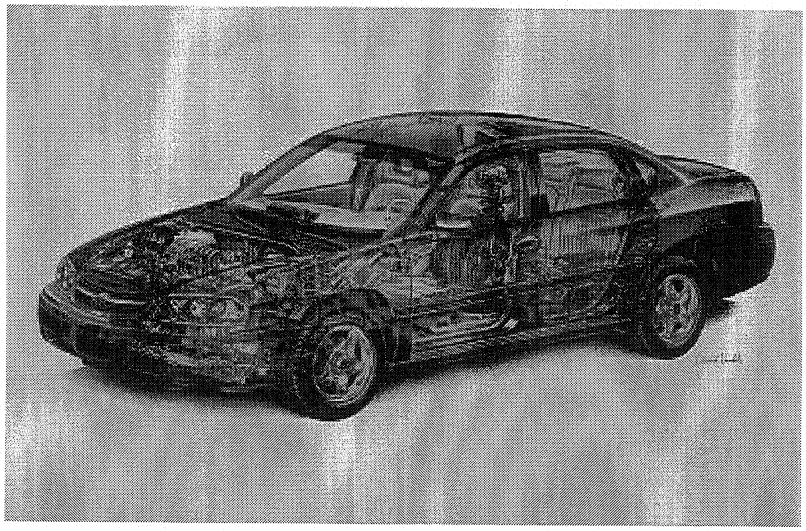
Chevrolet

Impala



2002

Table of Contents

Product Information

2002 Impala: The Car You'll Love To Drive

The Impala nameplate is the best-selling passenger car in Chevrolet history. Throughout the years customers have embraced the ride, handling, style and value of the Impala. In the early months of 2001, Impala reprised that popularity with record-setting monthly sales. In 2002, Chevrolet will continue its great heritage with new standard amenities and a sport appearance package, which will be unveiled during an Olympic Torch Relay run.

"The 2002 Impala builds on the heritage of a great car," said Don Parkinson, Impala brand manager. "Impala sales are strong – currently among the top 10 best-selling passenger cars. Since its introduction, Americans have shown they continue to love Impala. It's just plain fun to drive."

New amenities for 2002

Driver and front passenger dual temperature controls allow greater comfort, and will now be standard on all Impalas. Also standard on all models is AM/FM stereo with cassette and Radio Data System (RDS). The RDS-capable stereo may be programmed to interrupt a cassette or CD with important traffic bulletins or emergency weather reports. A new premium sound system delivers enhanced quality with fatigue-free sound reproduction.

Impala has new features that enhance the safety and comfort of the vehicle's passengers. The LATCH (Lower Anchorages and Top tethers for Children) system is standardized and allows child seat use without the vehicle's safety belts, making installing child safety seats easier.

A new leather accent bench seat is available on the LS model.

Two exterior colors are also introduced: Bright Red and Medium Green Pearl.

Smooth V6 performance

Impala has the highest fuel economy of any V6 in the industry, coupled with solid performance (0-60 mph in 9.1 seconds in the LS).

Impala owes its rigidity and stiffness, quiet ride and terrific suspension to a carefully engineered chassis and body architecture. An extruded aluminum engine cradle – a first for mass production – helps isolate engine noise and vibration.

Two dependable engines – the 3400 V6 and the award-winning 3800 V6 – power the impressive ride. The 3400 V6 provides 180 horsepower and 205 lb-ft of torque, while the 3800 V6 puts out 200 hp and 225 lb-ft of torque.

Roominess and comfort

The 2002 Impala offers unparalleled large car room with midsize exterior proportions. The base model has room for six passengers and 18.6 cubic feet of trunk space.

The Impala Sedan comes well equipped with auxiliary lighting in the glove box and trunk, electric rear window defogger, delayed exit/entry lighting, and intermittent variable-speed windshield wipers. Impala LS has a long list of standard features, including passenger assist grips, a trunk cargo net, split-folding rear seat and cruise control.

Safety and security

The Impala has a frontal rating of 5 stars on the driver's side and five stars on the passenger's side. The Impala has a side impact rating of 4 stars on the driver's side and four stars on the passenger's side. Impala has met 2003 Federal head impact criteria since its introduction.

More than 100 standard safety and security features make Impala a worry-free car to drive. Impala LS features a driver's side-impact air bag, remote keyless entry, traction control, tire inflation monitoring system and antilock brakes, all Optional on Impala Sedan.

Standard features on all models include passive theft-deterrent system, battery rundown protection and daytime running lamps. In addition, a "limp home" mode allows the car to be driven to a nearby service station even after a complete loss of coolant.

Sport appearance package/Torchbearers lead vehicle

To honor the Salt Lake City Winter Olympic Games, Chevrolet will offer a special sport appearance package for the Impala. The package is also on vehicles that will lead the Olympic Torchbearers, and will travel through 125 U.S. cities in 65 days.

The special package includes specific wheels and rear taillamps; a new fascia; 16-inch pace car aluminum wheels; interior appointments; and a special gauge package. The vehicle leading the Olympic Torchbearers will be monochromatic black, however, retail vehicles will be available in selected colors.

New For 2002

- Sport appearance package includes different rear taillamps and front fascia enhancements, interior appointments, special gauge group and 16-inch pace car aluminum wheels
- Standard driver and front passenger temperature controls
- AM/FM stereo with cassette and RDS now standard on all models
- New enhanced premium sound system on CD and CD/cassette combination radios
- Lower Anchors and Tethers for Children (LATCH) seat attachment system now standard
- Leather accent bench seat now available on LS model
- New exterior colors: Bright Red and Medium Green Pearl

Model Lineup

	Engines		Transmission
	3.4-liter 3400 V6	3.8-liter 3800 V6	4-Speed auto
Impala Sedan	S	O	S
Impala LS	–	S	S

Standard s
Optional o
Not available –

Specifications

Overview

Models:	Chevrolet Impala Sedan, Impala LS
Body style / driveline:	front-engine, front-drive, five- / six-passenger sedan
Body material:	two-sided galvanized steel (except roof)
EPA vehicle class:	large (although built on a midsize architecture)
Manufacturing location:	Oshawa, Ontario, Canada
Key competitors:	Ford Taurus, Dodge Intrepid, Honda Accord, Toyota Avalon, Toyota Camry

Engine

	3.4L 3400 V6 (LA1)	3.8L 3800 V6 (L36)
Type:	3400 V6 SFI, cast-iron	3800 SFI V6, cast-iron
Displacement (cu in / cc):	205 / 3359	231 / 3785
Bore & stroke (in / mm):	3.62 x 3.31 / 92 x 84.1	3.80 x 3.40 / 96.5 x 86.4
Cylinder head material:	cast-aluminum	cast-iron
Valvetrain:	OHV, two per cylinder	OHV, two per cylinder
Ignition system:	direct	direct
Fuel injection / delivery:	sequential fuel injection	sequential fuel injection
Compression ratio:	9.5:1	9.4:1
Horsepower (hp / kw @ rpm):	180 / 134 @ 5200	200 / 149 @ 5200
Torque (lb-ft / Nm @ rpm):	205 / 278 @ 4000	225 / 305 @ 4000
Recommended fuel:	87 octane	87 octane
Maximum engine speed (rpm):	6000	6000
Estimated fuel economy (mpg city / hwy / combined):	21 / 32 / 27	20 / 30 / 26

Transmission

Type:	4T65-E, four-speed automatic, front-wheel drive
Gear ratios (:1):	
First:	2.92
Second:	1.57
Third:	1.00
Fourth:	0.71
Reverse:	2.39
Final drive ratio:	Sedan: 2.86:1; LS Sedan: 3.05:1

Chassis/Suspension

Type:	four-wheel independent suspension with specially tuned MacPherson struts at all four corners
Front:	variable-rate front coil springs, hollow 32-mm stabilizer bar
Rear:	non-linear coil springs, solid 14-mm stabilizer bar
Steering:	power rack-and-pinion for all models
Ratio:	3400 V6 engine: 15.2:1; 3800 V6 engine: 13.3:1
Steering wheel turns, lock-to-lock:	2.9
Turning circle, curb-to-curb (ft / m):	38.0 / 11.6

Brakes

Type:	power-assisted four-wheel disc, standard ABS for LS
Front (diameter x thickness, in / mm):	11.0 x 1.26 / 303 x 32
Rear (diameter x thickness, in / mm):	10.9 x .43 / 278 x 11

Wheels/Tires

	Sedan	LS
Standard wheels:	16-inch steel with deluxe bolt-on wheel cover	16-inch sport, 5-spoke aluminum wheel
Optional wheel:	16-inch custom aluminum wheel	—
Standard tire:	P255/60R-16 all-season blackwalls	P255/60R-16 Touring
Optional tire:	P255/60R-16 Touring	—

Dimensions

Exterior

Wheelbase (in / mm):	110.5 / 2807
Overall length (in / mm):	200.0 / 5080
Overall width (in / mm):	73.0 / 1854
Overall height (in / mm):	57.3 / 1456
Track (in / mm):	
Front:	62.0 / 1574
Rear:	61.1 / 1551
Curb weight (lbs / kg):	sedan: 3308 / 1501; LS: 3450 / 1565
Weight distribution (% f / r):	62 / 38
Drag coefficient:	.30

Interior

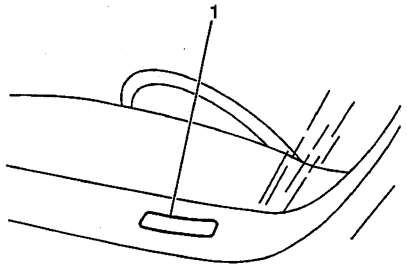
	Front	Rear
Seating capacity:	Sedan: 3; LS: 2	Sedan: 3; LS: 3
Head room (in / mm):	39.2 / 996	Rear: 36.8 / 935
Leg room (in / mm):	42.2 / 1072	38.4 / 975
Shoulder room (in / mm):	59.0 / 1499	58.9 / 1496
Hip room (in / mm):	56.5 / 1435	55.7 / 1415

Capacities

EPA passenger volume (cu ft / liters):	104 / 2945
EPA interior volume (cu ft / liters):	123.1 / 3485.5
Cargo volume (cu ft / liters):	18.6 / 526.7
Trailer towing (max lbs / kg):	1000 / 454
Fuel tank capacity (gals / liters):	17.0 / 64.4
Engine oil (qts / liters):	3400 V6: 4.5 / 4.3; 3800 V6: 4.3 / 4.1
Engine coolant (qts / liters):	3400 V6: 11.3 / 10.7; 3800 V6: 11.7 / 11.1

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	2	Canada
2	Manufacturer	G	General Motors
3	Make	1	Chevrolet
4	Car Line	W	Impala, Monte Carlo
5	Series	F H W X	Impala Impala LS Monte Carlo LS Monte Carlo SS
6	Body Style	1	2 Door Coupe (GM Style 27)
		5	4 Door Sedan (GM Style 19)
7	Restraint System	2	Active (Manual) Belts with Driver and Passenger Supplemental Inflatable Restraint
8	Engine Type	E	6 Cylinder MFI High Output 3400 (RPO Code LA1)
		K	6 Cylinder MFI High Output 3800 (RPO Code L36)
9	Check Digit	--	--
10	Model Year	2	2002
11	Plant Location	1	Oshawa #2
		9	Oshawa #1
12-17	Plant Sequence Number	--	--

VIN Derivative

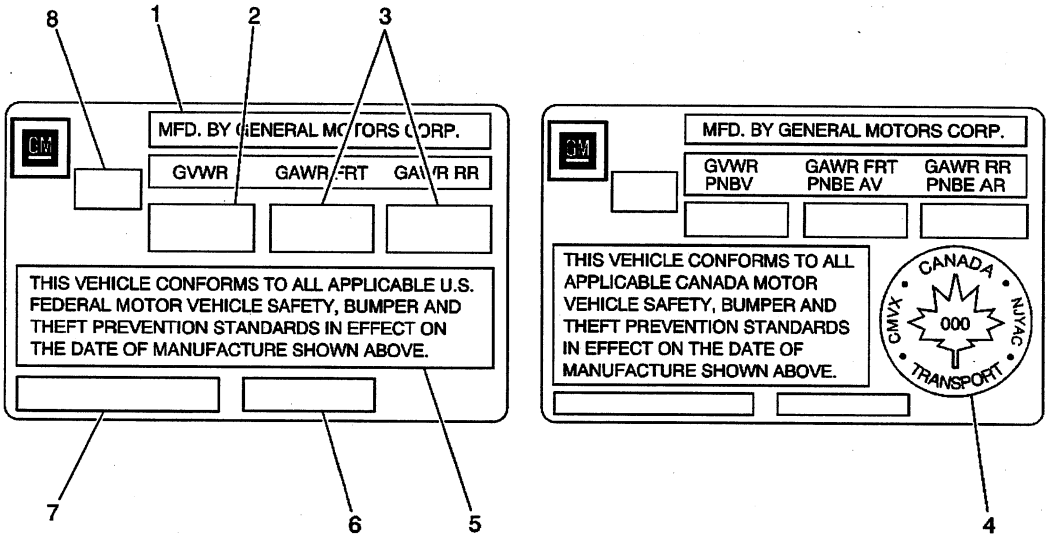
All engines and transmissions are stamped or laser etched with a partial vehicle identification number (VIN), which was derived from the complete VIN. A VIN derivative contains the following nine positions:

