description

The M86/M94 manual transmission has the following features:

- First and second gear double coned synchronizer
- Third, fourth, and fifth gear single coned synchronizer
- Reverse synchronized
- Three shaft design consisting of an input shaft, output shaft, and intermediate shaft
- Reverse inhibit feature
- One piece clutch actuator - no bleed screw
- Transmission venting system is part of the fill cap
- First gear ratio is 3.58
- Second gear ratio is 2.02
- Third gear ratio is 1.35
- Fourth gear ratio is 0.98
- Fifth gear ratio is 0.69
- Reverse gear ratio is 3.31
- Final drive ratio is 3.94

The manual transmission shift cables must be adjusted for proper shifter performance.

Clutch

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Clutch Actuator Bleed Screw	2 N·m	18 lb in
Clutch Cover to Flywheel Bolt 2.2L (L61)	24 N·m	18 lb ft
Clutch Master Cylinder and Clutch Pedal Bracket Nut	21 N·m	15 lb ft

Hydraulic Clutch Description

Clutch Spin Down Time

Check the clutch spin down time as follows:

1. Apply the parking brake. Block the vehicle wheels.
2. Shift the manual transmission into neutral.
3. Start the engine. Run the engine at idle speed.
4. Engage the clutch.
5. Disengage the clutch. Wait 9 seconds.
6. Shift the transmission into reverse.

Clutch Driving Members

The clutch driving members are two flat surfaces machined to a smooth finish. They are:

1. The rear face of the engine flywheel
2. The front face of the clutch pressure plate

Clutch Driven Members

The driven member is the clutch driven plate. The clutch driven plate has a splined hub. The splined hub slides lengthwise along the splines of the input shaft. The splined hub drives the input shaft through these same splines. The driving and driven members are held together with a spring pressure. This pressure is exerted by a diaphragm spring in the clutch pressure plate.

Hydraulic Clutch Fluid

Notice

Do not use mineral or paraffin-base oil in the clutch hydraulic system. These fluids may damage the rubber parts in the cylinders.

When refilling the system or adding fluid after service, use GM Delco Supreme No. 2 Brake Fluid, or equivalent that meets DOT 3 specifications.

Hydraulic Clutch Operating Members

The clutch system consists of the following components:

- A master cylinder with a reservoir
- A switch
- An concentric slave cylinder connected to hydraulic tubing
- Pressure Plate
- Clutch Cover
- Diaphragm Springs
- Release Bearing
- Clutch Disc
- Torsional Springs

With the depression of the clutch pedal, the clutch master cylinder becomes pressurized from the force of the push rod into the master cylinder. This forces hydraulic fluid into the tubing from the master cylinder to the concentric slave cylinder. The concentric slave cylinder then engages by pushing the releasing

bearing into the diaphragm spring and release the clutch. A hole in the cowl panel accommodates the master cylinder. A quick connect coupling helps route the hydraulic tubing. the concentric slave cylinder is inside the transmission and on the input bearing retainer. The hydraulic control system can be replaced without having to gain access to the clutch system internal components , simply engage the quick connect coupling mounted through the transmission housing. No adjustments to the clutch system are necessary. as the clutch wears, the fluid level in the master cylinder reservoir changes to compensates for clear wear. A new system will have fluid in the reservoir. An electrical switch on the push rod has two functions: One function is a clutch interlock, ensuring the engine does not start unless the clutch pedal is engaged (positioned to the floor). The second function is to cut off the cruise-control system (if so equipped) when the clutch pedal is engaged.

Automatic Transmission Shift Lock Control Description and Operation

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 consists of thew following components:

- The automatic transmission shift lock control solenoid
- 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 solenoid. The automatic transmission shift lock control solenoid receives a ground from the BCM. When the automatic transmission shift lock control solenoid is energized, the shift lever mechanically locked in the PARK position. When the driver presses the brake pedal the PCM sends a class 2 serial data message to the BCM. The BCM turns OFF the ground control circuit and this de-energizes the automatic transmission shift lock control solenoid. When the automatic transmission shift lock control solenoid is de-energized, the shift lever may be moved out of the PARK position. The BCM determines transaxle shift lever position through a class 2 serial data message from the PCM. The PCM receives inputs from the park/neutral position switch and determines shift lever position. When the BCM receives this information and determines that the shift lever is out of the PARK position, the automatic transmission shift lock control solenoid ground is opened.

