Chevrolet

HHR

2006

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Product Information

2006 Chevy HHR: Form Meets Function

With distinctive styling, a spacious, easily configurable interior and economical, Ecotec four-cylinder engine-based powertrains, the 2006 Chevy HHR suits any lifestyle.

The HHR's unique design fuses elements of the 1949 Chevy Suburban – the original utility vehicle – and the SSR roadster. It is built on the same solid platform as the new Chevy Cobalt. An overall length of 176.2 inches (4,475 mm) and a cargo capacity of up to approximately 63.1cubic feet (1,787 L) give the five-passenger HHR easy-to-maneuver dimensions and room for just about any lifestyle interest. Its reconfigurable and convenient storage compartments accommodate everything from groceries to surfboards.

"The HHR is what you want it to be, whether you're hauling band equipment around the country or hauling your friends across town," said Lori Queen, GM vehicle line executive for small car. "With its unmistakable styling and innovative features, the HHR is further proof that there is a new spirit at Chevrolet."

HHR rounds out Chevrolet's small-vehicle strategy that began with the successful Aveo, a vehicle that holds the leadership position in its segment, and continues with the recently introduced Cobalt.

Well-equipped LS and LT models

HHR comes well equipped from the factory in two models: LS and LT. The LT also comes in two packages – 1LT and 2LT. All HHR models include standard features such as air conditioning, power windows, power door locks, power outside mirrors and remote keyless entry.

All HHR sound systems, including the standard six-speaker AM/FM/CD stereo, feature an auxiliary channel and front-mounted auxiliary input jack, so that an iPod or other audio source can be played through the vehicle audio system. A powerful, 260-watt Pioneer enhanced-performance audio system with subwoofer is available.

Additional product highlights include:

- Driver information center
- Adjustable cargo configurations
- Available power sunroof with express close feature
- OnStar available
- XM Satellite Radio available
- 16.2-gallon fuel tank provides long cruising range
- Segment-largest 16-inch standard wheels and 17-inch wheel options
- Remote start (standard with automatic transmission)

The 1LT model also includes a standard MP3 player, eight-way power seat including power lumbar, 16-inch cast aluminum wheels and a satin chrome exterior appearance package. Bright chrome exterior trim and a bright exhaust tip are available. ABS and traction control are also available (traction control available only with automatic transmission).

HHR 2LT comes with the larger 2.4L Ecotec engine and includes standard features such as ABS, fog lamps, bright exhaust tip, leather-wrapped steering wheel and shifter, the 260-watt Pioneer sound system with subwoofer, 17-inch aluminum wheels, FE3 sport suspension and a bright chrome exterior trim. Heated leather seats (with two heating levels) are available on both LT packages.

Other details shared among HHR models include a sporty three-spoke steering wheel and chrome accents on the instrument panel.

Unmistakable HHR style

HHR is a four-door vehicle with a rear touchpad liftgate. Its high roof evokes the look of the innovative 1949 Chevy Suburban, while other exterior cues carry the expressive attributes of the SSR roadster – all unmistakably Chevy traits.

Like the SSR, the HHR features deep-draw, flared fenders that tuck in at the rockers for a solid, firmly-planted stance. A one-piece, stamped metal hood is reminiscent of the '49 Suburban's heritage and is evidence of precise assembly quality. More quality touches are found in the single-cavity headlamp design, which incorporates jeweled lighting effects, as well as a flared, twin round-taillamp design in the rear. Stamped door and window appearances with a one-piece wraparound molding contribute to the clean, detailed design. The HHR's rear window is flush with the body side.

The power outside mirrors are integrated into the overall design theme for a more custom appearance, and the available integrated roof rack side rails are designed to blend smoothly into the HHR's overall appearance. The HHR also incorporates contemporary Chevy styling cues, including a prominent cross-grille bar with a Bowtie logo.

A variety of expressive exterior colors, including Sandstone Metallic, Black, Sunburst Orange II Metallic, Daytona Blue Metallic, Dark Silver Metallic, Sport Red Metallic, Silverstone Metallic and an exclusive Majestic Amethyst Metallic; HHR also offers two available exterior chrome packages. Satin chrome is standard, with bright chrome available on LT models. Both finishes provide additional visual distinction and accent the HHR's curvaceous body lines.

Room for lots of stuff

Like the rest of the vehicle, the HHR's interior combines the reassuring high visibility and cargo flexibility of an SUV with the comfort, appointments, driving ease and ergonomics of an upscale sedan. The vehicle's high roofline provides increased headroom and creates an open, airy environment.

The HHR's interior evokes a feeling of roominess. Detailed, jewel-like instrument displays and chrome accents contribute to the interior style. Interior color combinations feature darker colors on upper sections of the interior and lighter colors for lower sections. Quality also is conveyed in the tailored seats, which provide firmer support, sculpture and plenty of comfort for long drives. The 60/40-split folding rear seat offers generous and comfortable seating for three, along with comfortable legroom.

HHR also has standard air conditioning, providing comfortable levels of airflow, cooling capability and reduced cool-down time. The system is designed to provide efficient side-window defogging and enhanced rear-window defogging.

Complementing the HHR's comfortable and expressive interior is a highly adaptable cargo system, which maximizes storage capability with a host of clever and useful configuration options, including:

- Auxiliary glove box with flip-up cover is located at the top center of the instrument panel for convenient storage of MP3s, cell phones, sunglasses and other smaller items
- The front passenger seat folds fully flat, extending the total load length from the liftgate to the instrument panel – allowing 8-foot items, such as a ladder, to be carried with the liftgate closed.
- The center armrest of the front seats is integrated into the seat back frame, so it is out of the way when pivoted into a stowed position; a characteristic of trucks and SUVs.
- The rear seats have a 60/40-split, which fold to form a continuous flat load surface in conjunction with the folded front passenger seat. The 60-percent folding side was thoughtfully positioned on the passenger side, enabling wider objects to be positioned diagonally and carried more securely in the vehicle.