Position	Definition	Character	Description
1	GM Division Identifier	1	Chevrolet
2	Model Year	2	2002
3	Assembly Plant	1	Oshawa #2
		9	Oshawa #1
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

Vehicle Certification Label



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

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

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

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

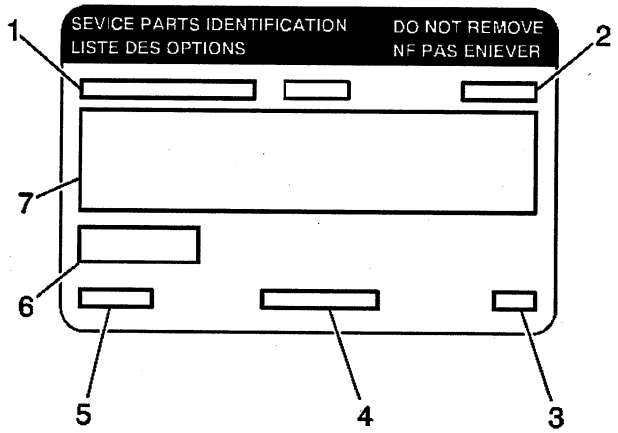
The GVW is the weight of the vehicle and everything the vehicle carries. Include the following items when figuring the GVW:

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

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

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

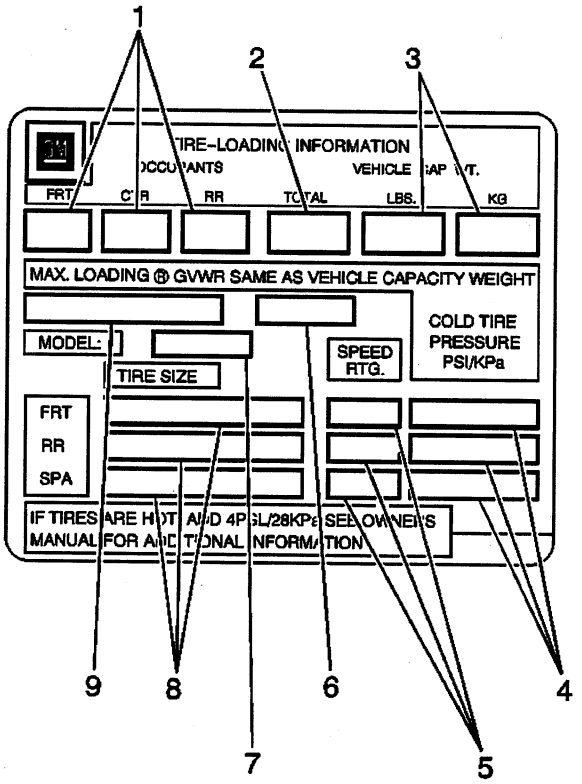
Service Parts Identification Label (SPID)



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

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

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

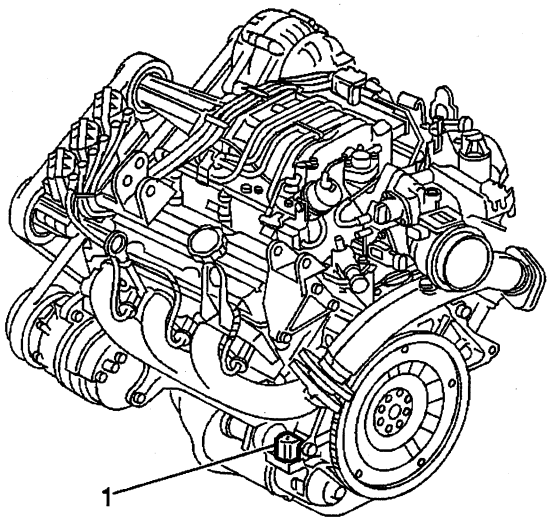
The Tire Placard is permanently located on the edge of the driver's door. Refer to the placard to obtain:

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

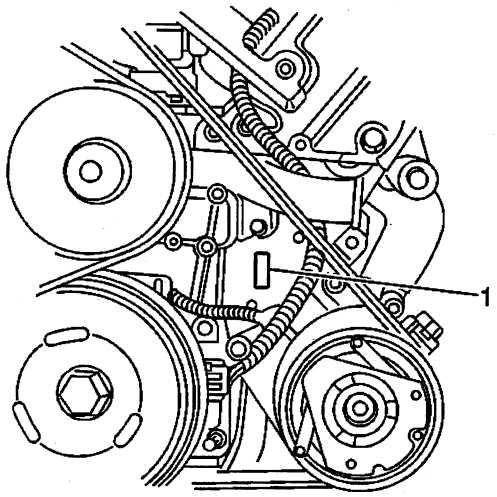
Engine ID and VIN Derivative Location

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

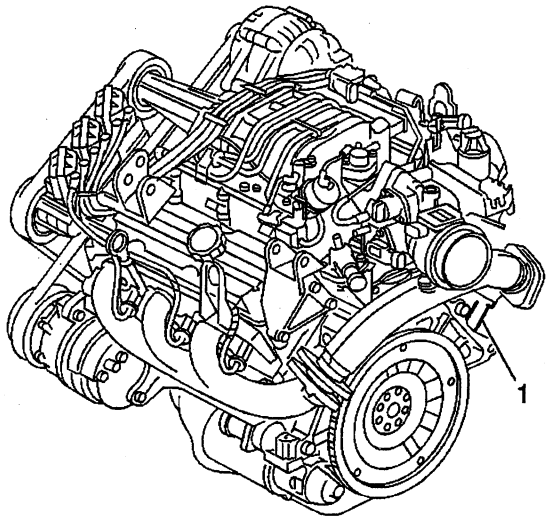
3.8L Engine VIN Derivative Location(c)



The primary location (1) of the VIN derivative for the 3800 L36 engine is in the center of the LH rocker arm or LH side of the engine in the oil pan rail area of the engine.

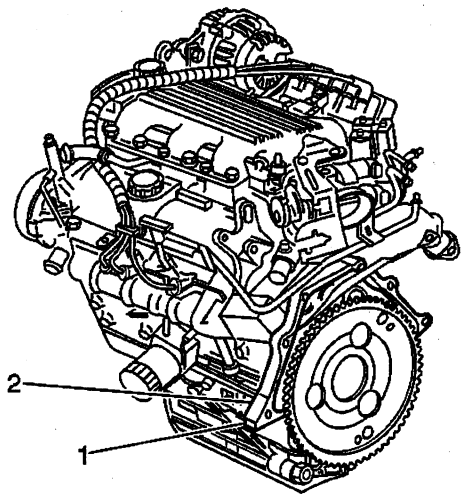


The secondary location (1) of the VIN derivative for the 3800 L36 engine is on the engine block below the water pump.

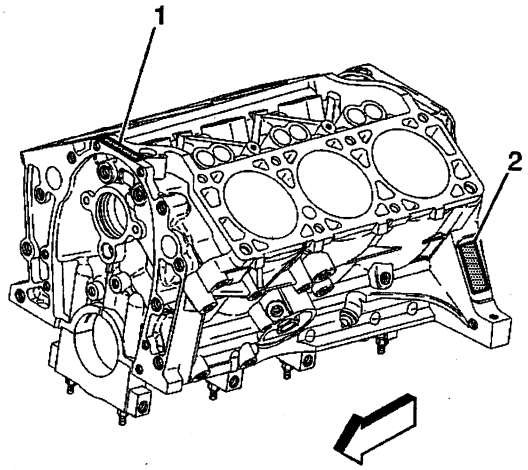


The primary location (1) of the Engine ID for the 3800 L36 engine is in the center of the LH rocker arm or LH side of the engine in the oil pan rail area of the engine.

3400 VIN E Engine



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



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

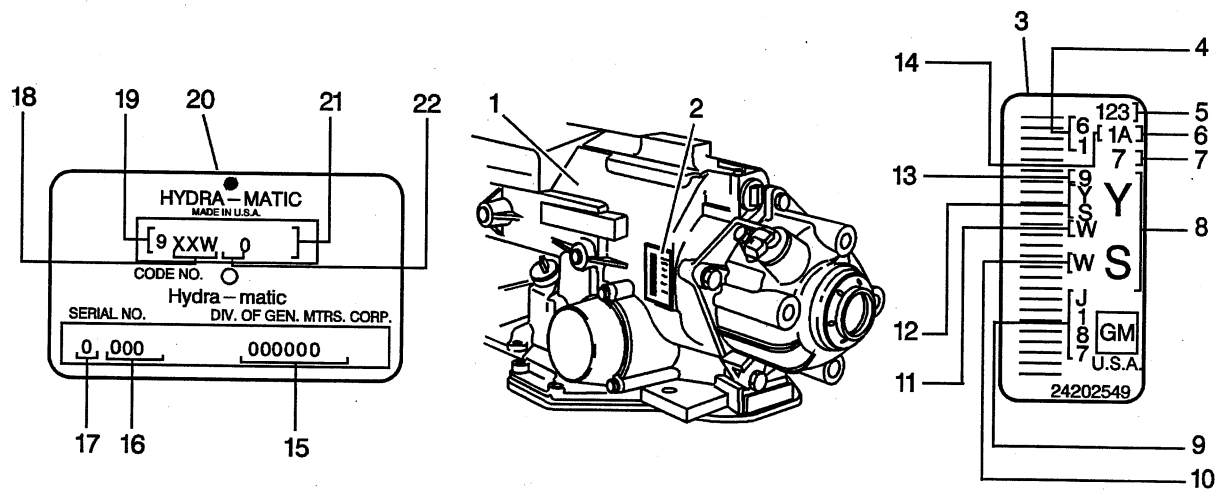
The primary location (1) of the Engine ID for the 3400 (LA1) engine on top of the RH rocker arm cover or front of RH oil pan rail. The secondary location (2) of the VIN derivative for the 3400 (LA1) engine is above the starter motor on the engine block. For additional information, refer to VIN Derivative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

Engine and Transmission Usage

Body Type	Car Line (Division)	Engine	Fuel System	Engine Rpo	Transmission	Transmission Rpo
W	Monte Carlo LS/ Impala (Base)	3.4L V6	MFI	LA1	4T65E	M15
W	Monte Carlo SS/ Impala (Optional)/ Impala LS	3.8L V6	MFI	L36	4T65E	M15

Transmission ID and VIN Derivative Location

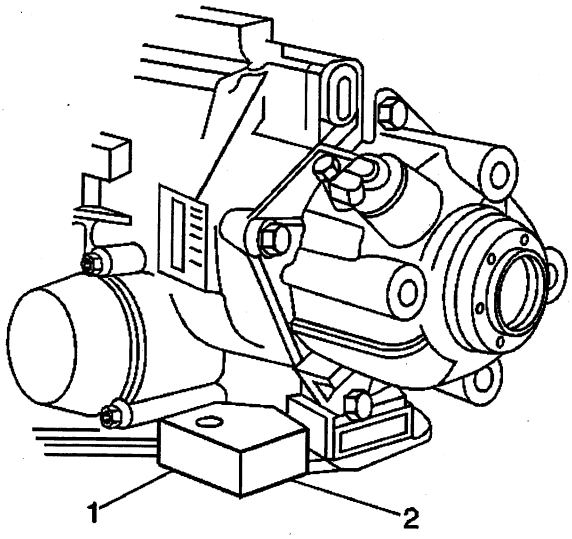
Transmission ID and VIN Derivative Location 4T60-E/4T65-E(c)



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

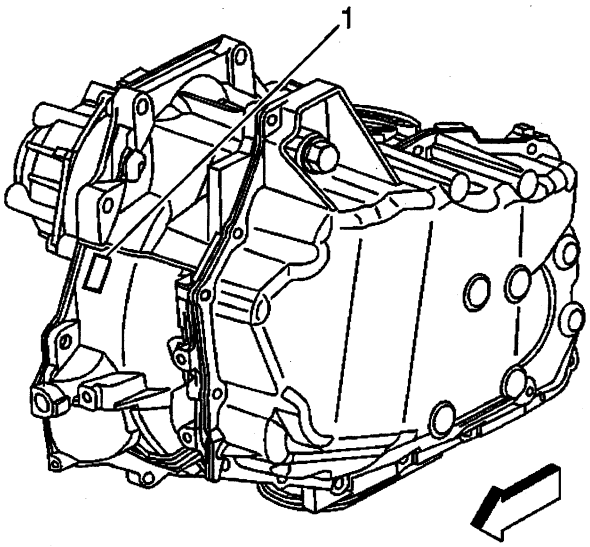
All automatic transmissions have a metal identification (ID) nameplate (9) attached to the case exterior.