Automatic Transaxle - 4T40-E/4T45-E

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Bottom Pan to Case -- M6 x 1.0 x 19.0 (Qty 12)	12 N·m	106 lb in
Case Cover	24 N·m	18 lb ft
Case Side Cover	20 N·m	15 lb ft
Channel Plate to Case -- M6 x 1.0 x 28.0 (Qty 6)	12 N·m	106 lb in
Channel Plate to Case -- M6 x 1.0 x 63.0 (Qty 2)	12 N·m	106 lb in
Channel Plate to Driven Sprocket Support -- M6 x 1.0 x 28.0 (Qty 2)	14 N·m	124 lb in
Clip, Wiring Harness -- M6 x 1.0 x 15.0 (Qty 1)	12 N·m	106 lb in
Converter Shield	10 N·m	18 lb ft
Cooler Pipes at Case	8 N·m	71 lb in
Cooler Pipes at Radiator	20-40 N·m	15-30 lb ft
Cover Assembly, Intermediate 4th Servo to Case -- M6 x 1.0 x 28.0 (Qty 3)	12 N·m	106 lb in
Cover, Lo/Reverse Servo to Case -- M6 x 1.0 x 28.0 (Qty 3)	12 N·m	106 lb in
Cover, Side to Case -- M8 x 1.25 x 28.0 (Qty 10)	20 N·m	15 lb ft
Cover, Side to Case (Stud) -- M8 x 1.25 x 28.0 (Qty 1)	20 N·m	15 lb ft
Flywheel to Torque Converter	62 N·m	46 lb ft
Oil Check Plug	14 N·m	124 lb in
Oil Feed Tube Bolts	14 N·m	124 lb in
Oil Pan to Case	10 N·m	89 lb in
Park/Neutral Position Switch to Case	24 N·m	18 lb ft
Plug, Pipe -- 1/8-27 NPTF (Qty 2)	12 N·m	106 lb in
Pressure Switch Assembly Bolts	12 N·m	106 lb in
Pump, Valve Body, Channel Plate to Case -- M6 x 1.0 x 103.0 (Qty 1)	12 N·m	106 lb in
Pump, Valve Body to Channel Plate -- M6 x 1.0 x 63.0 (Qty 1)	12 N·m	106 lb in
Pump, Valve Body to Channel Plate -- M6 x 1.0 x 90.0 (Qty 6)	12 N·m	106 lb in
Sensor, Input Speed -- M6 x 1.0 x 15.0 (Qty 1)	12 N·m	106 lb in
Sensor, Output Speed (Stud) -- M6 x 1.0 x 15.0 (Qty 1)	12 N·m	106 lb in
Shift Lever to Transmission Nut	20 N·m	15 lb ft
Spacer, Channel Plate to Driven Sprocket Support -- M6 x 1.0 x 70.0 (Qty 2)	14 N·m	124 lb in
Speed Sensor Housing to Case	11 N·m	97 lb in
Spring and Roller Assembly, Detent to Channel Plate -- M6 x 1.0 x 19.0 (Qty 1)	12 N·m	106 lb in
Support Assembly, Drive Sprocket to Case -- M6 x 1.0 x 17.2 (Qty 6)	12 N·m	106 lb in
TFP Switch, Valve Body, Channel Plate --M6 x 1.0 x 51.0 (Qty 3)	12 N·m	106 lb in
TFP Switch, Valve Body, Channel Plate -- M6 x 1.0 x 63.0 (Qty 1)	12 N·m	106 lb in
TFP Switch, Valve Body, Channel Plate to Case -- M6 x 1.0 x 90.0 (Qty 2)	12 N·m	106 lb in
Transmission to Engine Mount Bolts	90 N·m	66 lb ft
Tube Assembly, Transmission Oil to Case -- M6 x 1.0 x 19.0 (Qty 2)	12 N·m	106 lb in
Tube Assembly, Transmission Oil to Forward Clutch Support -- M6 x 1.0 x 19.0 (Qty 1)	12 N·m	106 lb in
Tube Assembly, Transmission Oil to Lo/Reverse Servo Cover -- M6 x 1.0 x 19.0 (Qty 1)	12 N·m	106 lb in
TV Cable to Case	9 N·m	80 lb in
Valve Body, Channel Plate to Case -- M6 x 1.0 x 90.0 (Qty 5)	12 N·m	106 lb in
Valve Body, Channel Plate to Case -- M6 x 1.0 x 103.0 (Qty 2)	12 N·m	106 lb in
Valve Body to Channel Plate -- M6 x 1.0 x 51.0 (Qty 5)	12 N·m	106 lb in