The cargo area in the rear also is thoughtfully designed:

- It provides a continuous flat load floor when the rear seats are folded down.
- The primary load floor can become a shelf when raised and mounted approximately 1 foot higher – the shelf can be mounted level or at a 45-degree angle to provide quick access to the cargo beneath it when the liftgate is opened.
- A 5-inch-deep recessed bin below the load floor can conceal 2.8 cubic feet (79.6 L); the spare tire is located beneath the bin.
- Two storage bins (0.5 cubic foot / 12.9 L total) are found forward of the load floor, nestled behind the rear seat, and plastic bag holders are conveniently located under the cargo shelf.
- It comes with a carpeted cargo mat.
- The rear liftgate is activated via touchpad, for ease of opening.

Ecotec-based powertrains

HHR relies on the renowned Ecotec family of technologically sophisticated inline four-cylinder engines, which balances usable power with fuel and emissions efficiency. The standard engine for LS and 1LT models is the 2.2L Ecotec engine, which is rated at 143 horsepower (107 kw) and 150 lb.-ft. of torque (203 Nm).*

The 2.4L Ecotec four-cylinder is available on the 1LT and standard on the 2LT. It is rated at 172 horsepower (128 kw) and 162 lb.-ft. of torque (220 Nm).* Both the 2.2L and the 2.4L engine have distinct performance and hardware differences, but share a basic structure and construction that includes:

- Dual overhead camshafts (DOHC) and four valves per cylinder
- Twin counter-rotating balance shafts for operational smoothness
- Electronic throttle control
- Low-friction, roller-finger follower valvetrain with hydraulic lash adjusters
- Low-maintenance chain-drive for the camshafts
- Direct-mount accessories, which reduce or eliminate traditional sources of noise and vibration
- Full-circle transmission mount to reduce noise and vibration
- GM Oil Life System, which can reduce the frequency for oil changes
- Innovative cast-in oil filter housing, which eliminates the need to crawl under the vehicle to perform oil changes and eliminates throwaway oil filter cans that retain used oil
- Catalytic converter located close to exhaust manifold to speed catalyst "light off," reducing hydrocarbon emissions

HHR's Ecotec engines also benefit from features designed to reduce noise and vibration. The pistons, for example, have a polymer coating and skirt design that reduces noise during cold starts, while a new, two-layer acoustic engine cover is tuned to reduce noise. NVH is also reduced with a new automatic tensioner that maintains optimal tension on the timing chain.

Transmissions include a standard F23 five-speed manual transmission or an available Hydra-Matic 4T45-E electronically controlled four-speed automatic, which are available with both engines. The F23 five-speed manual transmission delivers smoothness and durability, with all gears – including reverse – featuring synchronization.

The available 4T45-E is a smooth-shifting, highly durable automatic transmission. Like the F23 manual transmission, there are calibration differences to optimize the performance of 2.2L-equipped models and 2.4L-equippped models. All models, regardless of engine or transmission, are designed for flat towing.

Chassis and suspension details

HHR is built on the same robust GM global small car architecture as the Cobalt. This lower-dominant structure is designed with strength in the lower portions of the chassis, contributing to an overall feeling of rigidity, effectively minimizing superior noise and vibration characteristics. The use of premium materials, such as Quiet Steel laminated panels in the plenum area, further enhances the vehicle's overall quietness.

Extensive use of high-strength steel and ultra-high-strength steel in key structural components, including the rocker panels and cross-vehicle reinforcing beam, bolsters the vehicle's rigid feel while providing additional side-impact support. The cockpit "safety cage" provides load-carrying protection and, along with laser-welded blanks used in the door frames, front doors and rear doors, contributes to the HHR's NVH characteristics and build quality.

HHR uses a MacPherson strut front suspension design, along with a semi-independent, torsion beam rear suspension and five-lug wheels. Two suspension systems are available: FE1 suspension standard on LS and 1LT, with an FE3 suspension standard on the 2LT model. The FE1 suspension is tuned for a softer ride and includes 16-inch wheels, while the FE3 provides sportier handling traits and offers standard 17-inch wheels and monotube shocks, which provide better ride and handling. Forged aluminum high-polished 17-inch wheels are available.

All models are equipped with rack-and-pinion steering with electric power steering (EPS) – a speed-sensitive, variable-effort system that is tuned to match the performance characteristics of two separate

suspension settings. EPS eliminates the use of an engine-driven power steering pump, as well as the corresponding fluid reservoir and plumbing, reducing both fuel consumption and the potential source of an environmental contaminant.

Brakes consist of large front discs and rear drums, with ABS and traction control standard on 2LT models (traction control available only with automatic transmission) and available on LS and 1LT models.

Safety

HHR is designed to protect occupants in the event of a crash. Standard safety features include dual-stage frontal air bags with GM's Passenger Sensing System. This system works with the front passenger seat and differentiates between adults – 5 th percentile females and larger – and small children or child seats to adjust air bag deployment.

Additionally, HHR has front safety belt pretensioners, rear seat center lap-shoulder safety belts and the LATCH child seat retention system. Head curtain side-impact air bags for front- and rear-seat occupants are available.

OnStar-equipped HHR models feature OnStar dual-mode (analog-digital) equipment. OnStar's digital equipment also includes enhanced hands-free voice recognition capabilities including more intuitive continuous digit dialing and improved voice recognition accuracy. OnStar is the leading provider of in-vehicle safety, security and information services in the United States and Canada . Using the GPS satellite network and wireless technology, OnStar features core safety services and OnStar Hands-Free Calling that allows drivers to make and receive voice-activated phone calls using an externally mounted antenna for greater reception.

The OnStar service standard on the 2006 HHR includes the General Motors Advanced Automatic Crash Notification (AACN) system, making crash data available to the participating 911 centers to help them dispatch the appropriate live-saving personnel and equipment to crash scenes faster.

