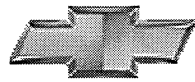
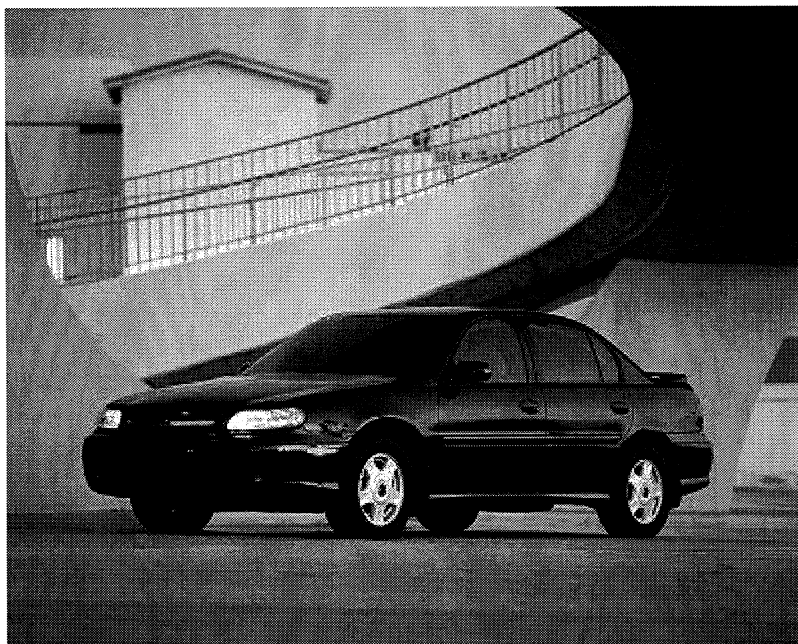


Chevrolet



Malibu



2002

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Product Information

2002 Chevrolet Malibu Adds Standard Equipment For Family Buyers

The 2002 Chevrolet Malibu offers a refined appearance and adds safety and convenience features for buyers who want a well-equipped midsize sedan priced lower than most popular imports.

"Malibu's standard equipment now includes a CD player for 2002, plus our continuing standard equipment, which includes a V6 engine, automatic transmission, air conditioning and antilock brakes," says Brand Manager Lew Elbert. "Malibu is a car for practical, family-centered people who need dependable transportation for everyday life."

New for 2002

In 2002, Malibu's smallest passengers will benefit from a new LATCH system (Lower Anchor and Top tethers for Children), which, when combined with a top shelf tether, enables adults to securely install LATCH-compatible child seats without using the seatbelt. Rear child seat anchors are located in the floorpan with an attachment at the juncture of seat cushion and seat back, taking the worry and guesswork out of child safety seat installation.

Three new exterior colors join the Malibu and Malibu LS palette for 2002: Dark Tropic Teal, Medium Green Pearl and Redfire Metallic, bringing the total to eight. A new 15-inch alloy wheel, with a bright machined face, graces the Malibu LS model.

Radios on all LS models feature a new 100-watt, two-channel subwoofer system, which improves sound quality. Floor mats have also been added as standard equipment on all models.

Proven powertrain

Ordering Malibu is simple. A proven 3.1-liter SFI V6 engine, generating 170 horsepower and 190 lb-ft of torque, is the sole engine on Malibu models, and an electronically controlled 4-speed automatic transmission is the only transmission. Four-wheel independent suspension, standard 15-inch all-season radial tires and rack-and-pinion power steering contribute to Malibu's great ride and handling.

Standard features

Malibu's well-equipped-vehicle approach also includes programmable power door locks, an electric rear window defogger, AM/FM stereo radio with CD player, child security and lock-out protection features, a full gauge package with tachometer, rear seat heating ducts, theatre lighting, tilt steering column, remote electric trunk release and battery rundown protection. LS customers also get cruise control, power windows, remote keyless entry, custom cloth bucket seats with six-way power on the driver's side, dual remote electric outside rear view mirrors, split-folding rear seat, fog lamps and 15-inch cast aluminum wheels.

New For 2002

- Three exterior colors: Dark Tropic Teal, Medium Green Pearl and Redfire Metallic
- CD as standard equipment
- 100-watt, 2-channel subwoofer system standard on all LS model radios
- LATCH system (Lower Anchor and Top tether for Children) in rear seat positions
- Floor mats standard on all models

Model Lineup

	Engine	Transmission
	3.1-liter SFI V6	4T40E 4-spd electronic auto
Malibu	S	S
Malibu LS	S	S

Standard S

Specifications

Overview

Body style / driveline:	5-passenger sedan, unit body frame, front engine, front-wheel drive
Construction:	two-sided galvanized steel on exterior panels
EPA vehicle class:	midsize
Manufacturing location:	Lansing, Michigan
Key competitors:	Toyota Camry, Honda Accord, Nissan Altima

Engine

Type:	3100 V6 SFI, cast-iron block, LG8
Displacement (cu in / cc):	191 / 3129
Bore & stroke (in / mm):	3.51 x 3.31 / 89 x 84
Cylinder head material:	cast-aluminum
Valvetrain:	OHV, two valves per cylinder
Ignition system:	electronic direct
Fuel injection / delivery:	sequential fuel injection
Compression ratio:	9.6:1
Horsepower (hp / kw @ rpm):	170 / 112 @ 5200
Torque (lb-ft / Nm @ rpm):	190 / 244 @ 4000
Recommended fuel:	87 octane
Maximum engine speed (rpm):	6000
Exhaust system:	stainless steel with aluminized coating on the muffler and tailpipe
Estimated fuel economy (mpg city / hwy / combined):	20 / 29 / 24

Transmission

Type:	4T40-E, 4-speed automatic w/overdrive, front-wheel drive
Gear ratios (:1):	
First:	2.96
Second:	1.63
Third:	1.00
Fourth:	0.68
Reverse:	2.14
Final drive ratio:	3.05:1

Chassis/Suspension

Front:	independent MacPherson coil-over-strut suspension, 24-mm front stabilizer bar, full frame front chassis cradle
Rear:	independent tri-link with coil-over-strut, 15-mm stabilizer bar
Steering:	power rack-and-pinion for all models
Ratio:	14.7:1
Steering wheel turns, lock-to-lock:	2.9
Turning circle, curb to curb (ft / m):	36.3 / 11.1

Brakes

Type:	front disc, rear drum, four-wheel ABS
Front rotor (diameter x thickness, in / mm):	10.9 x 1.02 / 274 x 25
Rear drum (diameter x thickness, in / mm):	8.8 x 1.8 / 224 x 45
Total swept area, (sq in / sq cm):	front: 208.3 / 1344; rear: 97.9 / 631.7

Wheels/Tires

	Sedan	LS Sedan
Standard wheels:	15-inch x 6-inch bolt on full wheel cover	15-inch x 6-inch aluminum wheel
Available wheel:	15-inch x 6-inch aluminum wheel	—
Standard tire:	P215/60R-15 blackwall touring tires, compact spare tire	P215/60R-15 blackwall touring tires, compact spare tire

Dimensions**Exterior**

Wheelbase (in / mm):	107 / 2717
Overall length (in / mm):	190.4 / 4836
Overall width (in / mm):	69.4 / 1762
Overall height (in / mm):	56.2 / 1427
Track (in / mm):	
Front:	59 / 1498
Rear:	59.3 / 1506
Min. ground clearance (in / mm):	5.5 / 139
Curb weight (lbs / kg):	Sedan: 3053 / 1385; LS: 3080 / 1397
Weight distribution (f / r):	64 / 36