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



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

Transaxle VIN Derivative Stamping(c)



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

Labeling - Anti-Theft

Notice

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

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

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

RPO Code List

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

RPO	Description
AG1	Adjuster, Driver Seat Power 6-Way
AG2	Adjuster, Passenger Seat Power 6-Way
AK5	Restraint System, Front Seat Inflatable Driver and Passenger
AM6	Seat, Front Split Bench
AM9	Split Folding Rear Seat
AP9	Convenience Net
AR9	Seat Front Bucket, Deluxe
AU0	Lock Control, Remote Entry
AW6	Restraint System Seat, Inflatable, Driver and Passenger Front, Inflatable Driver Side
A75	Seat Cushion Back Front, HD
A76	Seat Cushion Back Rear, HD
A98	Lock Control Rear Compartment Lid, Remoter Control Electric Release, Ignition Powered
BAG	Parts Package Export
BYP	Sales Sport Equipment Package
B18	Ornamentation Interior, Deluxe
B3V	Add Test Water
B34	Covering, Front Floor Mats, Carpeted Inserts
B35	Covering, Rear Floor Mats, Carpeted Inserts
B42	Covering Floor Mat, Luggage Compartment, Fitted
CD5	Wiper System Windshield, High Speed Antilift
CF5	Roof, Sun Glass, Sliding Electric
CJ3	HVAC System, Air Conditioner Front, Manual Temperature Control, Auxiliary Temperature Control
CKD	Vehicle Completely Knocked Down CKD
C79	Interior Lamp, Roof Rail, Courtesy and Single Reading
DD6	Mirror, Inside Rear View Light Sensitive, Dual Reading Lamps
DG7	Mirror Outside LH and RH, Remote Control, Electric, Color
DH6	Mirror, Inside Sunshade Illuminated LH and RH
DK5	Mirror Outside LH and RH, Remote Control, Electric, Heated, Color
DK6	Console Roof Interior
DL5	Decal, Roadside Service Information
D55	Console Front Compartment, Floor
D81	Aero Wing Rear Spoiler
EXP	Export
E27	Handle, Assist, Pass
E28	Handle, Assist
FE1	Suspension System, Soft Ride
FE2	Suspension System, Ride, Handling
FE3	Suspension System, Sport
FQ3	Ratio, Transaxle Final Drive, 2.86
FR9	Ratio, Transaxle Final Drive, 3.29
F83	Ratio, Transaxle Final Drive, 3.05
JA9	Brake, Heavy Weight, Disc/Disc
JB9	Brake, Light Weight, Disc/Disc
JL9	Brake System, Power Front and Rear Disc, Antilock Front and Rear Wheel
J65	Brake System, Power Front and Rear Disc
KA1	Heater, Seat

KG7	Generator, 125 Amp
K05	Heater, Engine Block
K20	Module, Electronic Control
K29	Module, Powertrain Control
K34	Cruise Control, Automatic, Electronic
K43	Generator, 102-Amp
LA1	Engine Gas, 6 CYL, 3.4L, MFI, HO, GM
L36	Engine, Gas, 6 CyL, 3.8 L, MFI, HO, ERV6 Series
MXO	Merchandised Transmission Automatic Provisions, O/D
M15	Transmission, Automatic 4-Speed 4T65-E, Enhanced Electronic
NB8	Emission System California LEV
NC1	Emission System California LEV
NC8	Emission System California, ULEV
NF7	Emission System, Federal, NLEV
NK5	Steering Wheel, Standard
NP5	Steering Wheel, Leather-Wrapped
NW9	Electronic Traction Control
NX5	Wheel, 16 x 16.5, Aluminum, Sport
N05	Lock Control, Fuel Filler Cap
N81	Tire, Spare, Full Size
N92	Cover, Wheel, Bolt-on
N99	Wheel, Heavy Duty
OSH	Plant Code Oshawa 1, Ontario Canada
PY0	Wheel, 16 x 6.5 Aluminum
P01	Trim, Disc Wheel, VAR 1
QB5	Wheel 16 x 6.5, Steel
QD1	Wheel 16 x 6.5, Aluminum, Styled
QD2	Wheel 16 x 6.5, Aluminum, 5 Spokes
QD5	Wheel Spare Compact, Aluminum
QNX	Tire, All P225/60R16/N BL R/PE ST TL AL2
QPX	Tire, All P225/60R16-97S BW R/PE ST TL ALS
QTI	Tire, All P225/60R16-97H BW R/PE ST TL AL3, Police Usage
QVG	Tire, All P225/60R16-97S BL R/PE ST TL AL3
RPA	Rear Parking Assist
T53	Lamp Package Emergency Vehicle Rear Compartment Lid
UA6	Theft Deterrent System
UB3	Cluster Instrument, Oil, Coolant, Temperature, Volts, Trip Odometer, Tachometer
UE1	Communication System Vehicle, G.P.S. 1
UG1	Garage Door Opener, Universal
UH8	Cluster, Instrument, Coolant Temperature, Trip Odometer, Tachometer
UJ6	Indicator, Low Tire Pressure
UK3	Control Steering Wheel, Accessory
UL0	Radio, AM/FM Stereo, Seek/Scan, Automatic Reverse Music Search Cassette, Automatic Tone, Clock, ETR
UL2	European Frequencies
UN0	Radio, AM/FM Stereo, Seek/Scan, CD, Auto Tone, Clock, ETR
UP0	Radio, AM/FM Stereo, Seek/Scan, Automatic Reverse Music Search Cassette, CD, Auto Tone, Clock ETR
UN9	Radio Equipment Suppression
UQ3	Speaker System, Performance-Enhanced Audio
UT7	Provision Auxiliary Electrical System Ground
UW6	Speaker System 6, Dual F/D Tweet and MWoof, Dual Ext Range Shelf
U11	Cluster Instrument, Police, Certified Speedo
U19	Speedometer, Instrument Cluster, Kilometer and Miles, Kilometer Odometer

U2E	Instrument Cluster, Coolant Temperature, Trip Odometer
U62	Speaker System 4, Dual Coax Front, Dual Coax Package Shelf
U68	Display Driver Information Center
U77	Antenna, Rear Window Radio
VG9	Protector Wax, Exterior Body
VH9	Envelope, Owner Information Manual
VK3	License Plate Mounting Package, Front
VR6	Hook Tie-Down Shipping
V08	Cooling System Heavy Duty
WU1	Switch Instrumentation Lighting Shut Off
WX7	Wiring Provisions
W86	Equipment, Misc Equipment for Venezuela GMV Controlled
W87	Parts, North American Parts Sourced in Venezuela GMV Controlled
W99	Equipment, Misc Equipment for Venezuela GM Platform Controlled
X44	Parts, North American Sourced and Shipped to Outside Supplier & Checked GMCL Controlled
Z49	English/French SIR Warning Label
6A3	Covering Floor Mats, Front land Rear, H.D.
6B2	Handle Rear Door, Inoperative
6B7	Wiring Provisions, Roof Panel Access Hole Center
6C7	Lamp Dome Pass
6C8	Cable RG58 A/U Coax Radio Antenna
6E2	Cylinder Unit Single Key System, Coded DF81
6E8	Cylinder Unit Single Key System, Coded NU97
6F5	Wiring Provisions, Roof
6J1	Wiring Provisions, Ignition and Main Power Supply
6J3	Wiring Provisions, Headlamp Flasher, Grille Lamps & Speakers
6J4	Wiring Provisions, Horn/Siren Circuit
6J5	Wiring Provisions, Roof Panel Access Hole RH SI
6J6	Lamp Package Emergency Vehicle R/WDO Panel
6J7	Flasher Headlamp
6N5	Handle Inoperative, RR Window
6N6	Lock Control RR Door, Inoperative
7B3	Suspension System, Special Handling
7L9	Cooling System Steering, Oil
7X6	Spotlamp Left Pillar Mounted, Halogen
7X7	Spotlamp Left & Right Pillar Mounted, Halogen
7X8	Spotlamp Provisions, Left
7X9	Spotlamp Provisions, Left & Right
7Y6	Switch Dome Lamp, Door Jamb Inoperative
8X1	Vehicle Label, Fasten Seat Belts

Technical Information

Maintenance and Lubrication

Capacities - Approximate Fluid

Application	Specification	
	Metric	English
Automatic Transmission		
• Pan Removal	7.0 liters	7.4 quarts
• Complete Overhaul	9.5 liters	10.0 quarts
• Dry	12.7 liters	13.4 quarts
Engine Cooling System		
• 3.4L, LA1	10.7 liters	11.3 quarts
• 3.8L, L36	11.0 liters	11.7 quarts
Engine Oil		
• 3.4L, LA1		
• With Filter Change	4.3 liters	4.5 quarts
• Without Filter Change	3.75 liters	4.0 quarts
• 3.8L, L36		
• With Filter Change	4.3 liters	4.5 quarts
• Without Filter Change	3.75 liters	4.0 quarts
Fuel Tank	64.0 liters	17.0 gallons
Power Steering Capacities	0.70 liters	1.5 pints
Wheel Nut Torque	140 N·m	100 lb ft

Maintenance Items

Item	Type/Part Number
Automatic Transmission Filter	24206433
Engine Air Cleaner/Filter	A1614C
Engine Oil Filter	
• 3.4L (LA1)	AC Type PF47
Passenger Compartment Air Filter	GM P/N 10406026
• 3.8L (L36)	AC Type PF47
Spark Plugs and Gap	
• 3.4L (LA1)	AC Type 41-101, 1.52 mm (0.060 in) Gap
• 3.8L (L36)	AC Type 41-101, 1.52 mm (0.060 in) Gap
Windshield Wiper Blades	GM P/N 10418004 - Hook Type, 56.0 cm (22 in)

Tire Inflation Pressure Specifications

Application	Specification	
	Metric	English
Front and rear tires	210 kPa	30 psi
Compact spare	420 kPa	60 psi
Police Vehicle	240 kPa	35 psi

Fluid and Lubricant Recommendations

Usage	Fluid/Lubricant
Automatic Transaxle	DEXRON®-III Automatic Transaxle Fluid
Engine Oil	Engine oil with the American Petroleum Institute Certified For Gasoline Engines Starburst symbol of the proper viscosity.
Engine Oil (Export)	In areas of the world other than North America, it may be difficult to find oils that display the API STARBURST, look for oils that meet the API Service SJ and ACEA requirements.
Engine Coolant	50/50 mixture of clean, drinkable water and GM Goodwrench® DEX-COOL® or Havoline® DEX-COOL® (silicate-free) coolant
Hood and Door Hinges	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241 or equivalent)
Hood Latch Assembly, Secondary Latch, Pivots, Spring Anchor and Release Pawl	Lubriplate® Lubricant Aerosol (GM P/N 12346293 or equivalent) or lubricant meeting requirements of NLGI #2 Cataegory LB or GC-LB
Hydraulic Brake System	Delco Supreme 11® Brake Fluid (GM P/N 12377967 or equivalent DOT-3 brake fluid)
Key Lock Cylinders	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241 or equivalent)
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 Part No. 1051515) or equivalent.

Descriptions and Operations

Power Steering System Description

Power Steering Pump Description

The power steering pump is a vane-type pump which provides hydraulic pressure for the system. The power steering system consists of the following components:

- The driveshaft
- The pump housing
- The pump ring
- The pressure plate
- The thrust plate
- The flow control valve
- The rotor
- The vanes

The opening at the rear of the pump housing contains the following components:

- The pump ring
- The pressure plate
- The thrust plate
- The rotor
- The vanes
- The end plate

The small opening on the side of the housing contains the following components:

- The pressure line fitting
- The flow control valve
- The spring

The flow control orifice is a component of the pressure line fitting. A pressure relief valve inside the flow control valve limits the pump pressure.

Power Steering Gear Description

The movement of the steering wheel has the following results:

1. The movement of the steering wheel transfers to the pinion.
2. The movement of the pinion transfers through the pinion teeth.
3. The pinion teeth mesh with the teeth on the rack.
4. This action causes the rack to move.