* *Preliminary, pending certification. A new voluntary power and torque certification procedure developed by the SAE Engine Test Code committee was approved March 31, 2005 . This procedure (J2723) ensures fair, accurate ratings for horsepower and torque by allowing manufacturers to certify their engines through third-party witness testing. GM was the first auto manufacturer to begin using the procedure and expects to use it for all newly rated engines in the future.*

Vehicle Highlights

- Styling influenced by SSR and 1949 Suburban
- Two well-equipped models and three trim levels: LS and 1LT and 2LT
- Generous storage capability with up to 63.1 cu. ft. (1787 L) of cargo space
- Auxiliary glove box with flip-up located at the top center of the instrument panel
- Fold-flat front passenger seat enables carrying longer cargo items
- Standard 2.2L Ecotec engine with 143 horsepower (107 kw) and 150 lb.-ft. of torque (203 Nm)*
- Available 2.4L Ecotec engine with 172 horsepower (128 kw) and 162 lb.-ft. of torque (220 Nm)*
- Standard five-speed manual transmission
- Available four-speed automatic transmission with standard remote vehicle starter
- All models and powertrains capable of being flat-towed
- Standard air conditioning with air filtration
- Standard AM/FM/CD stereo with audio accessory input jack for auxiliary (iPod/MP3) players
- Standard dual-stage frontal air bags with GM Passenger Sensing System
- Available side-curtain air bags

Model Lineup

	Engines		Transmissions	
	2.2L Ecotec 4-cyl.	2.4L Ecotec 4-cyl.	5-speed manual	4-speed automatic
HHR LS	S	–	S	O
HHR 1LT	S	O	S	O
HHR 2LT	–	S	S	O

Standard S
Optional O
Not available –

Specifications

Overview	
Models:	Chevrolet HHR LS and LT (1LT and 2LT)
Body style / driveline:	5-passenger, 5-door / front-engine, front -wheel drive
Construction:	welded steel monocoque; galvanized except for roof
EPA vehicle class:	sport utility vehicle – 2WD
Manufacturing location:	Ramos Arizpe, Mexico
Key competitors:	Ford Escape, Jeep Liberty, Scion xB, Honda Element, Chrysler PT Cruiser

Engine		
	Ecotec 2.2L (L61)	Ecotec 2.4L (LE5)
Application	std on LS and 1LT	std 2LT; opt on 1LT
Type:	2.2L DOHC I-4	2.4L DOHC I-4
Displacement (cu in / cc):	134 / 2189	145 / 2384
Bore & stroke (in / mm):	3.39 x 3.72 / 86 x 94.6	3.46 x 3.85 / 88 x 98
Block material:	cast aluminum	cast aluminum
Cylinder head material:	cast aluminum	cast aluminum
Valvetrain:	overhead camshafts, 4 valves per cylinder	overhead camshafts, 4 valves per cylinder; variable valve timing
Ignition system:	electronic direct	electronic direct
Fuel delivery:	sequential multi-port fuel injection with electronic throttle control	sequential multi-port fuel injection with high-pressure injectors and electronic throttle control
Compression ratio:	10:1	10.5:1
Horsepower (hp / kw @ rpm):	143 / 107 @ 5600*	172 / 128 @ 6200*
Torque (lb-ft / Nm @ rpm):	150 / 203 @ 4000*	162 / 220 @ 5000*
Recommended fuel:	regular unleaded	premium recommended but not required
Maximum engine speed:	6500	6750
Emissions controls:	close-coupled catalytic converters; Quick-Sync 24x ignition system; returnless fuel rail; fast-response O 2 sensor	close-coupled catalytic converters; Quick-Sync 24x ignition system; returnless fuel rail; fast-response O 2 sensor
Estimated fuel economy		
(mpg city / hwy / combined):	manual: 22 / 30 automatic: 23 / 30	manual: 22 / 30 automatic: 23 / 30

Transmissions		
Type:	F23 5-speed manual	Hydra-Matic 4T45-E 4-speed automatic
	Gear ratios: (:1):	
First:	3.58	2.95
Second:	2.02	1.62
Third:	1.35	1.00
Fourth:	0.98	0.68
Fifth:	0.69	–
Reverse:	3.31	2.14
Final drive ratio:	4.17:1	3.91:1

Chassis/Suspension	
Front:	independent strut-type suspension with stabilizer bar
Rear:	semi-independent torsion beam with stabilizer bar
Steering type:	electric, power-assisted variable-speed rack-and-pinion
Steering ratio:	18.5:1
Steering wheel turns, lock-to-lock: (est)	3.5 (FE1); 3.25 (FE3)
Turning circle, curb-to-curb (ft / m): (est)	36 / 11 (FE1); 37.7 / 11.5 (FE3)

Brakes	
Type:	power front disc/rear drum, optional anti-lock brakes
Rotor diameter x thickness (in / mm):	front: 11.65 x 1.02 / 296 x 26
Drum diameter x width (in / mm):	rear: 9.84 x 1.7 / 250 x 45

Wheels/Tires	
Wheel size and type:	std: LS and 1LT 16-inch x 6.5-inch steel; opt: 1LT 16-inch x 6.5-inch aluminum std: 2LT 17-inch x 7-inch painted aluminum ; opt: 2LT 17-inch x 6.5-inch polished aluminum
Tires:	P215/55R16 all-season steel-belted radial blackwall tires; P215/50R17 all-season steel-belted radial blackwall tires

Dimensions

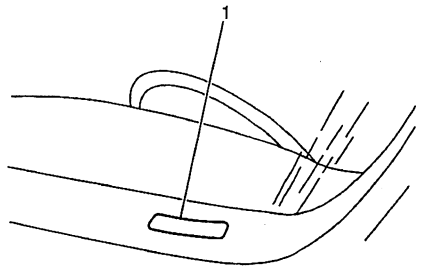
Exterior	
Wheelbase (in / mm):	103.5 / 2628
Overall length (in / mm):	176.2 / 4475
Overall width (in / mm):	69.2 / 1757
Overall height (in / mm):	65.2 / 1657
Track (in / mm):	front: 58.7 / 1492
	rear: 58.7 / 1492
Minimum ground clearance (in / mm):	6.3 / 159.4
Ground to rear load floor (in / mm):	TBD
Curb weight, base (lb / kg):	3155 / 1431 (2.2L); 3208 / 1455 (2.4L)
Weight distribution (front / rear):	57 / 43