Interior

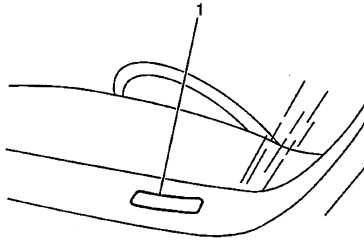
	Front	Rear
Seating capacity:	2	3
Head room (in / mm):	39.4 / 1000	37.6 / 955
Leg room (in / mm):	41.9 / 1074	38 / 965
Shoulder room (in / mm):	55.5 / 1409	55.3 / 1418
Hip room (in / mm):	52 / 1333	52 / 1333

Capacities

EPA passenger volume (cu ft / liters):	98.6 / 2792
EPA interior volume (cu ft / liters):	115 / 3256.5
Cargo volume (cu ft / liters):	17.3 / 438
Trailer towing (max lbs / kg):	1000 / 454
Fuel tank capacity (gals / liters):	14.1 / 54
Engine oil (qts / liters):	4.5 / 4.3
Engine coolant (qts / liters):	13.6 / 12.9

Vehicle Identification

Vehicle Identification Number (VIN)



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

Position	Definition	Character	Description
1	Country of Origin	1	U.S.A.
2	Manufacturer	G	General Motors
3	Make	1	Chevrolet
4-5	Carline/Series	N/D N/E	Malibu Malibu LS
6	Body Style	5	Four Door Sedan (69)
7	Restraint System	2	Active (Manual) Belts w/Driver and Passenger Inflatable Restraint System
8	Engine Type	J	LG8 (3.1L)
9	Check Digit	--	Check Digit
10	Model Year	2	2002
11	Plant Location	Y 6	Wilmington, DE Oklahoma City, OK
12-17	Plant Sequence Number	--	Plant Sequence Number

VIN Derivative

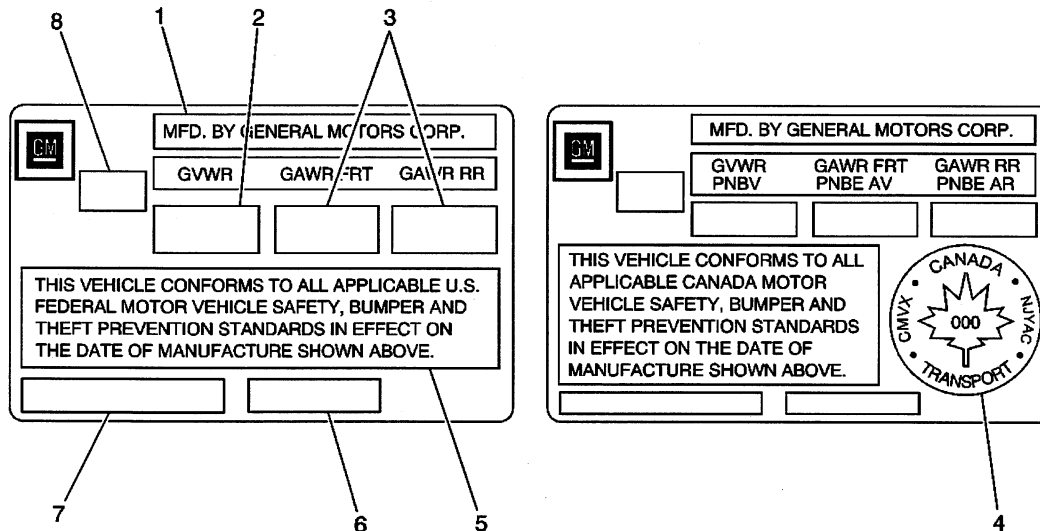
All engines and transmissions are stamped or laser etched with a partial vehicle identification number (VIN), which was derived from the complete VIN. A VIN derivative contains the following nine positions:

Position	Definition	Character	Description
1	GM Division Identifier	1	Chevrolet
2	Model Year	2	2002
3	Assembly Plant	Y 6	Wilmington, DE Oklahoma City, OK
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).

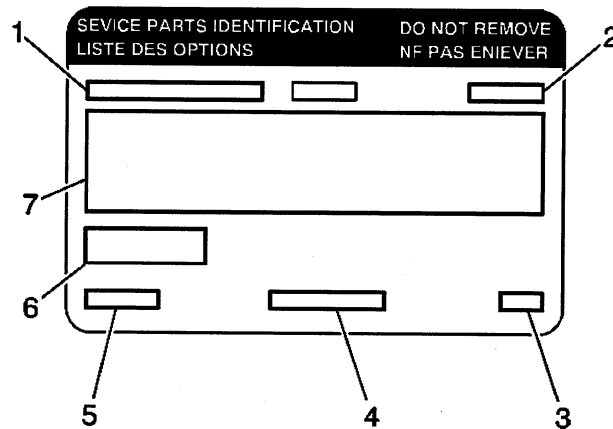
The GVW is the weight of the vehicle and everything the vehicle carries. Include the following items when figuring the GVW:

- 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 .

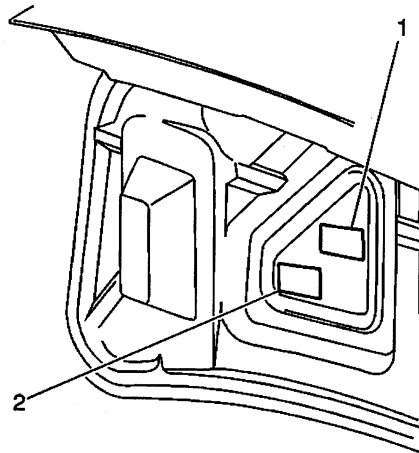
The GAW is the weight exerted on one of the axles (front or rear).

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.



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

Tire Placard

The diagram shows a rectangular Tire Placard with the following fields and callouts:

- 1** points to the 'OCCUPANTS' field, which includes sub-fields for 'FRT', 'C/R', and 'RR'.
- 2** points to the 'TOTAL' field under 'OCCUPANTS'.
- 3** points to the 'VEHICLE CAP WT.' field, which includes sub-fields for 'LBS.' and 'KG'.
- 4** points to the 'COLD TIRE PRESSURE PSI/KPa' field.
- 5** points to the 'SPEED RTG.' field.
- 6** points to the 'TIRE SIZE' field.
- 7** points to the 'MODEL' field.
- 8** points to the 'TIRE SIZE' field.
- 9** points to the 'VEHICLE IDENTIFICATION NUMBER' field.

Other text on the placard includes: 'TIRE-LOADING INFORMATION', 'MAX. LOADING @ GVWR SAME AS VEHICLE CAPACITY WEIGHT', 'IF TIRES ARE HOT AND 4 PSI/28KPa SEE OWNER'S MANUAL FOR ADDITIONAL INFORMATION', and 'FRT', 'RR', 'SPA' labels for tire positions.