Transmission General Specifications

Name	Hydra-Matic® 4T40-E/4T45-E
RPO Codes	MN4 - 4T40-E MN5 - 4T45-E
Production Location	Windsor, Ontario, Canada
Vehicle Platform Engine/Transmission Usage	J, N
Transmission Drive	Transverse Mounted Front Wheel Drive
Maximum Engine Torque	4T40-E 270 N·m (200 lb ft) 4T45-E 290 N·m (215 lb ft)
Maximum Shift Speed	1-2 6,500 RPM 2-3 6,500 RPM 3-4 6,500 RPM
1st Gear Ratio	2.960:1
2nd Gear Ratio	1.626:1
3rd Gear Ratio	1.000:1
4th Gear Ratio	0.681:1
Reverse	2.143:1
Torque Converter Size - Diameter of Torque Converter Turbine	245 mm
Pressure Taps	Line Pressure
Transmission Fluid Type	DEXRON® III
Transmission Fluid Capacity - Approximate	Bottom Pan Removal: 6.5 L (6.9 qts) Complete Overhaul: 9.0 L (9.5 qts) Dry: 12.2 L (12.9 qts)
Transmission Type: 4	Four Forward Gears
Transmission Type: T	Transverse Mount
Transmission Type: 40	Product Series
Transmission Type: E	Electronic Controls
Position Quadrant	P, R, N, Overdrive, 3, 2, 1
Case Material	Die Cast Aluminum
Transmission Weight Dry	4T40-E 74.7 kg (164 lbs) 4T45-E 75.1 kg (165.6 lbs)
Transmission Weight Wet	4T40-E 85.0 kg (187 lbs) 4T45-E 85.5 kg (188.5 lbs)
Maximum Trailer Towing Capacity	487 kg (1,000 lbs)
Maximum Gross Vehicle Weight (GVW)	1,826 kg (4,100 lbs)

Ratios		
Chain	Final Drive	Effective - Overall
32/38	3.29	3.91
32/38	3.05	3.63
35/35	3.29	3.29
35/35	3.05	3.42
33/37	3.29	3.69
33/37	3.05	3.42

Fluid Capacity Specifications - Approximate

Application	Specification	
	Metric	English
Bottom Pan Removal	6.5 liters	6.9 quarts
Complete Overhaul	9.0 liters	9.5 quarts
Dry	12.2 liters	12.9 quarts

Transmission General Description

The 4T40-E is a fully automatic front wheel drive electronically controlled transmission. The 4T40-E provides four forward ranges including overdrive and one reverse gear range. The PCM controls shift points by means of two shift solenoids. A vane type pump supplies the oil pressure. The PCM regulates oil pressure by means of the Pressure Control Solenoid (PCS).

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, hilly terrain, and trailer towing. Drive provides three gear ranges and 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. You may select this range at any vehicle speed, but you cannot downshift the transmission into Second gear until the vehicle speed drops below approximately 100 km/h (62 mph).
- 1 -- Manual Lo provides maximum engine braking. You may select this range at any vehicle speed, but you cannot downshift the transmission into First gear until the vehicle speed drops below approximately 60 km/h (37 mph).