Interior	
Seating capacity:	5
Headroom (in / mm):	front: 39.5 / 1003
	rear: 39.6 / 1006
Legroom (in / mm):	front: 40.6 / 1031
	rear: 39.5 / 1004
Shoulder room (in / mm):	front: 53.5 / 1358
	rear: 52.7 / 1339
Hip room (in / mm):	front: 50.1 / 1273
	rear: 50.6 / 1266
Capacities	
EPA interior volume (cu ft / L):	TBD
Passenger Volume (cu ft / L)	97.4 / 2758
Cargo volume (cu ft / L):	55.6 / 1574.6 (with rear seat folded) 63.1 / 1787 (with rear seat removed)
GVWR, standard (lb / kg):	4173 / 1893 (preliminary)
Payload, base (lb / kg):	900 / 408
Trailer towing maximum (lb / kg):	1000 / 453
Fuel tank (gal / L):	16.2 / 49
Engine oil (qt / L):	2.2L and 2.4L: 5 / 4.7
Cooling system (qt / L):	48.6 / 46 (2.2L); 51.8 / 49 (2.4L)

* Preliminary, pending certification. A new voluntary power and torque certification procedure developed by the SAE Engine Test Code committee was approved March 31, 2005 . This procedure (J2723) ensures fair, accurate ratings for horsepower and torque by allowing manufacturers to certify their engines through third-party witness testing. GM was the first auto manufacturer to begin using the procedure and expects to use it for all newly rated engines in the future.

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	5/3	U.S.A./Mexico
2	Manufacturer	G	General Motors
3	Make	1	Chevrolet
4-5	Carline/Series	A1 A2	LHD/FWD LS LHD/FWD SPORT/LT
6	Body Style	2	MPV - 5 Door
7	Restraint System	5	Active Manual Belts w/Driver and Passenger Inflatable Restraint, Frontal and Side
8	Engine Type	F B	2.2L (L61) L4 MFI DOHC, ALUM 2.4L (LS5) L4 MFI DOHC HD, ALUM
9	Check Digit	--	Check Digit
10	Model Year	6	2006
11	Plant Location	S	Ramos Arizpe, Mexico

VIN Derivative

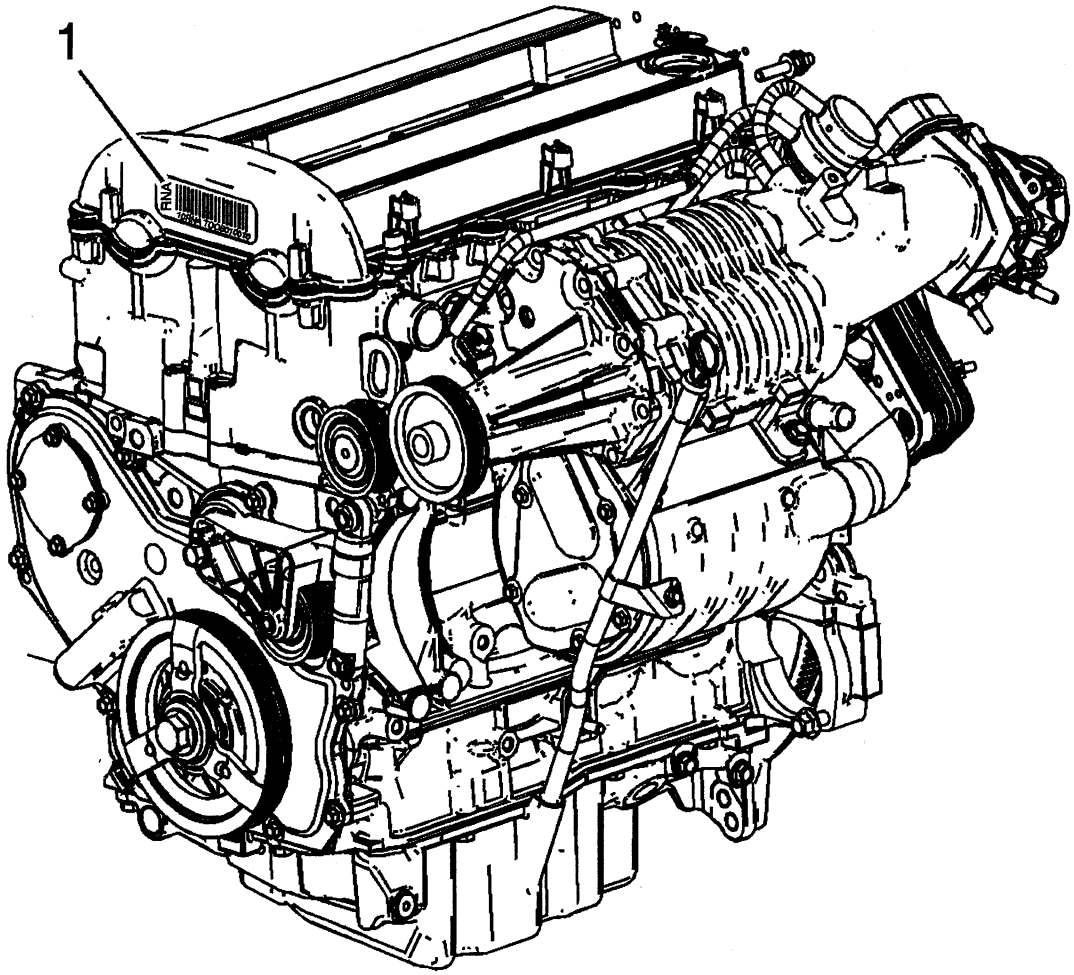
All engines and transmissions are stamped or laser etched with a partial vehicle identification number (VIN), which was derived from the complete VIN. A VIN derivative contains the following nine positions:

Position	Definition	Character	Description
1	GM Division Identifier	1	Chevrolet
2	Model Year	6	2006
3	Assembly Plant	S	Ramos Arizpe, Mexico
4-9	Plant Sequence Number	--	100001