- (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

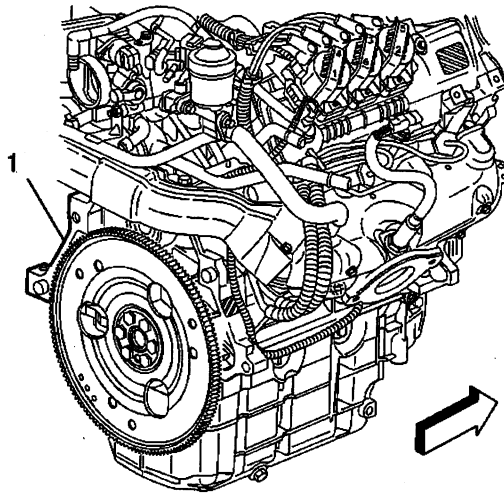
The Tire Placard is permanently located on the edge of the driver's door. Refer to the placard to obtain:

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

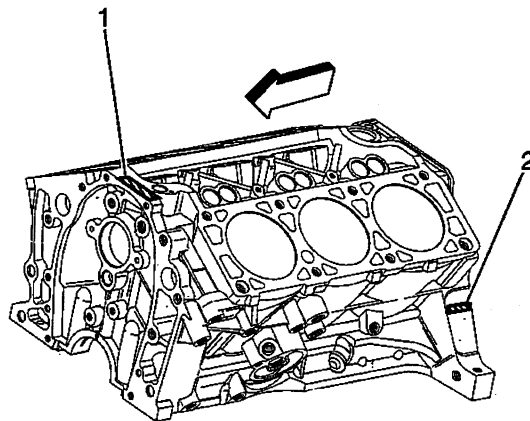
Engine ID and VIN Derivative Location

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.

3.1L Engine VIN Derivative Location(c)



The primary location (1) of the VIN derivative for the 3100 LG8 engine is shown.

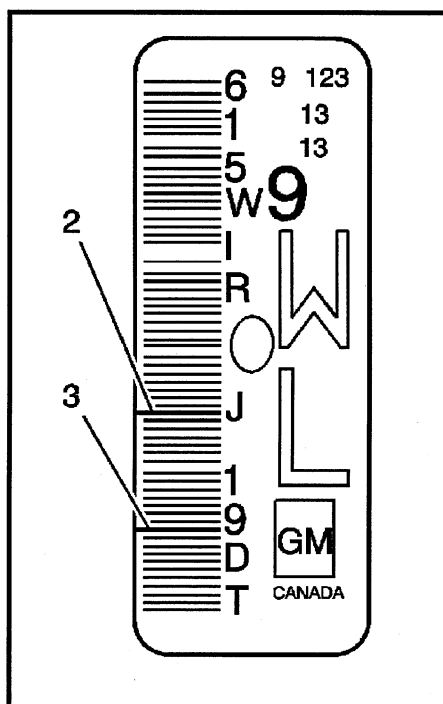
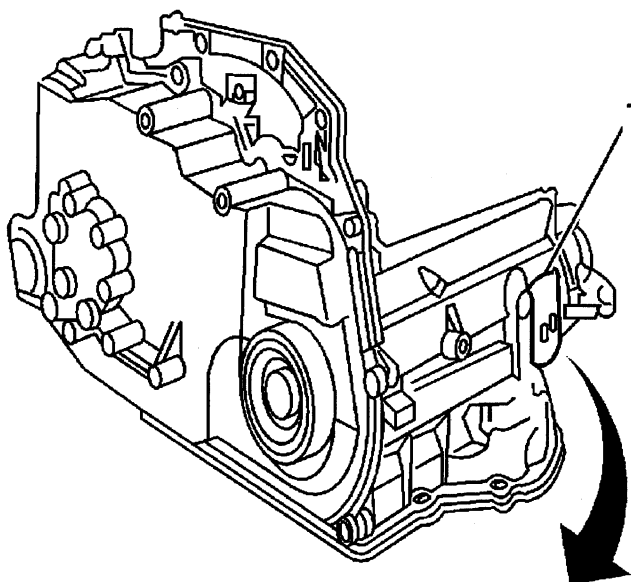


The primary location (1) and the secondary location (2) for the Engine ID for the 3100 LG8 engine is on top of the RH rocker arm cover or front of RH oil pan rail.

Engine and Transmission Usage

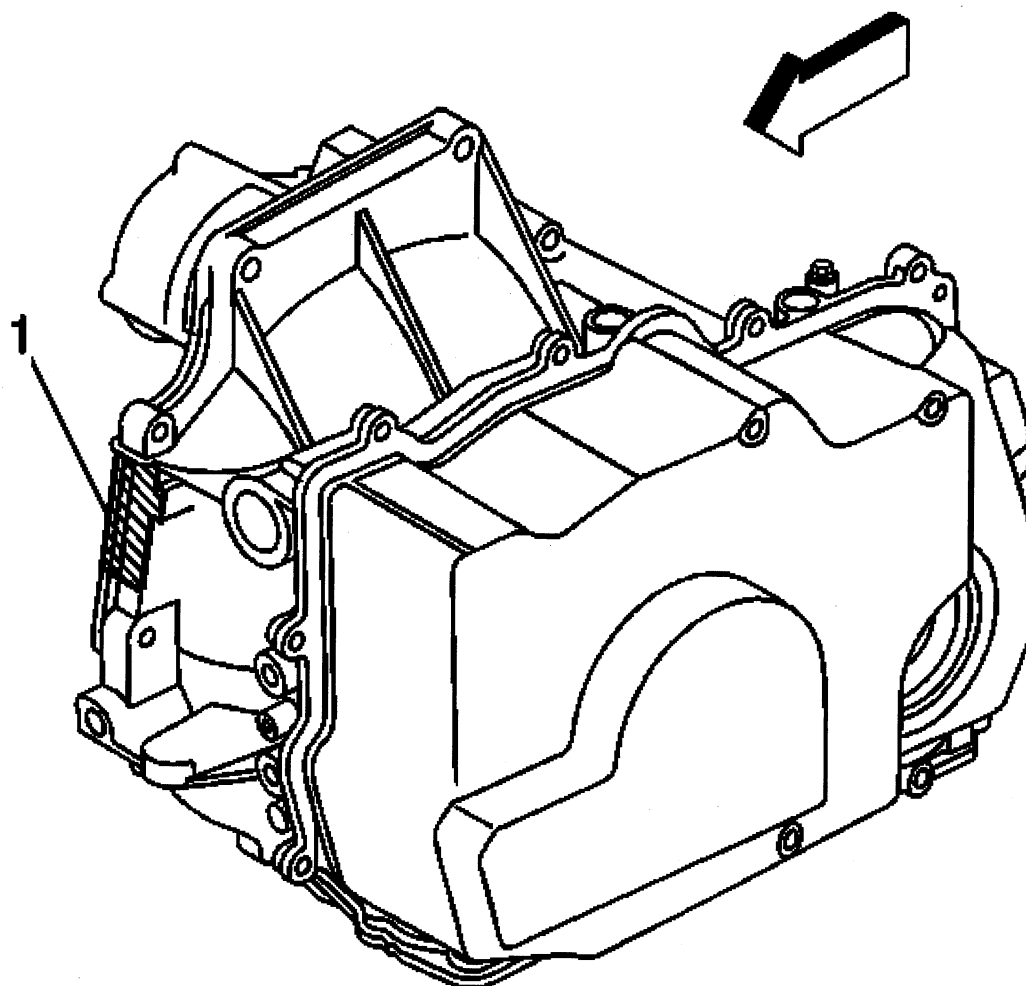
Body Type	Car Line	Engine Size	Fuel System	Engine RPO	Transmission Used	Transmission RPO
N	Malibu	3.1L V6	SFI	LG8	4T40-E/4T45E	MN4

Transmission ID and VIN Derivative Location 4T40-E (c)



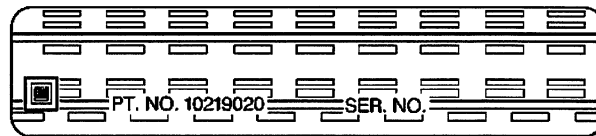
- (1) Goodwrench Tag Location
- (2) Remanufacturing Site Code
- (3) Serial Number

Derivative Location 4T40-E/4T45-E(c)



The Vehicle Identification Number (VIN) Derivative location for the 4T40E Transmission.