The power rack and pinion steering system has a rotary control valve. The rotary control valve directs the hydraulic fluid that flows from the hydraulic pump to either side of the rack piston.

The integral pick piston attaches to the rack.

The integral rack piston has the following effects:

1. The rack piston converts hydraulic pressure to linear force.
2. The linear force moves the rack left or right.
3. The linear force transmits to the inner and outer tie rods to the steering knuckles.
4. The steering knuckles turn the wheels.

The system will require more steering effort if hydraulic assist is not available. If hydraulic assist is not available, the system will maintain manual control.

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

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

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

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

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

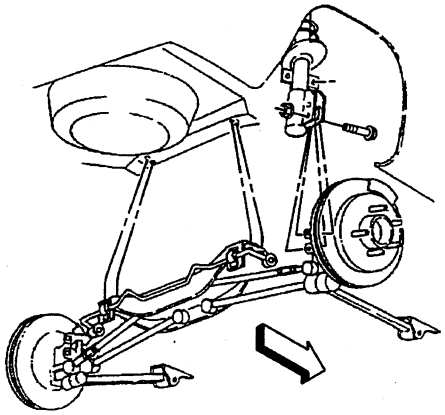
A ball joint assembly is riveted and bolted to the outer end of the upper control arm. A castellated nut and a cotter pin join the steering knuckle to the upper ball joint.

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

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

Rear Suspension

The rear suspension utilizes coil springs over struts and lightweight aluminum knuckles. Each wheel is mounted to a tri-link independent suspension system. The three links are identified as the inverted U channel trailing arm and the tubular front and rear rods.



Parallel links allow the rear wheels to reflect upward when the rear wheels hit a road hazard, without moving the toe angle in a positive direction. An advantage of this suspension system is the reduction of unsprung and overall weight. Handling is improved with the independent action of each rear wheel. The rods control the lateral wheel deflection.

Several techniques are employed to achieve this independent wheel movement. The tri-link design may be compared to a right angle. The wheel is located at the right angle formed by the rods and the trailing arm. The ends of the tri-links hinge in order to provide vertical wheel travel. The solid links force the wheel to travel through a controlled arc whose fore-aft position is determined by the trailing arm, and whose lateral position is determined by the rods.

Aside from maintaining geometric wheel location, each portion of the suspension has additional functions. The knuckle supports the brake caliper. All brake torque and braking forces are transmitted through the tri-links and the strut. The final duty of the rods is to maintain the camber angle of the wheel throughout the wheel's travel, and to allow for setting the toe. The overall result of this rear suspension geometry is to maintain the rear wheels in a near vertical position at all times.

The stabilizer shaft attaches to the stabilizer bar drop link and extends rearward, where the stabilizer connects to the rear suspension support by two rubber bushings and mounting brackets.

A non-serviceable unit hub and bearing bolts to the knuckle. This hub and bearing is a sealed, maintenance-free unit.

Check the suspension system periodically for the following conditions:

- Shock absorbency
- Bushing durability
- Tightness of attaching bolts
- Visible damage
- Misalignment
- Excessive wear

Wheels and Tires

General Description

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

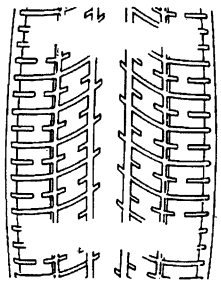
The following factors have an important influence on tire life:

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

The following factors increase tire wear:

- Heavy cornering
- Excessively rapid acceleration
- Heavy braking

Tread Wear Indicators Description



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

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

Metric Wheel Nuts and Bolts Description

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

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

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

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

Tire Inflation Description

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

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

Inspect the tire pressure when the following conditions apply:

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

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

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

Inflation Pressure Conversion (Kilopascals to PSI)

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

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

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

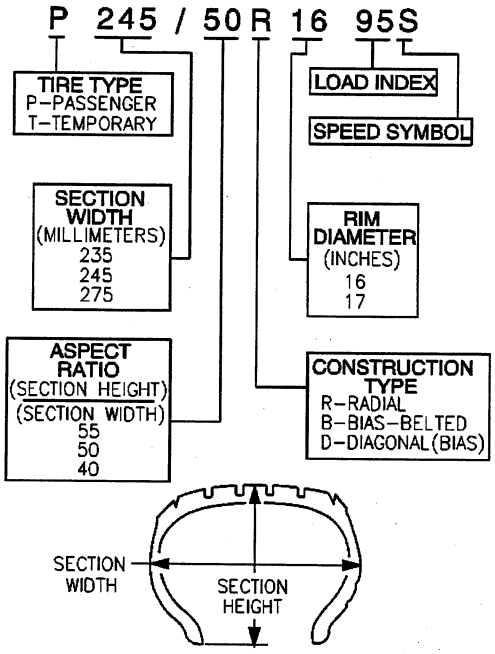
Tires with a lower than recommended pressure can cause the following conditions:

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

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

- Uneven braking
- Steering lead
- Reduced vehicle handling

P-Metric Sized Tires Description



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

Tire Inflation Monitoring System Operation

The tire pressure monitor (TPM) system alerts the driver when the pressure changes in one of the tires. The system only detects a low pressure condition while the vehicle is being driven. Once a low tire pressure condition is detected, the system informs the driver whenever the ignition is ON.

The LOW TIRE PRESSURE indicator illuminates if the tire pressure in one or more tires become at least 82 kPa (12 psi) lower or higher than the other tires. The message does not appear if the system is not calibrated properly. The system does not inform the driver which tire is low. To clear this message, set the tire pressures in all four tires to the proper pressures and perform the system reset procedure

The Tire Pressure Monitor software requires approximately one half hour of straight line driving to complete the TPM autolearn. There are several speed ranges that the EBCM needs to learn the tire inflation configuration in order to have the full capability of detecting a low tire condition. The speed detection ranges are the following:

- 24-64 km/h (15-40 mph)
- 64-113 km/h (40-70 mph)
- 113-145 km/h (70-90 mph)

Each speed range has 2 modes of low tire detection.

- Monitor Mode 1
- Monitor Mode 2

The EBCM learns the tire inflation configuration for each speed range independently. In Monitor Mode 1, the EBCM has only partially learned the tire inflation configuration for the speed range and has limited detection capability for a low tire condition. In Monitor Mode 2, the EBCM has fully learned the tire inflation configuration for the speed range and has full detection capability for a low tire condition. If the EBCM is not in Monitor Mode 1 or Monitor Mode 2, a low tire condition cannot be detected because the EBCM has not learned the tire inflation configuration of the vehicle.

Driveline System Description and Operation

Wheel Drive Shafts

Front wheel drive axles are flexible assemblies.

Front wheel drive axles consist of the following components:

- A front wheel drive shaft tri-pot joint (inner joint)
- A front wheel drive shaft constant velocity joint (outer joint)
- A front wheel drive shaft The front wheel drive shaft connects the front wheel drive shaft tri-pot joint and the front wheel drive shaft constant velocity joint.

The front wheel drive shaft tri-pot joint is completely flexible. The front wheel drive shaft tri-pot joint can move in and out.

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

Boots (Seals) And Clamps

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

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

The boot (seal) provides the following functions:

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

Important

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

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

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

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

- The housing
- The front wheel drive shaft

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

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

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

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

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

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

Front Wheel Drive Shaft Constant Velocity Joint (Outer Joint)

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

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

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

Braking System Description and Operation

Hydraulic Brake System Description and Operation

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir

Contains supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.

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

Hydraulic Brake Pressure Balance Control System

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

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

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

Converts hydraulic input pressure into mechanical output force.

System Operation

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

Brake Assist System Description and Operation

System Component Description

The brake assist system consists of the following:

Brake Pedal

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

Brake Pedal Pushrod

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

Vacuum Brake Booster

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

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

Vacuum Source

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

Vacuum Source Delivery System

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

System Operation

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

Disc Brake System Description and Operation

System Component Description

The disc brake system consists of the following components:

Disc Brake Pads

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

Disc Brake Rotors

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

Disc Brake Pad Hardware

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

Disc Brake Caliper Hardware

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

System Operation

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

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

Park Brake System Description and Operation

System Component Description

The park brake system consists of the following:

Park Brake Pedal Assembly

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

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

Park Brake Cables

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

Park Brake Cable Equalizer

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

Park Brake Apply Lever

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

Park Brake Actuator/Adjuster

Uses multiplied input force from apply lever to expand drum brake shoes toward the friction surface of the brake drum.

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

Drum Brake Shoes

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

System Operation

Park brake apply input force is received by the park brake lever assembly being applied. The input force is multiplied by the lever assembly, transferred, and evenly distributed, through the park brake cables and the park brake cable equalizer, to the left and right park brake apply levers. The park brake apply levers multiply and transfer the apply input force to the park brake actuators/adjusters which expand the drum brake shoes toward the friction surface of the brake drum in order to prevent the rotation of the rear tire and wheel assemblies. The park brake lever assembly releases an applied park brake system when it is returned to the at-rest, lowered, position.

ABS Description and Operation

Antilock Brake System

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

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

or popping noise may also be heard as the solenoid valves cycle rapidly. During antilock braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during antilock operation.

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

Engine Description and Operation

Engine Mechanical – 3.4L

Mechanical Specifications

Application	Specification	
	Metric	English
General Data		
• Engine Type	60 degree V-6	
• Displacement	3.4L	204 cu in
• RPO - VIN Code	LA1 (E)	
• Bore	92 mm	3.62 in
• Stroke	84 mm	3.31 in
• Compression Ratio	9.6:1	
• Firing Order	1-2-3-4-5-6	
• Oil Pressure - Warm	103 kPa	15 psi @ 1100 RPM
Cylinder Bore		
• Diameter	92.019-92.037 mm	3.6228-3.6235 in
• Out Of Round Maximum	0.009 mm	0.00035 in
• Taper -- Thrust Side Maximum	0.010 mm	0.0004 in
Piston - non-coated		
• Diameter-Gaged on the skirt 50 mm (0.02 in) from the top of piston - production	91.985-92.003 mm	3.6215-3.222 in
• Diameter-Gaged on the skirt 50 mm (0.02 in) from the top of piston - service limit	91.955-91.973 mm	3.620-3.621 in
• Clearance - production	0.016-0.052 mm	0.0006-0.0020 in
• Clearance - service limit	0.047-0.083 mm	0.0019-0.0033 in
• Pin Bore	23.005-23.010 mm	0.9057-0.9059 in
Piston - Grafal coated		
• Diameter-Gaged on the skirt 50 mm (0.02 in) from the top of piston - production	91.990-92.028 mm	3.6217-3.6232 in
• Diameter-Gaged on the skirt 50 mm (0.02 in) from the top of piston - service limit	91.950-91.988 mm	3.6201-3.6216 in
• Clearance - production	0.008-0.048 mm	0.00031-0.0019 in
• Clearance - service limit	0.032-0.088 mm	0.0013-0.0035 in
• Pin Bore	23.005-23.010 mm	0.9057-0.9059 in
Piston Ring		
• Top Groove Side Clearance	0.04-0.086 mm	0.002-0.0034 in
• Second Groove Side Clearance	0.04-0.09 mm	0.002-0.0035 in
• Top Ring Gap	0.21-0.48 mm	0.008-0.019 in
• Second Ring Gap	0.54-0.86 mm	0.0213-0.0339 in
• Oil Ring Groove Clearance	0.46-0.20 mm	0.0018-0.0079 in
• Gap in Cylinder Bore	0.31-0.89 mm	0.012-0.035 in
Piston Pin		
• Diameter	22.994-22.997 mm	0.9053-0.9054 in
• Clearance In Piston	0.008-0.016 mm	0.00031-0.00063 in
• Fit In Rod	-0.047 to -0.019 mm press fit	-0.0019 to -0.0007 in