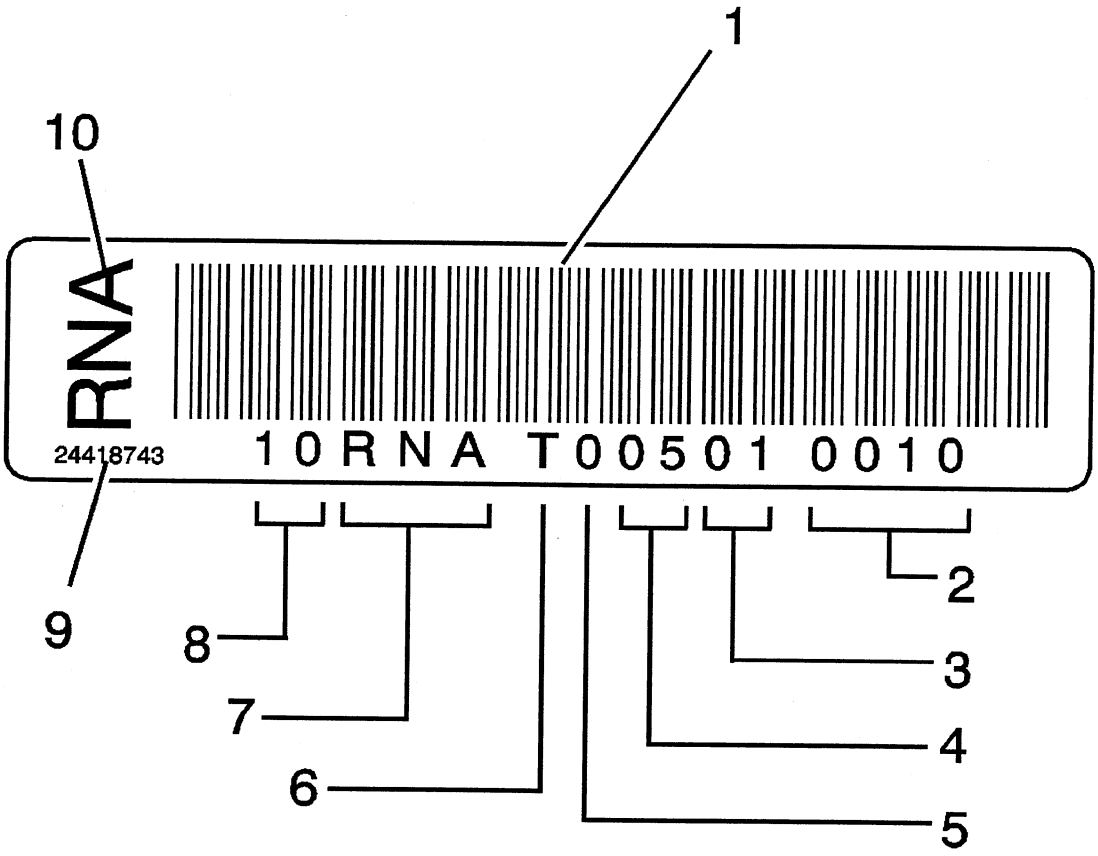
A VIN derivative can be used to determine if a vehicle contains the original engine or transmission, by matching the VIN derivative positions to their accompanying positions in the complete VIN:

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

Engine ID and VIN Derivative Location



Identification can be made through the use of the Broadcast Code label on the engine front cover (1) and the use of the partial VIN etched on the oil filter bowl (2).

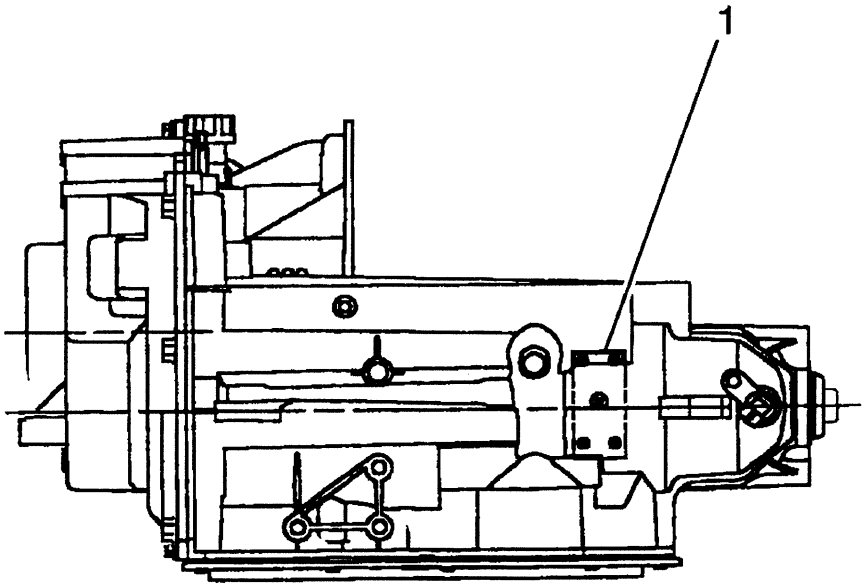


- Barcode (1)
- Sequence Number (2)
- Day (3)
- Month (4)
- Year (5)
- Engine Assembly Plant (6)
- Broadcast Code (7)
- Part Designation (8)
- Engine Assembly Number (9)
- Broadcast Code (10)

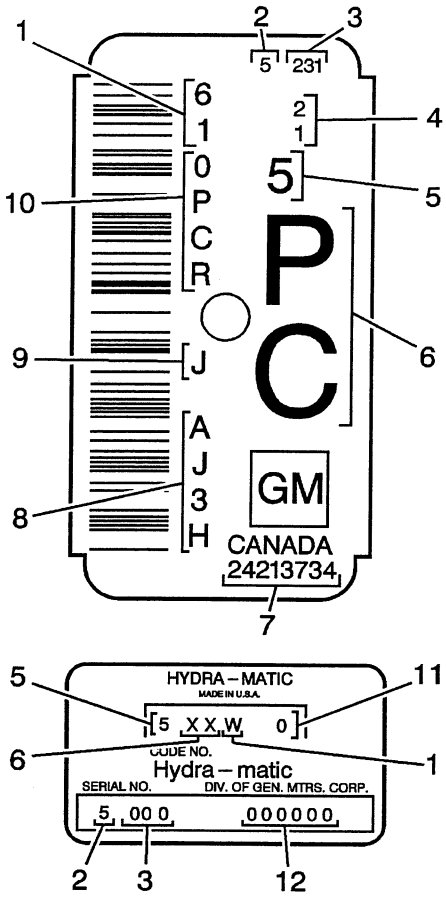
The partial VIN identifies the specific vehicle by sequence number.