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	Seat, Power 6-Way Adjustment
AK5	Restraint System Front Seat, Inflatable, Driver and Passenger
AM9	Seat, Rear, Split Fold Down
AP9	Restraint, Cargo Net
AR9	Seats; Bucket, Reclining
AU0	Remote Keyless Entry
A31	Window Power Operated, Side
CF5	Sun Roof, Glass, Sliding, Electric
C60	HVAC System Air Conditioner, Front Manual Controls
DC4	Mirror, Inside Rearview Tilt, Dual Reading Lamps
DD9	Mirrors, Power - OSRV Breakaway, Painted
DHB	Mirrors, Power - OSRV Breakaway
DT3	Box Rear Stowage Compartment
D37	OSRV Mirrors - Break - Away Driver Side Remote/Pass Side Manual, Painted
FE1	Suspension System, Soft Ride
F83	Transaxle Ratio, Final Drive 3.05
JM4	Brakes System Power, Front Disc, Rear Drum, Cast Iron, Antilock, Front and Rear Wheel
KC4	Engine Oil Cooling System
K05	Engine Block Heater
K34	Cruise Control Automatic, Electronic
LG8	Engine Gas, 6 CYL, 3.1L, SFI, V6, GM
MN4	Transmission, Automatic 4 Speed, 4T40E
MX0	Merchandised Transmission Automatic Provisions, Overdrive
NC1	Emission System California LEV
NF7	Emission System Federal NLEV
NK5	Steering Wheel Standard
NM2	Emission System Export, Leaded Fuel
NP5	Steering Wheel Leather Wrapped
N05	Lock Control Fuel Filler Cap
N81	Fullsize Spare Tire
PB4	Lock Control Wheel
PG1	Wheel 15 x 6, Steel
QCD	Tire All, P215/60R15 BW R/PE ST TL AL2 93S
QLM	Tire All, P215/60R15/N BL R/PE ST TL ALS NSC
RPA	Rear Parking Assist
T43	Rear Spoiler
T61	Lighting, Daytime Running
T96	Front Fog Lamp
UD4	Alarm Vehicle Speed, 120 K/H
UH8	Cluster Instrument, Cool Temp, Trip Odom, Tach
UL0	Radio, AM/FM Stereo, Seek/Scan, Auto Reverse Music Search Cassette, Auto Tone, Clock
UL2	European Frequencies
UN0	Radio, AM/FM, Stereo, Seek/Scan, Compact Disc, Auto Tone, Clock
UP0	Radio, AM/FM, Stereo, Seek/Scan, Auto Reverse Music Search Cassette, CD, Auto Tone, Clock
UQ3	Speaker System Performance Enhanced Audio
US6	Antenna Fixed, Painted, Radio

2002 Chevrolet Malibu Restoration Kit

U19	Metric Scale Instrument Cluster
U79	Speakers (4), 2 Rear Shelf, 1 Coaxial Per Door
VG9	Protector Wax, Exterior Body
VR6	Hook Tie Down
VY7	Leather Shift Knob
Y11	Sales Special Ornamentation Gold
Y70	Headliner; Include: Vanity Mirrors Covered No Light, Dome lamp w/3 Position Switch, Coat Hook-Rear Headliner. Mount, Visors w/Anchors
Y71	Sunroof Headliner - Vanity Mirrors Covered - Pass Lighted, Power Switch and Bezel, Inside Rear View Mirror w/Dual Reading Lamps, Coat Hooks - Rear Headliner. Mount, Assist Handles (3), Visors w/Anchors, Dome Lamp w/3 Position Switch
Y73	Up level Headliner; Include: C95 - Dual Reading Lamp, Assist Handles, Overhead Storage Bin Between Visors
Z49	Export Canadian Modification, Mandatory Base Equipment
Z5X	Mirror Provisions, Arabic Language

Technical Information

Maintenance and Lubrication

Capacities - Approximate Fluid

Application	Specification	
	Metric	English
Engine Cooling, 3.1L	12.9 liters	13.6 quarts
Engine Oil with Filter	4.3 liters	4.5 quarts
Fuel Tank	53.4 liters	14.1 gallons
Automatic Transaxle Complete Overhaul	9.0 liters	9.5 quarts
Power Steering System	0.70 liters	1.5 pints

Maintenance Items

Item	Type/Part Number
Air Cleaner Filter, 3.1L	AC Type A-1279C
Engine Oil Filter, 3.1L	AC Type PF47
Spark Plug and Gap, 3.1L	AC Type 41-940, 1.52 mm (0.060 in) Gap
PCV Valve	AC Type CV892C
Windshield Wiper Blades (Passenger Side)	48.0 cm (19.0 in)
Windshield Wiper Blades (Driver Side)	56.0 cm (22.0 in)

Tire Inflation Pressure Specifications

Application	Specification	
	Metric	English
Tire Inflation; Front Tires	200 kPa	29 psi
Tire Inflation; Rear Tires	180 kPa	26 psi
Tire Inflation; Compact Spare	420 kPa	60 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 Category LB or GC-LB
Hydraulic Brake System	Delco Supreme 11® Brake Fluid (GM P/N 12377967 or equivalent DOT-3 brake fluid)
Key Lock Cylinders	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241 or equivalent)
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

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

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

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

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

- A recirculating ball system
- A rack and pinion system

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

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

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

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

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

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

Steering Wheel and Column

The steering wheel and column has 4 primary functions:

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

Vehicle Steering

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

Vehicle Security

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

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

Driver Convenience

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

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

Driver Safety

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

Suspension Description and Operation

Front Suspension

The front suspension has 2 primary purposes:

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

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

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

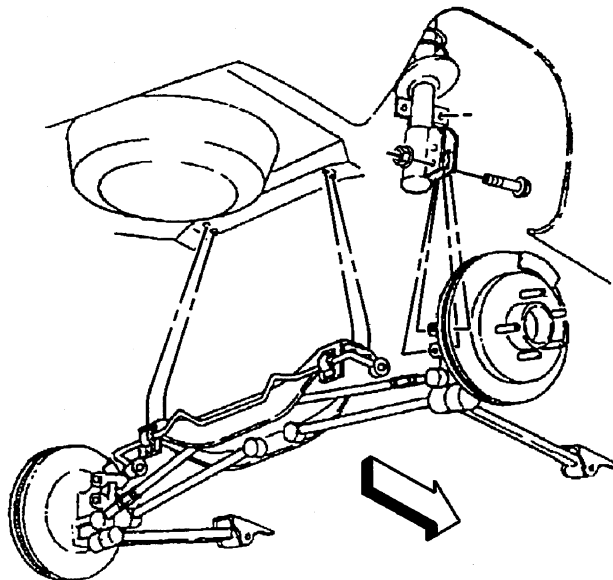
This up and down motion of the steering knuckle as the vehicle travels over bumps is absorbed predominantly by the coil spring. This spring is retained under tension over the strut assembly. A strut is used in conjunction with this system in order to dampen out the oscillations of the coil spring. A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

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

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

Rear Suspension

The rear suspension utilizes coil springs over struts and light weight 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 deflect 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.