Crankshaft		
• Main Journal Diameter	67.239-67.257 mm	2.6473-2.6483 in
• Main Journal Taper	0.005 mm	0.0002 in
• Out Of Round - Max	0.005 mm	0.0002 in
• Flange Runout - Max	0.04 mm	0.0016 in
• Cylinder Block Main Bearing Bore Diameter	72.155-72.168 mm	2.8407-2.8412 in
• Crankshaft Main Bearing Inside Diameter	67.289-67.316 mm	2.6492-2.6502 in
• Main Bearing Clearance	0.019-0.064 mm	0.0008-0.0025 in
• Main Thrust Bearing Clearance	0.032-0.077 mm	0.0012-0.0030 in
• Crankshaft End Play	0.060-0.210 mm	0.0024-0.0083 in
• Crankshaft Flange Runout - Max	0.04 mm	0.0016 in
Connecting Rod		
• Rod Bearing Journal Diameter	50.768-50.784 mm	1.9987-1.9994 in
• Rod Bearing Journal Taper - Max	0.005 mm	0.0002 in
• Rod Bearing Journal Out Of Round - Max	0.005 mm	0.0002 in
• Rod Bearing Bore Diameter	53.962-53.984 mm	2.124-2.125 in
• Rod Inside Bearing Diameter	50.812-50.850 mm	2.000-2.002 in
• Rod Bearing Journal Clearance	0.018-0.062 mm	0.0007-0.0024 in
• Rod Side Clearance	0.18-0.44 mm	0.007-0.017 in
Camshaft		
• Lobe Lift - Intake and Exhaust	6.9263 mm	0.2727 in
• Journal Diameter	47.45-47.48 mm	1.868-1.869 in
• Camshaft Bearing Bore Diameter-Front and Rear	51.03-51.08 mm	2.009-2.011 in
• Camshaft Bearing Bore Diameter-Middle #2 and #3	50.77-50.82 mm	1.999-2.001 in
• Camshaft Bearing Inside Diameter	47.523-47.549 mm	1.871-1.872 in
• Journal Clearance	0.026-0.101 mm	0.001-0.0039 in
• Journal Runout - Max	0.025 mm	0.001 in
Valve System		
• Roller Lifter	Hydraulic	
• Rocker Arm Ratio	1.60:1	
• Valve Face Angle	45 degrees	
• Seat Angle	46 degrees	
• Valve Seat Runout	0.050 mm	0.002 in
• Seat Width-Intake	1.55-1.80 mm	0.061-0.071 in
• Seat Width-Exhaust	1.70-2.0 mm	0.067-0.079 in
• Valve Margin - Minimum Intake	2.10 mm	0.083 in
• Valve Margin - Minimum Exhaust	2.70 mm	0.106 in
• Valve Stem Clearance	0.026-0.068 mm	0.0010-0.0027 in
Valve Spring		
• Valve Springs Free Length	48.5 mm	1.89 in
• Valve Springs Load - Closed	320 N @ 43.2 mm	75 lb @ 1.701 in
• Valve Springs Load - Open	1036 N @ 32 mm	230 lb @ 1.260 in
• Installed Height Intake-Exhaust	43.2 mm	1.701 in
• Approximate number of coils	6.55	
Oil Pump		
• Gear Lash	0.094-0.195 mm	0.0037-0.0077 in
• Gear Pocket Depth	30.52-30.58 mm	1.202-1.204 in
• Gear Pocket Diameter	38.176-38.226 mm	1.503-1.505 in

Oil Pump Gear		
• Length	30.45-30.48 mm	1.199-1.200 in
• Diameter	38.05-38.10 mm	1.498-1.500 in
• Side Clearance	0.038-0.088 mm	0.001-0.003 in
• End Clearance	0.040-0.125 mm	0.002-0.005 in
• Valve to Bore Clearance	0.038-0.089 mm	0.0015-0.0035 in

Fastener Tightening Specifications

Application	Specifications	
	Metric	English
Camshaft Position Sensor Bolt	10 N·m	89 lb in
Camshaft Sprocket Bolt	140 N·m	103 lb ft
Camshaft Thrust Plate Bolt	10 N·m	89 lb in
Connecting Rod Bearing Bolt		
• First Pass	20 N·m	18 lb ft
• Final Pass	75 degrees	
Coolant Drain Plug	19 N·m	14 lb ft
Coolant Temperature Sensor	23 N·m	17 lb ft
Crankshaft Balancer Bolt	103 N·m	76 lb ft
Crankshaft Oil Deflector Nut	25 N·m	18 lb ft
Crankshaft Position Sensor Bolt - Front Cover	10 N·m	89 lb in
Crankshaft Position Sensor Shield Bolt	11 N·m	98 lb in
Cylinder Head Bolt		
• First Pass	60 N·m	44 lb ft
• Final Pass	95 degrees	
Drive Belt Idler Pulley Bolt	50 N·m	37 lb ft
Drive Belt Shield Bolt	10 N·m	89 lb in
Drive Belt Tensioner Bolt	50 N·m	37 lb ft
EGR Valve to EGR Valve Pipe Bolt	30 N·m	22 lb ft
EGR Valve Adapter Pipe to Exhaust Manifold Nut	25 N·m	18 lb ft
Engine Flywheel Bolt	71 N·m	52 lb ft
Engine Front Cover Bolt - Large	55 N·m	41 lb ft
Engine Front Cover Bolt - Small	27 N·m	20 lb ft
Engine Mount Bracket Bolt	58 N·m	43 lb ft
Engine Mount Lower Nut	43 N·m	32 lb ft
Engine Mount Strut and Lift Bracket Bolt - Engine Left Rear	70 N·m	52 lb ft
Engine Mount Strut Bolt/Nut	48 N·m	35 lb ft
Engine Mount Strut Bracket Bolt - Upper Radiator Support	28 N·m	21 lb ft
Engine Mount Strut Bracket Bolt - Vehicle Right Side	50 N·m	37 lb ft
Engine Mount Upper Nut	47 N·m	35 lb ft
Engine Oil Pressure Indicator Switch	16 N·m	12 lb ft
Engine Wiring Harness Bracket Bolt	13 N·m	115 lb in
Fuel Line Bracket Bolt/Stud	20 N·m	15 lb ft
Fuel Pipe Clip Bolt	8 N·m	71 lb in
Intake Manifold Coolant Pipe Bolt	10 N·m	89 lb in
Knock Sensor	19 N·m	14 lb ft
Lower Intake Manifold Bolt		
• First Pass	7 N·m	62 lb in
• Final Pass	13 N·m	115 lb in
MAP Sensor Bolt	5 N·m	44 lb in
MAP Sensor Bracket Bolt	25 N·m	18 lb ft
Oil Filter Bypass Hole Plug	19 N·m	14 lb ft
Oil Filter Fitting	39 N·m	29 lb ft

Oil Level Indicator Tube Bolt	25 N·m	18 lb ft
Oil Level Sensor Bolt	10 N·m	89 lb in
Oil Pan Bolt	25 N·m	18 lb ft
Oil Pan Drain Plug	25 N·m	18 lb ft
Oil Pan Side Bolt	50 N·m	37 lb ft
Oil Pump Drive Clamp Bolt	36 N·m	27 lb ft
Oil Pump Mounting Bolt	41 N·m	30 lb ft
Timing Chain Dampener Bolt	21 N·m	15 lb ft
Transmission to Engine Bolts/Stud	75 N·m	55 lb ft
Upper Intake Manifold Bolt/Stud	25 N·m	18 lb ft
Valve Lifter Guide Bolt	10 N·m	89 lb in
Valve Rocker Arm Bolt		
• First Pass	19 N·m	14 lb ft
• Final Pass	30 degrees	
Valve Rocker Arm Cover Bolt	10 N·m	89 lb in
Water Outlet Bolt	25 N·m	18 lb ft
Water Pump Bolt	10 N·m	89 lb in
Water Pump Pulley Bolt	25 N·m	18 lb ft

Engine Component Description

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

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

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

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

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

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

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

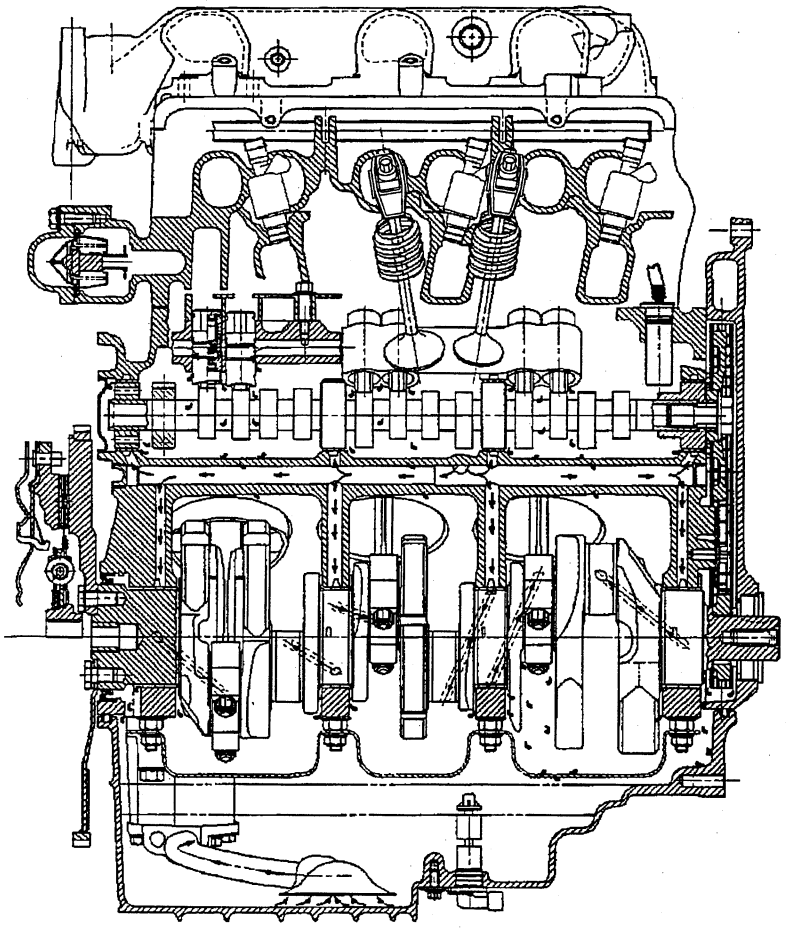
The connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal.

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

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

The exhaust manifolds are cast nodular iron.

Lubrication



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

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

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

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

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

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

Drive Belt System Description

The drive belt system consists of the following components:

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

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

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

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

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

Engine Mechanical – 3.8L

Mechanical Specifications

Application	Specification	
	Metric	English
General Data		
• Engine Type	90° V-6	
• Displacement	231 cu in	
• Liter (VIN)	3.8L (K), (1)	
• RPO	L36, L67	
• Bore	96.52 mm	3.8 in
• Stroke	86.36 mm	3.4 in
• Compression Ratio (VIN K)	9.4:1	
• Compression Ratio (VIN 1)	8.5:1	
• Firing Order	1-6-5-4-3-2	
Lubrication System		
• Oil Capacity with Oil Filter Change	4.25 L	4.5 qt
• Oil Capacity without Oil Filter Change	3.75 L	4 qt
• Oil Pressure @ Operating Temperature (1850 RPM) Using 10W-30 Oil	414 kPa	60 psi min
• Oil Filter Type	Throw Away Element and Can	
• Gear Pocket Depth	11.71-11.75 mm	0.461-0.4625 in
• Gear Pocket Diameter	89.10-89.20 mm	3.508-3.512 in
• Inner Gear Tip Clearance	0.152 mm	0.006 in
• Outer Gear Diameter Clearance	0.203-0.381 mm	0.008-0.015 in
• End Clearance	0.025-0.089 mm	0.001-0.0035 in
• Valve-to-Bore Clearance	0.038-0.076 mm	0.0015-0.003 in
Type of Lubrication		
• Main Bearings	Pressure	
• Connecting Rods	Pressure	
• Piston Pins	Splash	
• Balance Shaft Bearing - Front	Splash	
• Balance Shaft Bushing - Rear	Pressure	
• Camshaft Bearings	Pressure	
• Timing Chain	Splash	
• Cylinder Walls	Splash	
• Oil Pump Type	Gerotor	
• Oil Pressure Sending Unit	Electrical	
• Oil Intake	Stationary	
• Oil Filter System	Full Flow	
Cylinder Bore		
• Diameter	96.5 mm	3.8 in
• Out-Of-Round Maximum	0.0254 mm	0.001 in
• Taper	0.0254 mm	0.001 in
Piston (VIN K)		
• Used Piston Clearance (41 mm from Top of Piston)	0.050-0.091 mm	0.0020-0.0036 in
• New Piston Clearance (41 mm from Top of Piston)	0.010-0.051 mm	0.0004-0.0020 in