Transmission ID and VIN Derivative Location

4T40-E/4T45-E Transmission ID Location



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



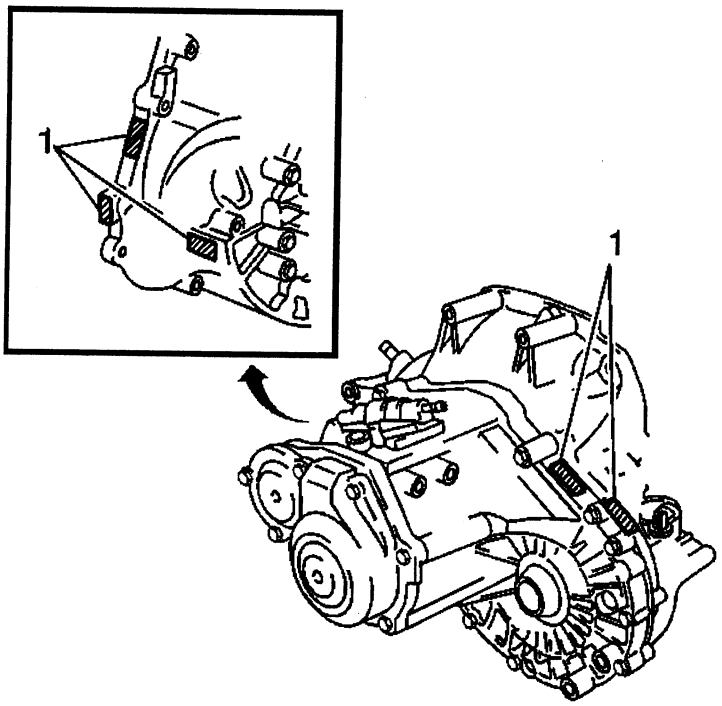
(1) Transaxle
(2) Calendar Year
(3) Julian Date or Day of the Year
(4) Shift and Line Number
(5) Model Year
(6) Model
(7) Part Number
(8) Serial Number in Base Code 34
(9) Plant
(10) Broadcast Code
(11) Control Number
(12) Serial Number

The Hydra-Matic 4T40-E transmission has a metal identification nameplate (1) attached to the case exterior.

The information on the nameplate assists the technician in servicing the transmission and ordering replacement parts from a GM Parts Catalog.

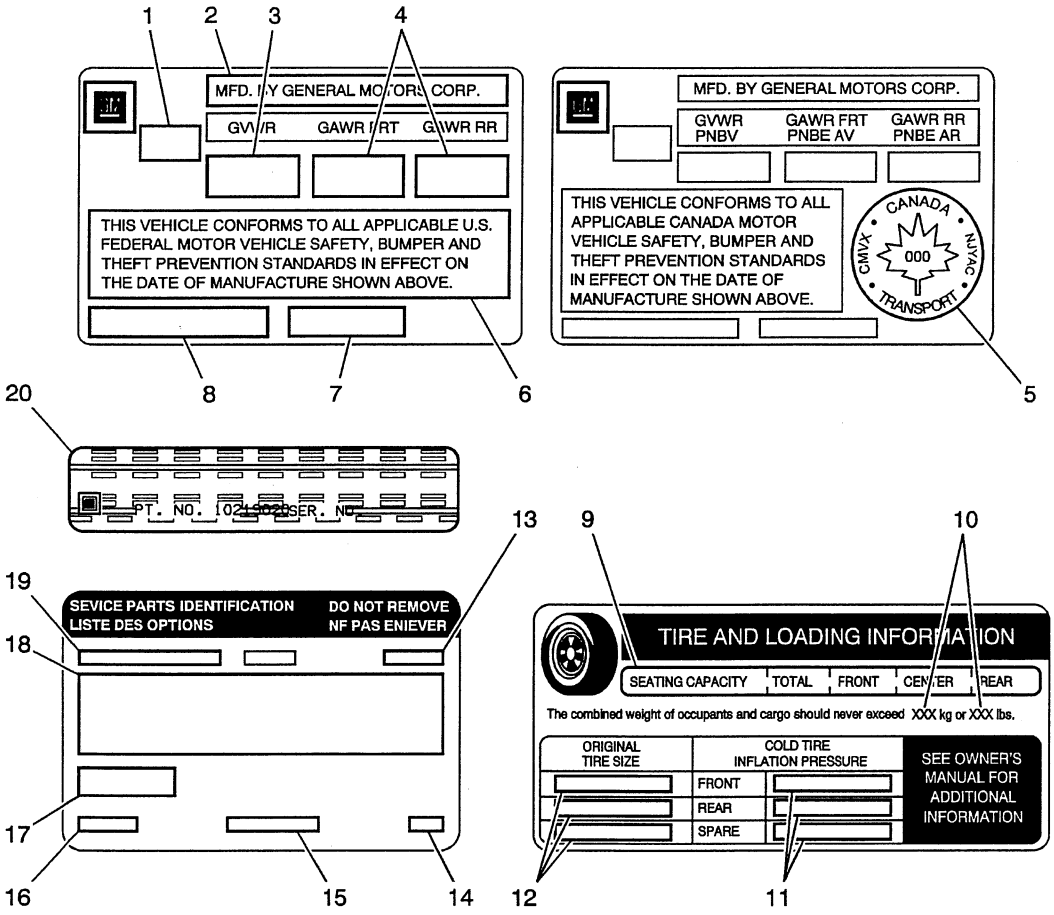
Additional transmission identification information is provided on the Service Parts Identification label. This label shows the Regular Production Options (RPO) as well as the standard and mandatory options. This label is affixed to the inside of each vehicle at the assembly plant.