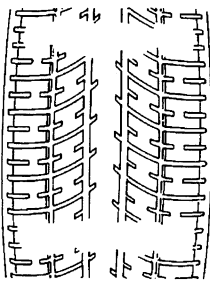
The following factors have an important influence on tire life:

- 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

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Inspect the tire pressure when the following conditions apply:

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

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

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

Inflation Pressure Conversion (Kilopascals to PSI)

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

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

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

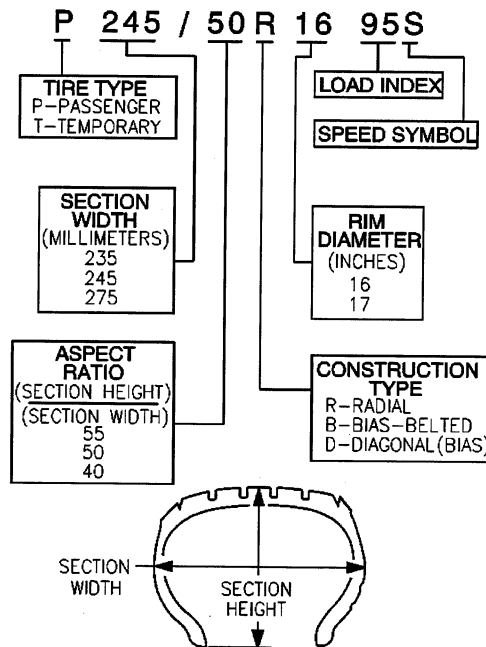
Tires with a lower than recommended pressure can cause the following conditions:

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

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

- Uneven braking
- Steering lead
- Reduced vehicle handling

P-Metric Sized Tires Description



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

Driveline System Description and Operation

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.

Drum Brake System Description and Operation

System Component Description

The drum brake system consists of the following:

Drum Brake Shoes

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

Brake Drums

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

Drum Brake Hardware

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

Drum Brake Adjusting Hardware

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

System Operation

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

Park Brake System Description and Operation

System Component Description

The park brake system consists of the following:

Park Brake Lever Assembly

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

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

Park Brake Cables

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

Park Brake Cable Equalizer

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

Park Brake Apply Lever

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

Park Brake Actuator/Adjuster

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

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

Drum Brake Shoes

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

System Operation

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

ABS Description and Operation

Antilock Brake System

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

During antilock braking, a series of rapid pulsations is felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as the EBCM responds to wheel speed sensor inputs and attempts to prevent wheel slip. These pedal pulsations are present only during antilock braking and stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves cycle rapidly. During antilock braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during antilock operation.

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

Engine Description and Operation

Engine Mechanical – 3.1L

Mechanical Specifications

Application	Specification	
	Metric	English
General Data		
• Engine Type	60° V-6	
• Displacement	3.1L	191 cu in
RPO - VIN Code	LG8 - J	
• Bore	89 mm	3.50 in
• Stroke	84 mm	3.31 in
• Compression Ratio	9.6:1	
• Firing Order	1-2-3-4-5-6	
• Oil Pressure	103 kPa	15 psi @ 1100 RPM

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Control Cable Bracket Bolt/Nut	10 N·m	89 lb in
Air Injection Check Valve (with NC1 California Emissions)	20 N·m	15 lb ft
Air Injection Check Valve Front Bracket Bolt and Nut (with NC1 California Emissions)	25 N·m	18 lb ft
Air Injection Check Valve Nut (with NC1 California Emissions)	10 N·m	89 lb in
Air Injection Check Valve Pipe Adapter (with NC1 California Emissions)	30 N·m	22 lb ft
Air Injection check Valve Rear Bracket Nuts (with NC1 California Emissions)	25 N·m	18 lb ft
Air Injection Solenoid Bolt (with NC1 California Emissions)	10 N·m	89 lb in
Camshaft Position Sensor Bolt	10 N·m	89 lb in
Camshaft Sprocket Bolt	140 N·m	103 lb ft
Camshaft Thrust Plate Screw	10 N·m	89 lb in
Connecting Rod Bearing Cap Nut	20 N·m + 75°	15 lb ft + 75°
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 Main Bearing Cap Bolt/Stud	50 N·m + 77°	37 lb ft + 77°
Crankshaft Oil Deflector Nut	25 N·m	18 lb ft
Crankshaft Position Sensor Bolt -- Front Cover	10 N·m	89 lb in
Crankshaft Position Sensor Stud -- Side of Engine Block	11 N·m	98 lb in
Crankshaft Position Sensor Wiring Bracket Bolt	50 N·m	37 lb ft
Cylinder Head Bolt	60 N·m + 95°	44 lb ft + 95°
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	25 N·m	18 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 -- Medium	47 N·m	35 lb ft
Engine Front Cover Bolt -- Small	21 N·m	15 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

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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	13 N·m	115 lb in
Engine Wiring Harness Bracket Bolt	13 N·m	115 lb in
Exhaust Crossover Pipe Heat Shield Bolt	10 N·m	89 lb in
Exhaust Crossover Pipe Nut/Stud	25 N·m	18 lb ft
Exhaust Manifold Heat Shield Bolt	10 N·m	89 lb in
Exhaust Manifold Nut	16 N·m	12 lb ft
Exhaust Manifold Stud	18 N·m	13 lb ft
Fuel Feed Pipe to Fuel Injector Rail Nut	17 N·m	13 lb ft
Fuel Injector Rail Bolt	10 N·m	89 lb in
Fuel Pipe Bracket Bolt/Stud	50 N·m	37 lb ft
Fuel Pipe Clip Bolt	8 N·m	71 lb in
Fuel Return Pipe to Fuel Injector Rail Nut	17 N·m	13 lb ft
Generator Bracket and Front Engine Lift Hook Bolt	50 N·m	37 lb ft
Heated Oxygen Sensor	42 N·m	31 lb ft
Heater Inlet Pipe Nut	25 N·m	18 lb ft
Ignition Coil Bracket Bolt/Nut/Stud	25 N·m	18 lb ft
Intake Manifold Coolant Pipe Bolt	10 N·m	89 lb in
Knock Sensor	19 N·m	14 lb ft
Lower Intake Manifold Bolt - Center		
• First Pass	7 N·m	62 lb in
• Final Pass	13 N·m	115 lb in
Lower Intake Manifold Bolt - Corner		
• First Pass	13 N·m	115 lb in
• Final Pass	25 N·m	18 lb ft
MAP Sensor Bolt	5 N·m	44 lb in
Oil Cooler Connector	50 N·m	37 lb ft
Oil Cooler Hose Fitting	19 N·m	14 lb ft
Oil Cooler Pipe Bracket Bolt	10 N·m	89 lb in
Oil Filter	13 N·m	115 lb in
Oil Filter Bypass Hole Plug	19 N·m	14 lb ft
Oil Filter Fitting	39 N·m	29 lb ft
Oil Gallery Plug -- 1/4 inch	19 N·m	14 lb ft
Oil Gallery Plug -- 3/8 inch	33 N·m	24 lb ft
Oil Level Indicator Tube Bolt	25 N·m	18 lb ft
Oil Level Sensor Bolt	10 N·m	89 lb in
Oil Pan Bolt	25 N·m	18 lb ft
Oil Pan Drain Plug	25 N·m	18 lb ft
Oil Pan Side Bolt	50 N·m	37 lb ft
Oil Pump Cover Bolt	10 N·m	89 lb in
Oil Pump Drive Clamp Bolt	36 N·m	27 lb ft
Oil Pump Mounting Bolt	41 N·m	30 lb ft
Spark Plug		
• Spark Plug - Initial Installation	20 N·m	15 lb ft
• Spark Plug - Reinstallation	15 N·m	11 lb ft
Thermostat Bypass Pipe to Cylinder Head Nut	25 N·m	18 lb ft
Thermostat Bypass Pipe to Engine Front Cover Bolt	12 N·m	106 lb in
Thermostat Bypass Pipe to Throttle Body Nut	25 N·m	18 lb ft
Throttle Body Bolt/Stud	25 N·m	18 lb ft
Timing Chain Dampener Bolt	21 N·m	15 lb ft
Transaxle-to-Engine Bolts	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	19 N·m + 30°	14 lb ft + 30°
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 and has six cylinders arranged in a V shape with three cylinders in each bank. The cylinder banks are set at a 60 degree angle from each other.