Piston (VIN 1)		
• Used Piston Clearance (41 mm from Top of Piston)	0.0193-0.0997 mm	0.0008-0.0039 in
• New Piston Clearance (41 mm from Top of Piston)	0.0207-0.0437 mm	0.0008-0.0017 in
Piston Ring Groove Depth		
• Top Compression	4.019-4.146 mm	0.158-0.163 in
• 2nd Compression	4.214-4.341 mm	0.0166-0.171 in
• Oil Control	3.814-3.941 mm	0.150-0.155 in
Piston Ring End Gap		
• Top Compression	0.25-0.46 mm	0.010-0.018 in
• 2nd Compression	0.58-0.84 mm	0.023-0.033 in
• Oil Control	0.254-0.762 mm	0.010-0.030 in
Piston Ring Side Clearance		
• Top Compression	0.033-0.079 mm	0.0013-0.0031 in
• 2nd Compression	0.033-0.079 mm	0.0013-0.0031 in
• Oil Control	0.023-0.201 mm	0.0009-0.0079 in
Piston Ring Width		
• Top Compression	1.176-1.197 mm	0.0463-0.0471 in
• 2nd Compression	1.476-1.497 mm	0.0581-0.0589 in
• Oil Control	1.854-2.007 mm	0.073-0.079 in
Piston Pin (VIN K)		
• Diameter	21.9950-22.0000 mm	0.8659-0.8661 in
• Clearance in Piston	0.0020-0.0130 mm	0.00008-0.00051 in
• Fit-In-Rod (Clearance)	0.0066-0.0217 mm	0.0003-0.0009 in
Piston Pin (VIN 1)		
• Diameter	22.995-23.0000 mm	0.90531-0.90551 in
• Clearance in Piston	0.0065-0.0155 mm	0.00061-0.00026 in
• Fit-In-Rod (Clearance)	0.0073-0.0225 mm	0.00029-0.00089 in
Crankshaft		
• Main Journal Diameter-All	63.470-63.495 mm	2.4988-2.4998 in
• Rod Journal Diameter-All	57.1170-57.1475 mm	2.2487-2.2499 in
• Main Journal Taper-Maximum	0.00889 mm	0.00035 in
• Rod Journal Taper-Maximum	0.00889 mm	0.00035 in
• Main Journal Out-of-Round-Maximum	0.00635 mm	0.00025 in
• Rod Journal Out-of-Round-Maximum	0.00508 mm	0.00020 in
• Main Bearing to Journal Clearance 1	0.0178-0.0406 mm	0.0007-0.0016 in
• Main Bearing to Journal Clearance 2, 3 and 4	0.0229-0.0457 mm	0.0009-0.0018 in
• Rod Bearing Clearance	0.0127-0.0660 mm	0.0005-0.0026 in
• Crankshaft End Play	0.076-0.276 mm	0.003-0.011 in
Connecting Rod		
• Rod Side Clearance	0.102-0.508 mm	0.004-0.0200 in
• Connecting Rod Large End Bore ID	60.295-60.312 mm	2.37378-2.3745 in
Camshaft		
• Journal Diameter	47.655-46.858 mm	1.8462-1.8448 in
• Bearing Inside Diameter 1 and 4	46.970-46.934 mm	1.8428-1.8492 in
• Bearing Inside Diameter 2 and 3	46.977-46.942 mm	1.8481-1.8495 in
• Bearing-to-Journal Clearance	0.041-0.119 mm	0.0016-0.0047 in

• Intake Maximum Lobe Lift	6.56 mm	0.258 in
• Exhaust Maximum Lobe Lift	6.56 mm	0.258 in
Balance Shaft		
• End Play	0.0-0.171 mm	0.0-0.0067 in
• Rear Journal Diameter	38.085-38.105 mm	1.4994-1.5002 in
• Radial Play-Front, Bearing Clearance	0.0-0.026 mm	0.0-0.0010 in
• Rear Bearing to Journal Clearance	0.012-0.109 mm	0.0005-0.0043 in
• Drive Gear Lash	0.050-0.125 mm	0.002-0.0049 in
• Bearing Bore Diameter-Front	51.973-51.999 mm	2.0462-2.0472 in
• Bearing Bore Diameter-Rear, In Block	47.584-47.612 mm	1.8735-1.8745 in
• Bearing Inside Diameter-Rear	38.118-38.194 mm	1.5007-1.5037 in
Valve System		
• Lifter	Hydraulic Roller	
• Rocker Arm Ratio	1.66:1	
• Face Angle	46 degrees	
• Seat Angle	45 degrees	
• Minimum Margin	0.635 mm	0.025 in
• Seat Runout-Maximum	0.050 mm	0.002 in
• Seat Width-Intake	1.53-2.03 mm	0.060-0.080 in
• Seat Width-Exhaust	2.29-2.79 mm	0.090-0.110 in
• Stem Height-All	49.15-50.17 mm	1.93-1.975 in
• Stem Clearance-Intake	0.031-0.071 mm	0.0012-0.0028 in
• Stem Clearance-Exhaust	0.036-0.074 mm	0.0014-0.0029 in
Valve Spring		
• Free Length	49.78 mm	1.960 in
• Load-Closed	334 N @ 43.69 mm	75 lb @ 1.72 in
• Load-Open	1014 N @ 32.4 mm	228 lb @ 1.277 in
• Installed Height	42.93-44.45 mm	1.690-1.750 in
• Approximate Number of Active Coils	4.48	
• Approximate Number of Total Coils	6.60	
Flywheel		
• Runout-Maximum	0.38 mm	0.015 in

Fastener Tightening Specifications

Application	Specifications	
	Metric	English
A/C Compressor Bracket Bolt	50 N·m	37 lb ft
A/C Compressor Nut	30 N·m	22 lb ft
Balance Shaft Gear Bolt	22 N·m + 70°	16 lb ft + 70°
Camshaft Position Sensor Bolt	10 N·m	89 lb in
Camshaft Sprocket Bolt	100 N·m + 90°	74 lb ft + 90°
Camshaft Thrust Plate Bolt	15 N·m	11 lb ft
Connecting Rod Bearing Cap Nut	27 N·m + 50°	20 lb ft + 50°
Crankshaft Balancer Bolt	150 N·m + 76°	111 lb ft + 76°
Crankshaft Position Sensor Stud	30 N·m	22 lb ft
Crankshaft Rear Oil Seal Housing Bolt	15 N·m + 50°	11 lb ft + 50°
Cylinder Head Bolt	50 N·m + 120°	37 lb ft + 120°
Cylinder Head Bolt (Center)	50 N·m + 120°	37 lb ft + 120°
Drive Belt Tensioner Bolt	50 N·m	37 lb ft

EGR Valve Adapter Bolt	50 N·m	37 lb ft
EGR Valve Nut	29 N·m	21 lb ft
EGR Valve Outlet Pipe Bolt/Nut	29 N·m	21 lb ft
EGR Valve Wiring Harness Heat Shield Bolt/Nut	10 N·m	89 lb in
Engine Block Coolant Drain Plug (Knock Sensors)	18 N·m	13 lb ft
Engine Coolant Temperature Sensor	25 N·m	18 lb ft
Engine Flywheel Bolt	15 N·m + 50°	11 lb ft + 50°
Engine Front Cover Bolt/Stud	20 N·m + 40°	15 lb ft + 40°
Engine Ground Nut	35 N·m	26 lb ft
Engine Lift Bracket Bolt/Nut/Stud	30 N·m	22 lb ft
Engine Mount Bracket Bolt	102 N·m	75 lb ft
Engine Mount Nut (Lower)	78 N·m	58 lb ft
Engine Mount Nut (Upper)	78 N·m	58 lb ft
Engine Mount Strut Bolt	48 N·m	35 lb ft
Engine Mount Strut Bracket Bolt	50 N·m	37 lb ft
Engine Mount Strut Bracket Bolt (Upper Radiator Support)	28 N·m	21 lb ft
Engine Mount Strut Bracket nut (Lower)	30 N·m	22 lb ft
Engine Mount Strut Nut	48 N·m	35 lb ft
Engine Oil Pressure Sensor	16 N·m	12 lb ft
Engine to Transaxle Bolt	75 N·m	55 lb ft
Engine Wiring Harness Bolt	10 N·m	89 lb in
Fuel Injector Sight Shield Bracket Nut	30 N·m	22 lb ft
Generator Brace Bracket Bolt	50 N·m	37 lb ft
Lower Intake Manifold Bolt	15 N·m	11 lb ft
Oil Filter Adapter Bolt	15 N·m + 50°	11 lb ft + 50°
Oil Level Sensor	20 N·m	15 lb ft
Oil Level Indicator Tube Nut	19 N·m	14 lb ft
Oil Pan Bolt	14 N·m	10 lb ft
Oil Pan Drain Plug	30 N·m	22 lb ft
Oil Pump Cover Screw	11 N·m	98 lb in
Oil Pump, Pipe and Screen Bolt	15 N·m	11 lb ft
Positive Battery Terminal Nut	15 N·m	11 lb ft
Power Steering Bolt	34 N·m	25 lb ft
Throttle Body Support Bolt	10 N·m	89 lb in
Timing Chain Dampener Bolt	22 N·m	16 lb ft
Upper Intake Manifold Bolt	10 N·m	89 lb in
Valve Lifter Guide Bolt	30 N·m	22 lb ft
Valve Rocker Arm Bolt	15 N·m + 90°	11 lb ft + 90°
Valve Rocker Arm Cover Bolt	10 N·m	89 lb in
Water Outlet Housing Bolt	27 N·m	20 lb ft
Water Pump Bolt	15 N·m + 80°	11 lb ft + 80°
Water Pump Pulley Bolt	13 N·m	116 lb in

Engine Component Description

Engine Construction

Starting at the front of the engine, the cylinders of the left bank are numbered 1-3-5 and the cylinders of the right bank are numbered 2-4-6. The crankshaft is supported in the engine block by four bearings. The crankshaft is counterbalanced by the flywheel, the crankshaft balancer, and the weights cast into the crankshaft. Additional counterbalancing is obtained from the balance shaft which rides in the engine block above the camshaft and is driven by the camshaft. All 3800 engines are even-firing, the cylinders fire at equal 120 degree intervals of crankshaft rotation. The location of the crankshaft journals has been offset by 30 degrees to fire the cylinders at 120 degree intervals of crankshaft rotation. The camshaft lobes and timing also reflect the 120 degree intervals. The even firing crankshaft provides an equal interval of 120 degrees between ignition of each of the cylinders throughout the firing order. The firing order is 1-6-5-4-3-

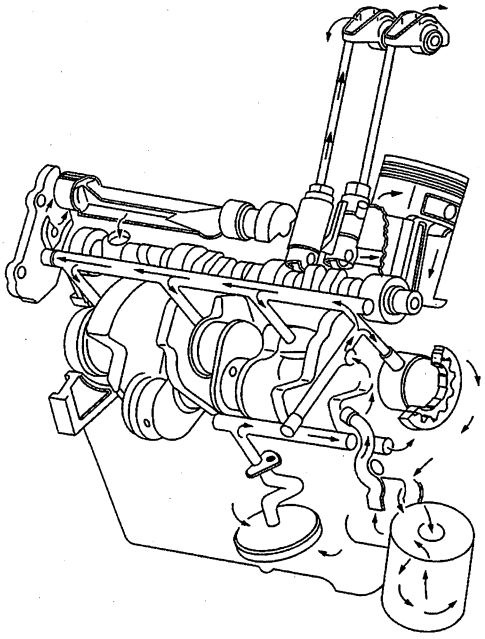
2. The aluminum alloy pistons have slipper skirts and are cam turned. Four drilled holes or casted slots in the oil ring grooves permit drain back of the oil collected by the oil ring. The camshaft is supported by four bearings in the engine block and is driven by the crankshaft through sprockets and a timing chain. The cylinder heads are cast iron and incorporate integral valve stem guides. Right and left cylinder heads are identical and are interchangeable, but it is good practice to reinstall the cylinder heads on the side from which they are removed. The intake manifold is bolted to the inner faces of both cylinder heads so it connects with all inlet ports.

Each exhaust and intake valve has a valve spring to insure positive seating throughout the operating speed range. The valve rocker arms for each bank of the cylinders pivot on pedestals bolted to the cylinder head. Hydraulic roller valve lifters and tubular push rods are used to operate overhead rocker arms and valves of both banks of the cylinders from a single camshaft. This system requires no lash adjustment at the time of assembly or service.

In addition to its normal function of a cam follower, each valve lifter also serves as an automatic adjuster which maintains zero lash in the valve train under all operating conditions. By eliminating all lash in the valve train and also providing a cushion of oil to absorb operating shocks, the valve lifter promotes quiet valve operation. It also eliminates the need for periodic valve adjustment to compensate for wear of parts. Oil is supplied to the valve lifter through a hole in the side of the valve lifter body which indexes with a groove and a hole in the valve lifter plunger. Oil is then metered past the oil metering valve in the valve lifter, through the push rods to the valve rocker arms. When the valve lifter begins to move up the camshaft lobe, the check ball is held against its seat in the plunger by the check ball spring which traps the oil in the base of the valve lifter body below the plunger.