Getrag 5T45-E Transmission VIN Location, M86



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

Label - Vehicle Certification, Tire Place Card, Anti-Theft and Service Parts ID



Callout	Description
Vehicle Certification Label	
The vehicle certification label is located on the driver door and displays the following assessments: Gross Vehicle Weight Rating (GVWR) Gross Axle Weight Rating (GAWR), front and rear The gross vehicle weight (GVW) is the weight of the vehicle and everything it carries. The GVW must not exceed the GVWR. Include the following items when figuring the GVW: The base vehicle weight (factory weight) The weight of all vehicle accessories The weight of the driver and the passengers The weight of the cargo	
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)

Callout	Description
Tire Placard	
The tire placard label is located on the driver door and displays the following assessments:	
9	Specified Occupant Seating Positions
10	Maximum Vehicle Capacity Weight
11	Original Equipment Tires Size
12	Tire Pressure, Front, Rear, and Spare (Cold)
Service Parts ID Label	
The vehicle service parts identification label is located in the rear compartment under the spare tire cover. The label is use to help identify the vehicle original parts and options.	
13	Vehicle Identification Number
14	Engineering Model Number (Vehicle Division, Line and Body Style)
15	Interior Trim Level and Decor
16	Exterior (Paint Color) WA Number
17	Paint Technology
18	Special Order Paint Colors and Numbers
19	Vehicle Option Content
Anti-Theft Label	
20	The Federal law requires that General Motors label certain body parts on this vehicle with the VIN. The purpose of the law is to reduce the number of motor vehicle thefts by helping in the tracing and recovery of parts from stolen vehicles. Labels are permanently affixed to an interior surface of the part. The label on the replacement part contains the letter R, the manufacturer's logo, and the DOT symbol. The anti-theft label must be covered before any painting, and rustproofing procedures, and uncovered after the procedures. Failure to follow the precautionary steps may result in liability for violation of the Federal Vehicle Theft Prevention Standard and possible suspicion to the owner that the part was stolen.

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
AJ6	Adjuster - Seat, Power, 6-way, Vert, Driver
AP3	Lock Control, Entry - Remote, Keyless Entry, Start
AR9	Seat - FRT BKT, Deluxe
ASF	Restraint Roof Side, LH and RH, Inflatable
ATY	Seat RR - Not Installed (Seat Belts, Labels, MTG Hardware)
BVE	Steps, Runningboard, Side
B41	Covering - Floor Mat, Load Floor
B50	Covering - Floor Mat, FRT and RR, Aux - Deluxe
B57	Ornamentation - EXTR, Deluxe
CF5	Roof - Sun, Glass, Sliding, Electric
CV3	Country - Mexico
C2Y	GVW Rating - 4,240 lbs
C67	HVAC System - Air Conditioner FRT, Electronic Controls
DD8	Mirror I/S R/V - LT Sensitive
DG7	Mirror O/S - LH and RH, Remote Control, Electric, Color
DT4	Ashtray - Cigarette Lighter
D22	Mirror O/S - LH and RH, Remote Control, Electric
FE1	Suspension System - Soft Ride
FE3	Suspension System - Sport
FE9	Certification - Emission, Federal
FR8	Ratio - Transaxle Final Drive 4.17
FX2	Ratio - Transaxle Final Drive 3.91
G63	Provisions - Luggage Carrier, Roof
JM4	Brake System - PWR, FRT Disc, RR Drum, Cast Iron, Antilock FRT and RR WHL
J41	Brake System - PWR, FRT Disc, RR Drum, Cast Iron
KA1	Heater - Seat, FRT
K05	Heater Engine - Block
LE5	Engine - Gas, 4 Cyl, 2.4L, MFI, Alum, DOHC, HO, ECOTEC
L61	Engine - Gas, 4 Cyl, 2.2L, MFI, Alum, DOHC
MM5	Merchandised Trans - Auto Provisions, O/D
MN5	Transmission - Auto 4 SPD, HMD, 4T45-E
MX0	Merchandised Trans - Auto Provisions, O/D
M86	Transmission - MAN 5 SPD, GETRAG, 5T45-E, M, F23, 75MM, 3.58 1st, 2.02 2nd, 1.35 3rd, 0.98 4th, 0.69 5th
NE1	Certification - Emission, Geographically Restricted Registration for Vehicles up to 14,000 lbs, GVW (Use 2003 Mdl Yr)
NF4	Emission System - Clean Fuel Fleet
NP5	Steering Wheel - Leather Wrapped
NT7	Emission System - Federal, Tier 2
NU1	Emission System - California, Lev 2
NW7	Traction Control - Powertrain Management Only
N24	Steering Wheel - Plastic, 3 Spokes
N85	Wheel - 17 X 6.5, Aluminum
QBV	Tire All - P215/50R17-90S BW ST TL AL2
QB5	Wheel - 16 X 6.5, Steel
QDB	Tire All - P215/55R16-91S BW R/PE ST TL AL2
QDJ	Tire All - P215/55R16-91H BW R/PE ST TL AL3

RPO	Description
QG9	Wheel - 16 X 6.5, Aluminum, Machined Face
QP2	Wheel - 17 X 6.5, Aluminum Polished
Q8H	Mud Flaps - FRT and RR, Formed
SAL	Plant Code - Ramos Arizpe, Mexico
TL1	Grille - Special
T43	Spoiler - RR
UE1	Communication System - Vehicle, G.P.S. 1
UQ3	Speaker System - Enhanced Audio
US8	Radio - AM/FM Stereo, Seek/Scan, CD, Auto Tone, Clock, ETR, MP3, RDS
US9	Radio - AM/FM Stereo, Seek/Scan, RDS, Multiple Compact Disc, Auto Tone Control, Clock, ETR, MP3
UW5	Speaker System - 6, Base
U1C	Radio - AM/FM Stereo, Seek/Scan, CD, Clock, ETR
U2K	Digital Audio System - S-Band
U19	Speedometer, Inst, Kilo and Miles, Kilo Odometer
VCL	Certification - Emission, Clean Fuel Vehicle, Fleet
VGG	Protector - Rear Bumper
VK3	License Plate Front - FRT Mounting Pkg
VY7	Knob - Trans Control Lever, Leather
V1K	Bar - Luggage Carrier, Center Cross
V73	Vehicle Statement - Delete
V78	Vehicle Statement - Delete
YF5	Certification - Emission, California
Z49	Export - Canadian Modif Mandatory Base Equip
1LS	Package - LS Option 1
1LT	Package - LT Option 1
2LT	Package - LT Option 2

Technical Information

Maintenance and Lubrication

Capacities - Approximate Fluid

The following approximate capacities are given in English and metric conversions. All capacities are approximate. When adding, be sure to fill to the approximate level, as recommended in the owner's manual. Recheck fluid level after filling.