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

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

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

The crankshaft is cast nodular iron with deep rolled fillets on all six crankpins and all four main journals. Four steel-backed aluminum bearings are used, with the #3 bearing being 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 four journals and includes an oil pump drive gear.

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

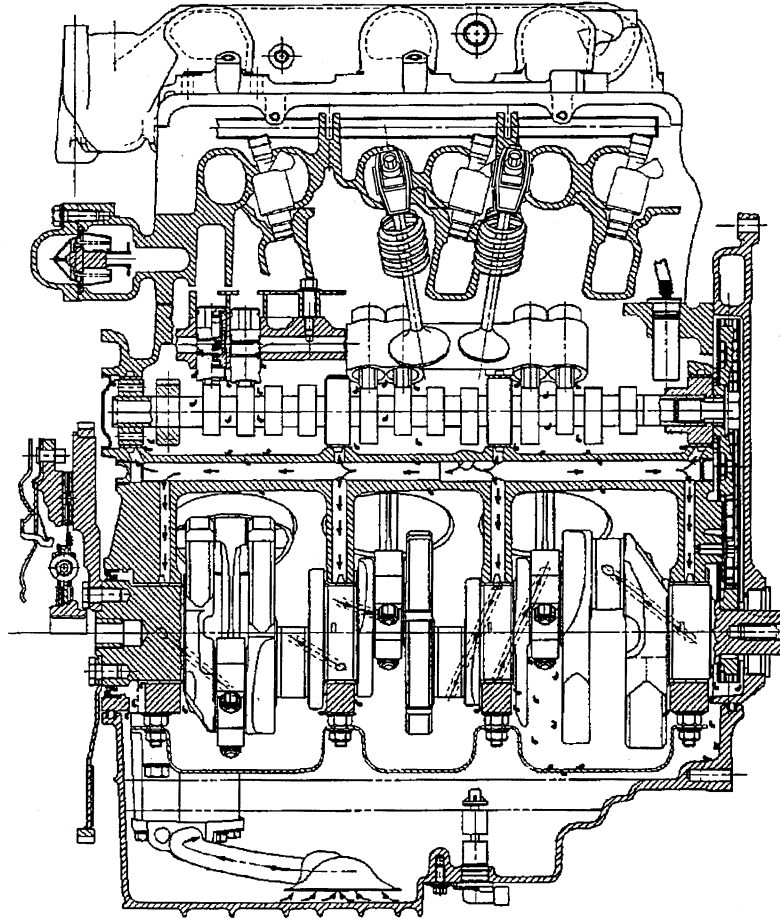
Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal.

A roller rocker type valve train is used. Motion is transmitted from the camshaft through the hydraulic roller lifter and the pushrod to the roller rocker arm. The rocker arm pivots on needle roller bearings and transmits the camshaft motion to the valve. The rocker arm pedestal locates in a slot in the cylinder head and 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 two-piece cast aluminum unit. It centrally supports a fuel rail with six fuel injectors.

The exhaust manifolds are cast nodular iron.

Lubrication



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

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

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

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

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

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

Drive Belt System Description

The drive belt system consists of the following components:

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

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

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

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

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

Engine Cooling

Engine Cooling System Approximate Capacities

Application	Specifications	
	Metric	English
Cooling System Fluid Capacity 3.1L	12.4 L	13.1 qt

Fastener Tightening Specifications

Application	Specifications	
	Metric	English
A/C Condenser-to-Radiator Bolts	10 N·m	89 lb in
Battery Cable to Battery Bolt	16 N·m	12 lb ft
Coolant Outlet Bolts 3.1 L	25 N·m	18 lb ft
Fan-to-Shroud Bolts	5 N·m	44 lb in
Radiator Lower Support Panel to Cradle Bolts	10 N·m	89 lb in
Radiator Surge Tank Inlet Pipe Fitting 3.1 L	21 N·m	15 lb ft
Surge Tank Bolt	9 N·m	80 lb in
Surge Tank Cap	4 N·m	35 lb in
Transaxle Oil Cooler Fittings at Radiator	30 N·m	22 lb ft
Water Pump Pulley-to-Pump Bolts 3.1 L	25 N·m	18 lb ft
Water Pump-to-Front Cover Bolts 3.1 L	10 N·m	89 lb in
Water Pump-to-Timing Chain Housing 2.4 L	26 N·m	19 lb ft

Cooling System Description and Operation

Coolant Heater

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

Cooling System

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

Cooling Cycle

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

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

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

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

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

Coolant

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

Radiator

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

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

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

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

Pressure Cap

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

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

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

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

Coolant Recovery System

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

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

Air Baffles and Seals

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

Water Pump

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

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

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

Thermostat

The thermostat is a coolant flow control component. Its 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	N·m	Lb Ft	Lb In
Battery Retainer Bolt	18	13	--
Front Generator Bracket to Block Attaching Bolt (3.1L)	50	37	--
Generator Rear Mounting Bolt (3.1L)	25	18	--
Ignition Wire Harness Bracket Nut (3.1L)	13	10	--
Ignition Wire Harness Retaining Bolt (3.1L)	25	18	--
Negative Battery to Transaxle Stud Nut	30	22	--
Positive Battery Cable to Generator Nut (3.1L)	7.5	--	65
Positive Battery Cable to Starter Solenoid Nut	12	--	106
Spark Plugs (3.1L)	19	14	--
Starter Lead Wire to Starter Solenoid S Terminal Nut	2.5	--	22
Starter Motor to Engine Bolt (3.1L)	43	32	--

Battery Usage

Application	Specification
Cold Cranking Amperes	600 Amps
Original Equipment Battery Catalog Number	19000672
Reserve Capacity Rating	90 Minutes
Recommended Replacement Battery Catalog Number	75A-72
Test Load Amperes	300 Amps

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	Specification
Type 2.4L	PG260-MQ
Type 3.1L	PG260-F1
No Load Test @	11.5 V
Amps	60-120
RPM at Drive Pinion	2,900-3,400

Generator Usage

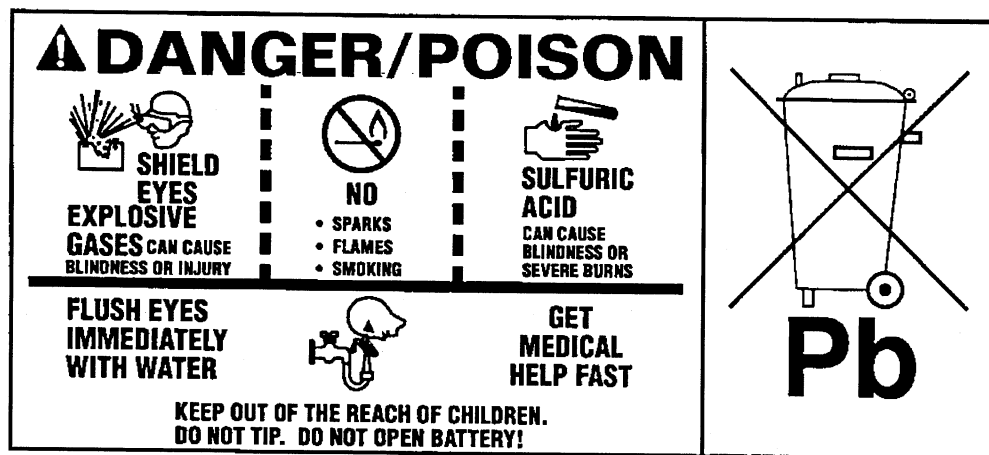
Application	Specification
Model	CS130D
Rated Output	105 A
Load Test	73 A

Battery Description and Operation

Caution

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

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



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

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

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

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

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

CATALOG NO.	
1819	
CCA 770	LOAD TEST 380
REPLACEMENT MODEL 100-6YR	

A battery has 2 ratings:

- Reserve capacity
- Cold cranking amperage

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

Reserve Capacity

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

Cold Cranking Amperage

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

Circuit Description

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

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

Starting System Description and Operation

The cranking circuit consists of the battery, starter motor, ignition switch, and related wiring.