The plunger and the valve lifter body then raise as a unit, pushing up the push rod to open the valve. The force of the valve spring which is exerted on the plunger through the valve rocker arm and push rod, causes a slight amount of leakage between the plunger and the valve lifter body. This leakage allows a slow escape of trapped oil in the base of the valve lifter body. As the valve lifter rolls down the other side of the camshaft lobe and reaches the base circle or valve closed position, the plunger spring quickly moves the plunger back (up) to its original position. This movement causes the check ball to open against the ball spring, and any oil inside the plunger is drawn into the base of the valve lifter. This restores the valve lifter to the zero lash.

Lubrication Description



The engine lubrication system is of the force-feed type. The oil is supplied under full pressure to the crankshaft, connecting rods, valve lifters, camshaft, and rear balance shaft bearing. A controlled volume of oil is supplied to the valve rocker arms and push rods. All other moving parts are lubricated by gravity flow or splash. The engine oil is stored in the lower crankcase (oil pan) which is filled through a filler opening in the valve rocker arm cover. A removable oil level indicator, on the left side of the engine block, is provided to check the oil level. The oil pump is located in the engine front cover and is driven by the crankshaft. It is a gerotor-style pump which is a combination of a gear and a rotor pump. It is connected by a passage in the cylinder block to an oil screen and pipe assembly. The screen is submerged in the oil supply and has ample volume for all operating conditions. If the screen becomes clogged, oil may be drawn into the system through the oil pressure relief valve in the oil filter adapter. Oil is drawn into the pump through the screen and pipe assembly, and a passage in the crankcase, connecting to the passages in the engine front cover. Oil is discharged from the oil pump to the oil filter adapter. The oil filter adapter consists of an oil filter bypass valve and a nipple for installation of an oil filter. The spring-loaded oil pressure relief valve, located in the engine front cover, limits the oil pressure. The oil filter bypass valve opens when the oil filter is restricted to approximately 68.95 kPa (10 psi) of pressure difference between the oil filter inlet and discharge. The oil will then bypass the oil filter and channel unfiltered oil directly to the main oil galleries of the engine. A full-flow oil filter is externally mounted to the oil filter adapter on the lower right front side of the engine. If the filter element becomes restricted, not allowing engine oil to pass through, a spring-loaded bypass valve opens. The main oil galleries run the full length of the engine block and cut into the valve lifter guide holes to supply oil at full pressure to the valve lifters. Holes, drilled from the crankshaft bearings to the main oil gallery, intersect the camshaft bearing bores to supply oil to the cam bearings.

Oil is transfered from the crankshaft bearings to the connecting rod bearings through holes drilled in the crankshaft. Pistons, piston pins, and cylinder walls are lubricated by oil splash from the crankshaft and connecting rods.

Each valve rocker arm and valve is supplied with oil through the tubular push rod. The oil comes from the inside of the valve lifter passing around the metering valve and through a hole in the push rod seat. Oil from the push rod passes through a hole in the push rod seat, and emerges on top of the push rod seat boss.

Engine Cooling

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Coolant Recovery Reservoir Mounting Nut	3.3 N·m	29 lb in
Cooling Fan Shroud Bolt	10 N·m	89 lb in
Coolant Heater Bolt	2 N·m	18 lb in
Engine Block Coolant Drain Plug	19 N·m	14 lb ft
Engine Block Heater Screw	2 N·m	18 lb in
Knock Sensor (3.8L)	19 N·m	14 lb ft
Radiator Bracket Mounting Bolt	10 N·m	18 lb in
Radiator Lower Air Deflector	20 N·m	15 lb ft
Thermostat Bypass Pipe Bolt	11 N·m	98 lb in
Thermostat Bypass Pipe Nut	25 N·m	18 lb ft
Water Outlet Housing Bolt (3.4L)	25 N·m	18 lb ft
Water Outlet Housing Bolt/Stud (3.8L)	27 N·m	20 lb ft
Water Pump Bolt (3.4L)	10 N·m	89 lb in
Water Pump Bolt (Long) (3.8L)	34 N·m	25 lb ft
Water Pump Bolt (Short) (3.8L)	22 N·m	16 lb ft
Water Pump Pulley Bolt (3.4L)	25 N·m	18 lb ft
Water Pump Pulley Bolt (3.8L)	13 N·m	115 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 Bolt	18 N·m	13 lb ft
Battery Negative Cable Bolt to Frame Rail	10 N·m	89 lb in
Battery Negative Terminal Bolt	15 N·m	11 lb ft
Battery Positive Cable Junction Block Lead Nut	10 N·m	89 lb ft
Battery Positive Terminal Bolt	15 N·m	11 lb ft
Battery Tray Bolts	5 N·m	44 lb in
Generator Bolt	50 N·m	37 lb ft
Generator Bracket Bolt	50 N·m	37 lb ft
Generator Output BAT Terminal Nut	20 N·m	15 lb ft
Generator Pivot Bolt	50 N·m	37 lb ft
Generator Rear Brace Bolt/Nut 3.4L	25 N·m	18 lb ft
Generator Rear Brace Bolt/Nut 3.8L	50 N·m	37 lb ft
Generator Stud 3.8L	50 N·m	37 lb ft
Starter Bolt	43 N·m	32 lb ft
Starter Solenoid BAT Terminal Nut	10 N·m	89 lb in
Starter Solenoid S Terminal Nut	2.3 N·m	20.5 lb in
Underhood Accessory Wiring Juntion Block Nuts	2 N·m	18 lb in
Transaxle Stud Nut	45 N·m	33 lb ft

Battery Usage

Application	Specification
LA1	
GM Part Number	19001810
Cold Cranking Amperage (CCA)	600 A
Reserve Capacity	115 Minutes
Replacement Model Number	78-6YR
L36	
Catalog Number	19001812
Cold Cranking Amperage (CCA)	790 A
Reserve Capacity	115 Minutes
Replacement Model Number	78-7YR

Battery Temperature vs Minimum Voltage

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

Starter Motor Usage

Application	Model
LA1	PG260 D
L36	PG260 F2

Generator Usage

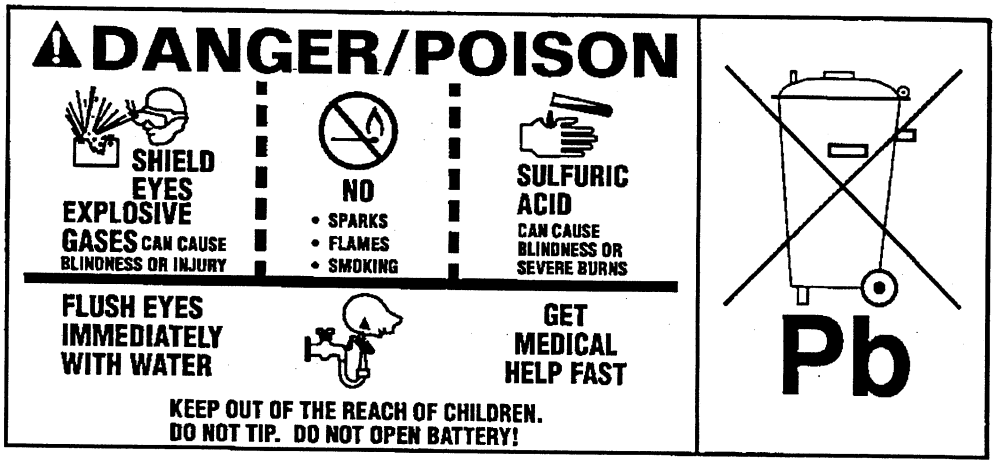
RPO K43	
Application	Specification
Generator Model	Delphi CS 130D
Rated Output	102 A
Load Test Output	70 A
RPO KG7	
Application	Specification
Generator Model	Bosch NCB1
Rated Output	125 A
Load Test Output	87.5 A

Battery Description and Operation

Caution

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

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



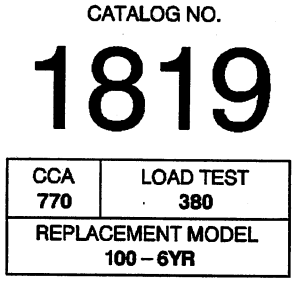
The maintenance free battery is standard. There are no vent plugs in the cover. The battery is completely sealed except for two small vent holes in the side. These vent holes allow the small amount of gas that is produced in the battery to escape.

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

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

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

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



A battery has 2 ratings:

- Reserve capacity
- Cold cranking amperage

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

Reserve Capacity

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

Cold Cranking Amperage

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

Circuit Description

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

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

Starting System Description and Operation

This vehicle has two starter motor applications. The 3400 LA1 (VIN E) uses the PG260 D starter motor. The 3800 L36 (VIN K) uses the PG260 F2 starter motor.

These starter motors have pieces that are arranged around the armature. The solenoid windings are energized when the ignition switch is turned to START. The resulting plunger and shift lever movement causes the pinion to engage the flywheel ring gear and the solenoid main contact switch to close. When the engine starts, the pinion overrun protects the armature from excessive speed until the switch is opened. Once the solenoid windings are de-energized, the return spring causes the pinion to disengage.

Charging System Description and Operation

A Delphi CS130D 105 ampere generator is standard equipment on this vehicle. A Bosch NCB1 125 ampere generator is used for the police (9C1) and the taxi (9C6) options. The components of these generators include the following:

The generator provides voltage to operate the vehicle's electrical system and to charge the 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.

The generator's digital regulator uses digital techniques to supply the rotor current and thereby control the output voltage. The rotor current is proportional to the width of the electrical pulses supplied by the digital regulator. When the ignition switch is ON, voltage is supplied to terminal L from the Powertrain Control Module (PCM), turning on the digital regulator. Narrow width pulses are supplied to the digital rotor, creating a weak magnetic field. When the engine is started, the digital regulator senses generator rotation by detecting AC voltage at the stator through an internal wire. Once the engine is running, the digital regulator varies the field current by controlling the pulse width. This regulates the generator output voltage for proper battery charging and electrical system operation.

Engine Controls

Engine Controls – 3.4L

Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-2-3-4-5-6	
Spark Plug Gap	1.52 mm	0.060 in
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Type	41-940 [AC plug type]	
Spark Plug Wire Resistance	3000 ohms per ft	

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Cable Bracket Retaining Bolts	13 N·m	115 lb in
Accelerator Cable Bracket Retaining Nut	10 N·m	89 lb in
Accelerator Pedal Retaining Bolt	5 N·m	44 lb in
Air Cleaner Duct Clamp	2 N·m	18 lb in
Camshaft Position (CMP) Sensor Retaining Bolt	10 N·m	89 lb in
Crankshaft Position 7X (CKP) Sensor Bolts	11 N·m	97 lb in
Crankshaft Position 24X (CKP) Sensor Bolts	10 N·m	89 lb in
Exhaust Gas Recircluation (EGR) Pipe Bolt	30 N·m	22 lb ft
Exhaust Gas Recirculation (EGR) Pipe Nut	25 N·m	18 lb ft
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
EVAP Canister Purge Valve Bracket	10 N·m	89 lb in
Exhaust Gas Recirculation (EGR) Valve Bolts	30 N·m	22 lb ft
Fuel Filler Pipe Attaching Screw	10 N·m	89 lb in
Fuel Filter Feed Pipe Fitting	30 N·m	22 lb ft
Fuel Filter Mounting Bracket Bolt	20 N·m	15 lb ft
Fuel Pressure Regulator Attaching Bolt	8.5 N·m	76 lb in
Fuel Pressure and Return Pipes	17 N·m	13 lb ft
Fuel Rail Attaching Nuts or Bolts	10 N·m	89 lb in
Fuel Sender Access Panel Nuts	10 N·m	89 lb in
Fuel Tank Filler Pipe Hose Clamp	2.5 N·m	22 lb in
Fuel Tank Retaining Strap Bolts	48 N·m	35 lb ft
Heated Oxygen Sensors (HO2S)	41 N·m	30 lb ft
Idle Air Control (IAC) Valve Attaching Screws	3 N·m	27 lb in
Ignition Coil to Ignition Control Module (ICM) Screws	4.5 N·m	40 lb in
Knock Sensor (KS)	19 N·m	14 lb ft
Manifold Absolute Pressure (MAP) Sensor Retaining Bolt	3 N·m	27 lb in
Spark Plug		
To a New Cylinder Head	20N·m	15 lb ft
To an Existing Cylinder Head	15N·m	11 lb ft
Throttle Body Retaining Nuts or Bolts	28 N·m	21 lb ft
Throttle Position (TP) Sensor Screws	2 N·m	18 lb in

Fuel System Specifications

Use regular unleaded gasoline rated at 87 octane or higher. The gasoline should meet specifications which were 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 Manufacturers 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, your engine could be damaged.