Transmission Component and System Description

The mechanical components of this unit are as follows:

- A torque converter with a torque converter clutch (TCC)
- A drive link assembly
- Intermediate/4th and Lo/Reverse friction band assemblies
- Forward, Coast, 2nd, Reverse, and Direct multiple disc clutch assemblies
- Two planetary gear sets: Input and Reaction
- Two roller clutches - Lo and 2nd
- One sprag clutch
- One vane type oil pump
- One control valve assembly
- A final drive and differential assembly

The electrical components of this unit are as follows:

- Two shift solenoid valves, 1-2 and 2-3
- A torque converter clutch pulse width modulated (TCC PWM) solenoid valve
- A transmission pressure control (PC) solenoid valve
- An automatic transmission fluid temperature (TFT) sensor
- Two speed sensors: input and output speed sensor
- An automatic transmission fluid pressure (TFP) manual valve position switch assembly
- An automatic transmission wiring harness assembly
- A park/neutral position switch

Adapt Function

Transmission Adapt Function

The 4T40-E transmission uses a line pressure control system, which has the ability to continuously adapt the system's line pressure. This compensates for normal wear of the following parts:

- The clutch fiber plates
- The seals
- The springs

The PCM maintains the Upshift Adapt parameters for the transmission The PCM monitors the AT ISS sensor and the AT OSS during commanded shifts in order to determine if a shift is occurring too fast or too slow. The PCM adjusts the signal from the transmission pressure control solenoid in order to maintain a set shift feel.

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

This page intentionally left blank.

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

This page intentionally left blank.

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

This page intentionally left blank.

Fasteners

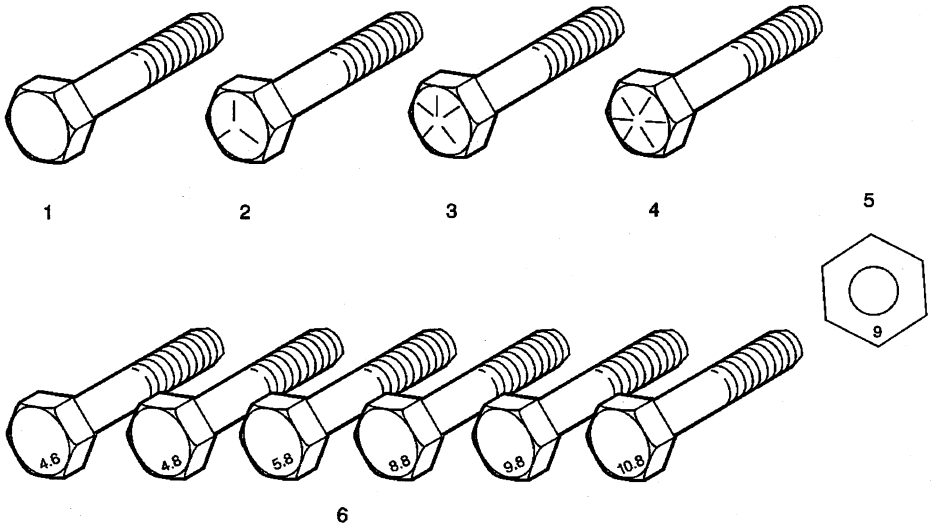
Metric Fasteners

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

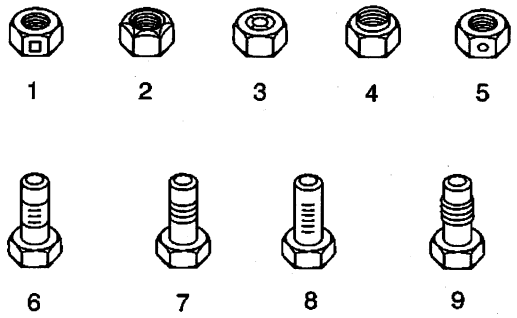
These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

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