These starter motors are not serviceable and are replaced as assemblies only.

The [PG] starter motors are [non-]repairable starter motors. They have pole pieces that are arranged around the armature within the starter housing. When the solenoid windings are energized, the pull-in winding circuit is completed to ground through the starter motor. The hold-in winding circuit is completed to ground through the solenoid. The windings work together magnetically to pull in and hold in the plunger. The plunger moves the shift lever. This action causes the starter drive assembly to rotate on the armature shaft spline as it engages with the flywheel ring gear on the engine. At the same time, the

plunger closes the solenoid switch contacts in the starter solenoid. Full battery voltage is then applied directly to the starter motor and it cranks the engine.

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

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

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

Charging System Description and Operation

Generator

The generator is non-repairable. The generator(s) feature the following major components:

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

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

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

Regulator

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

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

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

Engine Controls

Engine Controls – 3.1L

Fastener Tightening Specifications

Application	Specification	
	Metric	English
A/C Refrigerant Pressure Sensor	5 N·m	44 lb in
AIR Pump Mounting Bracket Nuts	50 N·m	37 lb ft
AIR Pipe Bolts	9 N·m	80 lb in
AIR Pump Exhaust Mounting Bolts	10 N·m	88 lb in
AIR Secondary Injection Combination Valve Bolts	9 N·m	80 lb in
AIR Vacuum Control Solenoid Bolts	10 N·m	7 lb ft
Accelerator Cable Bracket Retaining Nuts And Bolts	10 N·m	7 lb ft
Camshaft Position (CMP) Sensor Retaining Bolt	10 N·m	7 lb ft
Crankshaft Balancer Bolt	102.5 N·m	76 lb ft
Crankshaft Position 7X (CKP) Sensor Bolts	11 N·m	8 lb ft
Crankshaft Position 24X (CKP) Sensor Bolts	10 N·m	7 lb ft
Engine Coolant Temperature (ECT) Sensor	23 N·m	17 lb ft
Engine Oil Level Switch	22 N·m	17 lb ft
Engine Oil Pressure Indicator	16 N·m	12 lb ft
EVAP Purge Valve Bracket	10 N·m	7 lb ft
Exhaust Gas Recirculation Valve to Throttle Body Adapter Bolts	30 N·m	22 lb ft
Fuel Rail Attaching Nuts or Bolts	10 N·m	7 lb ft
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	41 N·m	30 lb ft
Idle Air Control 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 Bracket to Engine Studs and Nuts	25 N·m	18 lb Ft
In-Line Fuel Filter Outlet Nut	30 N·m	22 lb ft
Knock Sensors	19 N·m	14 lb ft
Manifold Absolute Pressure (MAP) Sensor Bracket Retaining Bolt	5 N·m	44 lb lb
Spark Plugs	27 N·m	20 lb ft
Throttle Body Retaining Nuts or Bolts	25 N·m	18 lb Ft
Throttle Position (TP) Sensor Attaching Screws	2 N·m	18 lb in
Transaxle Range Switch Attaching Bolts	28 N·m	20 lb ft
Wheel Lug Nuts	140 N·m	104 lb ft

Fuel System Specifications

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

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

If you're using fuel rated at 87 octane or higher and you hear heavy knocking, your engine needs service. But don't worry if you hear a little pinging noise when you're accelerating or driving up a hill. That's normal, and you don't have to buy a higher octane fuel to get rid of pinging. It's the heavy, constant knock that means you have a problem.

Notice

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

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

Some 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
Exhaust Manifold Pipe Assembly to Manifold Nut	45 N·m	33 lb ft
Hanger Brackets	25 N·m	18 lb ft
Muffler Assembly to Intermediate Pipe	25 N·m	18 lb ft
Three Way Catalytic Converter to Intermediate Pipe Bolts	34 N·m	25 lb ft

Exhaust System Clearances

Application	Millimeters	Inches
All of the Exhaust System Components to all of the Underbody Components (Minimum)	25	1.0
All of the Heat Shields to the Underbody (Maximum)	15	0.60
All of the Heat Shields to the Underbody (Minimum)	10	0.40

Exhaust System Description

Important

Use of non-OEM parts may cause driveability concerns.

General Description

The exhaust system is used to carry and treat the gases that are created by the engine. When the engine exhaust valve opens hot gases created by the engine combustion cycle are allowed to travel out through the cylinder head into the exhaust manifold. In the exhaust manifold the exhaust gases combine with exhaust gases from the other cylinders and pass through a flanged port into the three-way catalytic converter pipe. The exhaust gases pass through the catalytic converter to reduce pollutants from the exhaust stream gases. The three-way catalytic converter pipe carries the exhaust gases on to the exhaust system where the resonator and muffler are used to reduce the noise levels of the exhaust. The exhaust system exits at the rear of the vehicle to reduce exhaust noise and prevent fumes from entering the vehicle. Exhaust system hangers and insulators support the weight of the exhaust system, isolate engine noise, isolate engine vibration, space the system away from the underbody of the vehicle and allow for exhaust system expansion that occurs as the exhaust system warms up.

Exhaust Manifold

The exhaust manifold is a component of the exhaust system used to collect and carry hot exhaust gases away from the engine. Made from cast iron, the exhaust manifold combines the exhaust gases from several cylinders. The exhaust manifold is bolted to the cylinder head with a exhaust manifold gasket between them. The left (front) exhaust manifold connects to a crossover pipe that is part of the right (rear) exhaust manifold and carries the exhaust gases from the front of the vehicle over the transmission to the right (rear) exhaust manifold. The gases are combined in the right (rear) manifold and directed on to the three-way catalytic converter. The three-way catalytic converter pipe and gasket are bolted to the right (rear) exhaust manifold. The right (rear) exhaust manifold has two tapped holes. The heated oxygen sensor (HO2S) threads into the hole by the flange and the EGR valve pipe threads into the hole where the crossover meets the right (rear) exhaust manifold.

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:

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

The catalyst in the converter is not serviceable.

Exhaust Pipe Description

The exhaust pipe carries exhaust gases treated by the three-way catalytic converter through a resonator and into the exhaust muffler. As exhaust gases travel through the resonator and muffler baffles, exhaust noise is lessened. The exhaust system exits at the rear of the vehicle to reduce exhaust noise and eliminate fumes from entry into the vehicle. Exhaust system hangers and insulators support the weight of the exhaust pipe, the resonator, and the muffler. The exhaust system hangers also space the exhaust system away from the underbody of the vehicle and allow the exhaust system to expand as the exhaust system warms up.