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. The pinging is normal, and you do not have to buy a higher octane fuel in order to get rid of pinging. The heavy, constant knock indicates 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 underhood emission control label, the 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 the emissions control system performance may be affected. The malfunction indicator lamp (MIL) on your instrument panel may turn ON and/or your vehicle may fail a smog test. See "Malfunction Indicator Lamp" in the Index. If this occurs, return to your authorized GM dealer for diagnosis in order to determine the cause of the failure. If 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 the fuel contains MMT. General Motors does not recommend the use of such gasolines. If fuels containing MMT are used, spark plug life may be reduced and your emission control system performance may be affected. The MIL on your instrument panel may turn ON. If this occurs, return to your authorized GM dealer for service.

In order to provide cleaner air, all gasolines in the United States are now required to contain additives that will help prevent deposits from forming in your engine and fuel system, allowing your emission control system in order to function properly. Therefore, you should not have to add anything to the fuel. In addition, gasolines containing oxygenates, such as ethers and ethanol, and reformulated gasolines may be available in your area in order to contribute to clean air. General Motors recommends that you use these gasolines, particularly if they comply with the specification described earlier.

Fuels in Foreign Countries (Gasoline Engines)

If you plan to drive in another country outside the United States or Canada, the proper fuel may be hard to find. Never use leaded gasoline or any other fuel not recommended in the previous text on fuel. Costly repairs caused by the use of improper fuel would not be covered by your warranty.

In order to check on fuel availability, ask an auto club, or contact a major oil company that does business in the country where you will be driving.

Engine Controls – 3.8L

Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-6-5-4-3-2	
Spark Plug Wire Resistance	3000 ohms per ft	
Spark Plug Wire Resistance - POLICE	600 ohms per ft	
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Gap	1.52 mm	0.060 in
Spark Plug Type	41-921 [AC plug type]	

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Cable Bracket Retaining Bolts	10 N·m	89 lb in
Accelerator Control Pedal Bolt and Stud	3 N·m	27 lb in
Air Cleaner Assembly Screws	4 N·m	35 lb in
Air Cleaner Duct Clamps	2 N·m	18 lb in
Camshaft Position (CMP) Sensor Retaining Bolt	10 N·m	89 lb in
Crankshaft Position (CKP) Sensor Bolts	30 N·m	22 lb ft
EGR Valve Adapter Pipe Stud	50 N·m	37 lb ft
EGR Valve Intake Pipe to Exhaust Manifold Bolt	30 N·m	22 lb ft
EGR Valve Outlet Pipe to Adapter Nut	30 N·m	22 lb ft
EGR Valve Outlet Pipe to Intake Manifold Bolt	30 N·m	22 lb ft
EGR Valve to Retaining Nuts	30 N·m	22 lb ft
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
Fuel Filler Neck Bolts	2 N·m	18 lb in
Fuel Rail Attaching Nuts or Bolts	10 N·m	89 lb in
Fuel Rail Hold-Down Stud	25 N·m	18 lb ft
Fuel Sender Access Panel Nuts	10 N·m	89 lb in
Fuel Tank Filler Pipe Attaching Screw	2.5 N·m	22 lb in
Fuel Tank Filler Pipe Hose Clamp	2.5 N·m	22 lb in
Fuel Tank Retaining Strap Bolts	47 N·m	35 lb ft
Heated Oxygen Sensors	41 N·m	30 lb ft
Idle Air Control Valve Attaching Screws	3 N·m	27 lb in
Ignition Coil to Ignition Control Module Screws	4.5 N·m	40 lb in
Ignition Control Module 14-Way Connector to Module Bolt	2.1 N·m	19 lb in
In-Line Fuel Filter Mounting Bracket Bolt	20 N·m	15 lb ft
In-Line Fuel Filter Outlet Nut	30 N·m	22 lb ft
Knock Sensor	19 N·m	14 lb in
Knock Sensor Heat Shield Bolts	60 N·m	44 lb ft
Manifold Absolute Pressure (MAP) Sensor Retaining Screw	5 N·m	44 lb in
Mass Air Flow (MAF) Sensor Attaching Screws	3 N·m	27 lb in
Powertrain Control Module (PCM) Bolts	8 N·m	71 lb in
Secondary Air Injection Manifold Pipe Fasteners	9 N·m	80 lb in
Secondary Air Injection Pump Bracket Fasteners	10 N·m	89 lb ft
Secondary Air Injection Shut-Off Valve Bracket Fasteners	9 N·m	80 lb in
Spark Plug To a New Cylinder Head	27N·m	20 lb ft
Spark Plug To an Existing Cylinder Head	15N·m	11 lb ft
Throttle Body Retaining Nuts	10 N·m	89 lb in
Throttle Body Support Bracket Bolts	16 N·m	12 lb ft
Throttle Position Sensor Screws	2 N·m	18 lb in
Secondary Air Injection Vacuum Control Solenoid Fastener	10 N·m	89 lb in

Fuel System Specifications

If you have the 3400 V6 engine (VIN Code M) or 3800 V6 engine (VIN Code K), use regular unleaded gasoline rated at 87 octane or higher. IF you are using fuel rated at the recommended octane or higher and you hear a little pinging noise when you are accelerating or driving up a hill that is normal. You do not need to buy a higher octane fuel to get rid of pinging. It is the heavy, constant knock that means there is a problem.

If you have the 3800 Supercharged V6 engine (VIN Code 1), use premium unleaded gasoline rated at 91 octane or higher. With the 3800 Supercharged engine, in an emergency, you may be able to use an octane as low as 87, if heavy knocking does not occur. If you are using 91 or higher octane unleaded gasoline and you hear heavy knocking, your engine needs service.

It is recommended that the gasoline meet specifications which have been developed by the American Automobile Manufactures Association (AAMA) and endorsed by the Canadian Motor Vehicle Manufacturers Association for better vehicle performance and engine protection. Gasolines 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 91 for premium, at least 90 for middle grade, and at least 87 for regular grade. If the octane is less than 87, you may get a heavy knocking noise when you drive. If it is bad enough, it can damage your engine.

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

Some 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.

Exhaust System

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Catalytic Converter Bolt (3.8L)	45 N·m	33 lb ft
Catalytic Converter Nut (3.4L)	34 N·m	25 lb ft
EGR Adapter Pipe to Exhaust Manifold Bolt (3.8L)	29 N·m	21 lb ft
Engine Lift Bracket Bolt/Nut	30 N·m	22 lb ft
Exhaust Crossover Pipe Bolt/Stud (3.8L)	20 N·m	15 lb ft
Exhaust Crossover Pipe Heat Shield Bolt (3.4L)	10 N·m	89 lb in
Exhaust Crossover Pipe Heat Shield Nut	20 N·m	15 lb ft
Exhaust Crossover Pipe nut (3.4L)	25 N·m	18 lb ft
Exhaust Manifold Heat Shield Bolt (3.4L)	10 N·m	89 lb in
Exhaust Manifold Heat Shield Bolt (3.8L)	20 N·m	15 lb ft
Exhaust Manifold Bolt/Stud (3.8L)	30 N·m	22 lb ft
Exhaust Manifold Nut (3.4L)	16 N·m	12 lb ft
Exhaust Manifold Pipe Stud Nut	32 N·m	24 lb ft
Exhaust Pipe Rear Hanger Bolt	25 N·m	18 lb ft
Fuel Injector Sight Shield Bracket Nut	30 N·m	22 lb ft
Rear Bumper Impact Bar Bolt	25 N·m	18 lb ft

Exhaust System Description

Important

Use of non-OEM parts may cause driveability concerns.

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

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

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

Heat shields protect the vehicle from the high temperatures generated by the exhaust system.

Resonator

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

Catalytic Converter

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

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

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

The catalyst in the converter is not serviceable.

Muffler

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

Transmission/Transaxle Description and Operation

Automatic Transmission – 4T65E

Fastener Tightening Specifications

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

Transmission General Specifications

Name	Hydra-matic 4T65-E
RPO Codes	M15
Production Location	Warren, MI
Vehicle Platform (Engine/Transmission) Usage	W
Transaxle Drive	Transverse Mounted Front Wheel Drive
1st Gear Ratio	2.921:1
2nd Gear Ratio	1.568:1
3rd Gear Ratio	1.000:1
4th Gear Ratio	0.705:1
Reverse	2.385:1
Torque Converter Size (Diameter of Torque Converter Turbine)	245 mm (M15)
Pressure Taps	Line Pressure
Transaxle Fluid Type	DEXRON® III
Transaxle Fluid Capacity (Approximate)	Bottom Pan Removal: 7.0 L (7.4 qts) Complete Overhaul: 9.5 L (10.0 qts) Dry: 12.7 L (13.4 qts)
Transaxle Type: 4	Four Forward Gears
Transaxle Type: T	Transverse Mount
Transaxle Type: 65	Product Series
Transaxle Type: E	Electronic Controls
Chain Ratios (Designates Number of Teeth on the Drive/Driven Sprockets)	35/35
Final Drive Ratios	2.86, 3.05, 3.29
Overall Final Drive Ratios	2.86, 3.05, 3.29
Position Quadrant	P, R, N, D, 3, 2, 1
Case Material	Die Cast Aluminum
Transaxle Weight Dry	87.9 kg (194.2 lbs)
Transaxle Weight Wet	97.0 kg (214.4 lbs)
Maximum Trailer Towing Capacity	907 kg (2000 lbs)
Maximum Gross Vehicle Weight (GVW)	2903 kg (6,400 lbs)

Fluid Capacity Specifications

Application	Specification	
	Metric	English
Bottom Pan Removal	7.0 liters	7.4 quarts
Complete Overhaul	9.5 liters	10.0 quarts
Dry	12.7 liters	13.4 quarts

Transmission Component and System Description

Transmission General Description

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

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

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

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

Mechanical Componants

The mechanical components of this unit are as follows:

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

The electrical components of this unit are as follows:

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

Adapt Function

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

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

The PCM maintains information for the following transmission adaptive systems:

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

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

Steady State Adapts

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

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

Automatic Transmission Shift Lock Control Description

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

- The automatic transmission shift lock control solenoid.
- The automatic transmission shift lock control switch.
- The body control module (BCM).
- The powertrain control module (PCM).

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

Abbreviations and Meanings

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

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

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

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

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

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

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

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

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

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

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

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
21/32	0.65625	16.66875
43/64	0.671875	17.06562
11/16	0.6875	17.4625
45/64	0.703125	17.85937

Fraction (in)	Decimal (in)	Metric (mm)
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

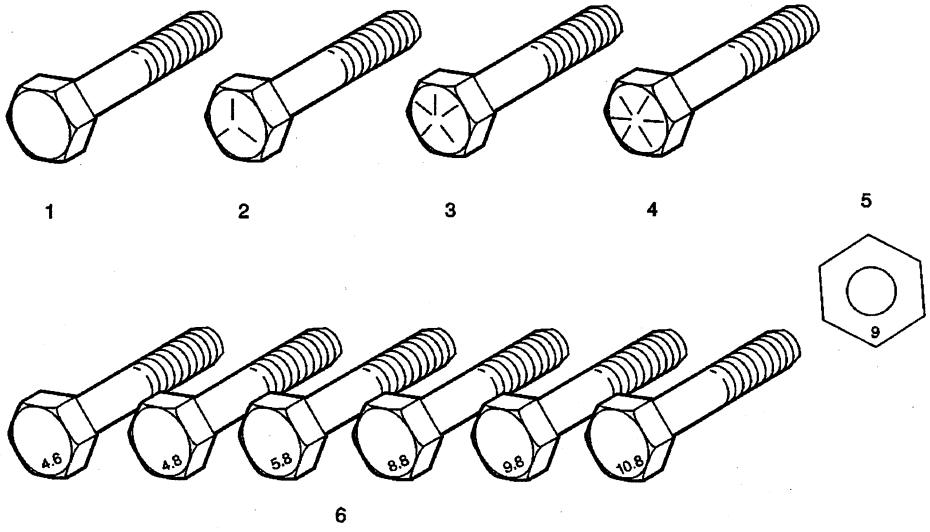
Metric Fasteners

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

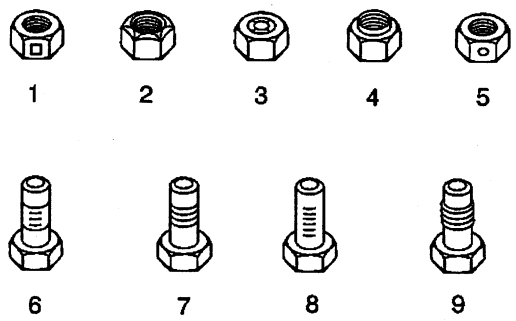
These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

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