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 – 4T40E-4T45E

Fastener Tightening Specifications

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

Transmission General Specifications

Name		Hydra-Matic® 4T40-E/4T45-E	
RPO Codes		MN4 - 4T40-E MN5 - 4T45-E	
Production Location		Windsor, Ontario, Canada	
Vehicle Platform Engine/Transmission Usage		J, N	
Transmission Drive		Transverse Mounted Front Wheel Drive	
Maximum Engine Torque		4T40-E 270 N·m (200 lb ft) 4T45-E 290 N·m (215 lb ft)	
Maximum Shift Speed		1-2 6,500 RPM 2-3 6,500 RPM 3-4 6,500 RPM	
1st Gear Ratio		2.960:1	
2nd Gear Ratio		1.626:1	
3rd Gear Ratio		1.000:1	
4th Gear Ratio		0.681:1	
Reverse		2.143:1	
Torque Converter Size - Diameter of Torque Converter Turbine		245 mm	
Pressure Taps		Line Pressure	
Transmission Fluid Type		DEXRON® III	
Transmission Fluid Capacity - Approximate		Bottom Pan Removal: 6.5 L (6.9 qts) Complete Overhaul: 9.0 L (9.5 qts) Dry: 12.2 L (12.9 qts)	
Transmission Type: 4		Four Forward Gears	
Transmission Type: T		Transverse Mount	
Transmission Type: 40		Product Series	
Transmission Type: E		Electronic Controls	
Position Quadrant		P, R, N, Overdrive, 3, 2, 1	
Case Material		Die Cast Aluminum	
Transmission Weight Dry		4T40-E 74.7 kg (164 lbs) 4T45-E 75.1 kg (165.6 lbs)	
Transmission Weight Wet		4T40-E 85.0 kg (187 lbs) 4T45-E 85.5 kg (188.5 lbs)	
Maximum Trailer Towing Capacity		487 kg (1,000 lbs)	
Maximum Gross Vehicle Weight (GVW)		1,826 kg (4,100 lbs)	
Ratios			
Chain	Final Drive		Effective - Overall
32/38	3.29		3.91
32/38	3.05		3.63
35/35	3.29		3.29
35/35	3.05		3.42
33/37	3.29		3.69
33/37	3.05		3.42

Fluid Capacity Specifications

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

Transmission Component and System Description

Transmission General Description

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

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

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

Components

The mechanical components of this unit are as follows:

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

The electrical components of this unit are as follows:

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

- An automatic transmission wiring harness assembly
- A park/neutral position switch

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 park/neutral position switch.

With the ignition in the ON position, battery positive voltage is supplied to the park/neutral position switch. With the transmission in the PARK position the contacts in the park/neutral position switch are closed and voltage flows through the normally closed contacts of the automatic transmission shift lock control switch to the automatic transmission shift lock control solenoid. The automatic transmission shift lock control solenoid is permanently ground. This energizes the automatic transmission shift lock control solenoid and locks 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, de-energizing the automatic transmission shift lock control solenoid. This allows the shift lever to move 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
CO ₂	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
GWR	Gross Vehicle Weight Rating

H	
H	Hydrogen
H ₂ O	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
HO ₂ S	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	
O ₂	Oxygen
O ₂ S	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
SO ₂	Sulfur Dioxide
SP	Splice Pack
S/P	Series/Parallel
SPO	Service Parts Operations
SPS	Service Programming System, Speed Signal
sq ft, ft ²	Square Foot/Feet
sq in, in ²	Square Inch/Inches
SRC	Service Ride Control
SRI	Service Reminder Indicator
SRS	Supplemental Restraint System
SS	Shift Solenoid
ST	Scan Tool
STID	Station Identification Station ID
S4WD	Selectable Four-Wheel Drive
Sw	Switch
SWPS	Steering Wheel Position Sensor
syn	Synchronizer
T	
TAC	Throttle Actuator Control
Tach	Tachometer
TAP	Transmission Adaptive Pressure, Throttle Adaptive Pressure
TBI	Throttle Body Fuel Injection
TC	Turbocharger, Transmission Control
TCC	Torque Converter Clutch
TCS	Traction Control System
TDC	Top Dead Center
TEMP	Temperature
Term	Terminal
TFP	Transmission Fluid Pressure
TFT	Transmission Fluid Temperature
THM	Turbo Hydro-Matic
TIM	Tire Inflation Monitoring, Tire Inflation Module
TOC	Transmission Oil Cooler

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

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

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Conversion - English/Metric

English	Multiply/ Divide by	Metric
In order to calculate English measurement, divide by the number in the center column.		
In order to calculate metric measurement, multiply by the number in the center column.		
Length		
in	25.4	mm
ft	0.3048	m
yd	0.9144	
mi	1.609	km
Area		
sq in	645.2	sq mm
	6.45	sq cm
sq ft	0.0929	sq m
sq yd	0.8361	
Volume		
cu in	16,387.00	cu mm
	16.387	cu cm
	0.0164	L
qt	0.9464	
gal	3.7854	
cu yd	0.764	cu m
Mass		
lb	0.4536	kg
ton	907.18	
	0.907	tonne (t)
Force		
Kg F	9.807	newtons (N)
oz F	0.278	
lb F	4.448	
Acceleration		
ft/s ²	0.3048	m/s ²
ln/s ²	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/m ²

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

Equivalents - Decimal and Metric

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

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

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Fasteners

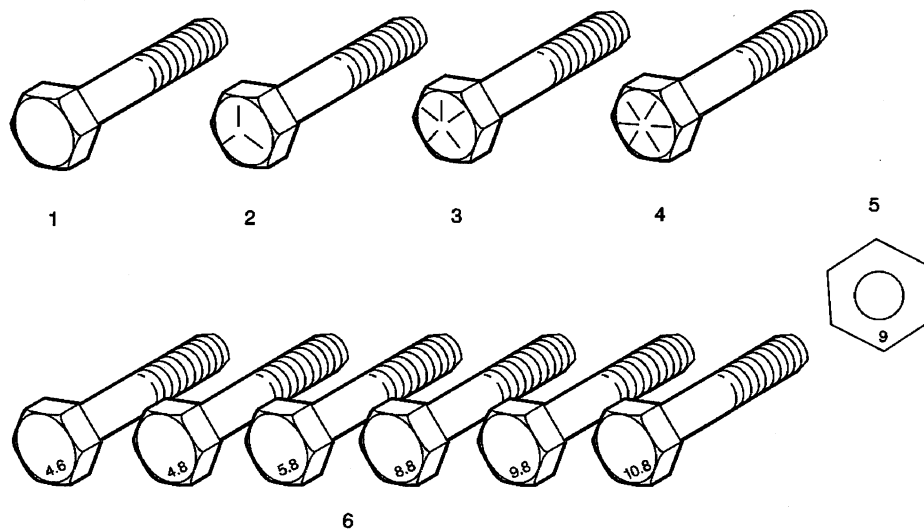
Metric Fasteners

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

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

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

Fastener Strength Identification



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

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

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

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

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

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

Prevailing Torque Fasteners

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

All Metal Prevailing Torque Fasteners

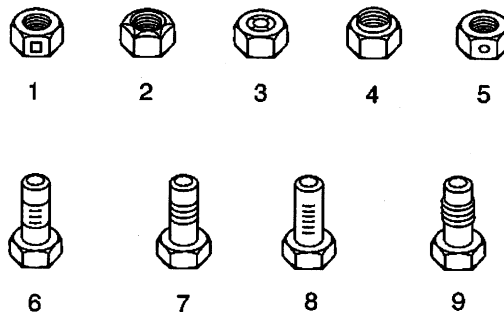
These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

Nylon Interface Prevailing Torque Fasteners

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

Adhesive Coated Fasteners

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



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

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

A prevailing torque fastener may be reused **ONLY** if:

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

Metric Prevailing Torque Fastener Minimum Torque Development

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

English Prevailing Torque Fastener Minimum Torque Development

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