Application	Specification	
	Metric	English
Cooling System		
2.2L Engine (RPO L61)	7.0 liters	7.4 quarts
2.4L Engine (RPO LE5)	7.5 liters	7.9 quarts
Engine Oil with Filter		
2.2L Engine	4.8 liters	5.0 quarts
2.4L Engine	4.8 liters	5.0 quarts
Fuel Tank	61.3 liters	16.2 gallons
Automatic Transaxle - 4T40-E/4T45-E		
Automatic - Drain and Refill	6.5 liters	6.9 quarts
Automatic - Complete Overhaul	9.0 liters	9.5 quarts
Automatic - Dry	12.2 liters	12.9 quarts
Manual Transaxle		
Manual Dry Getrag 5 Speed (RPO M86)	1.7 liters	1.8 quarts

Maintenance Items

Part	GM Part Number	ACDelco Part Number
Engine Air Cleaner/Filter	22731072	--
Engine Oil Filter	12579143	PF456G
Passenger Compartment Air Filter	52493319	CF125
Spark Plugs		
2.2L Engine	25337472	41-981
2.4L Engine	12599232	41-981
Windshield Wiper Blade (Hook Type)		
Driver's Side - 17.7 inches (45 cm)	15793205	--
Passenger's Side - 17.7 inches (45 cm)	15793204	--
Rear Wiper Blade - 10.8 inches (27.4 cm)	22709463	--

Fluid and Lubricant Recommendations

Usage	Fluid/Lubricant
Engine Oil	Engine oil which meets GM Standard GM6094M and displays the American Petroleum Institute Certified for Gasoline Engines starburst symbol. GM Goodwrench® oil meets all the requirements for your vehicle.
Engine Coolant	50/50 mixture of clean, drinkable water and use only DEX-COOL® Coolant.
Hydraulic Brake System	Delco® Supreme 11 Brake Fluid or equivalent DOT-3 brake fluid.
Hydraulic Clutch System	Delco® Supreme 11 Brake Fluid or equivalent DOT-3 brake fluid.
Windshield Washer	Optikleen Washer Solvent.

Usage	Fluid/Lubricant
Parking Brake Cable Guides	Chassis Lubricant (GM Part No. 12377985, in Canada 88901242) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Manual Transaxle	DEXRON®-III Automatic Transmission Fluid. Look for "Approved for the H-Specification" on the label.
Automatic Transaxle	DEXRON®-VI Automatic Transmission Fluid.
Key Lock Cylinders	Multi-Purpose Lubricant, Superlube (GM Part No. U.S. 12346241, in Canada 10953474).
Manual Transaxle Shift Linkage	Chassis Lubricant (GM Part No. U.S. 12377985, in Canada 88901242) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Clutch Linkage Pivot Points	Engine Oil.
Chassis Lubrication	Chassis Lubricant (GM Part No. U.S. 12377985, in Canada 88901242) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Hood Latch Assembly, Secondary Latch, Pivots, Spring Anchor, and Release Pawl	Lubriplate Lubricant Aerosol (GM Part No. U.S. 12346293, in Canada 992723) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Hood and Door Hinges	Multi-Purpose Lubricant, Superlube (GM Part No. U.S. 12346241, in Canada 10953474).
Weatherstrip Conditioning	Dielectric Silicone Grease (GM Part No. U.S. 12345579, in Canada 992887).

Descriptions and Operations

Steering

Power Steering System

The electric power steering (EPS) system reduces the amount of effort needed to steer the vehicle. The system uses the body control module (BCM), power steering control module (PSCM), torque sensor, discrete battery voltage supply circuit, EPS motor, serial data bus, and the instrument panel cluster (IPC) message center to perform the system functions. The PSCM, torque sensor, not the EPS motor are serviced separately from each other or from the steering column. Any EPS components diagnosed to be malfunctioning requires replacement of the steering column assembly, also known as the EPS assembly.

Torque Sensor

The PSCM uses a torque sensor as it's main input for determining the amount of steering assist. The steering column has an input shaft, from the steering wheel to the torque sensor, and an output shaft, from the torque sensor to the steering shaft coupler. The input and output shafts are separated by a torsion bar, where the torque sensor is located. The sensor consists of a compensation coil, detecting coil and 3 detecting rings. These detecting rings have toothed edges that face each other. Detecting ring 1 is fixed to the output shaft, detecting rings 2 and 3 are fixed top the input shaft. The detecting coil is positioned around the toothed edges of detecting rings 1 and 2. As torque is applied to the steering column shaft the alignment of the teeth between detecting rings 1 and 2 changes, which causes the detecting coil signal voltage to change. The PSCM recognizes this change in signal voltage as steering column shaft torque. The compensation coil is used to compensate for changes in electrical circuit impedance due to circuit temperature changes from the electrical current and voltage levels as well as ambient temperatures for accurate torque detection.

EPS Motor

The EPS motor is a 12 volt brushed DC reversible motor with a 58 amp rating. The motor assists steering through a worm shaft and reduction gear located in the steering column housing.

Power Steering Control Module (PSCM)

The PSCM uses a combination of torque sensor inputs, vehicle speed, calculated system temperature and the steering calibration to determine the amount of steering assist. When the steering wheel is turned, the PSCM uses signal voltage from the torque sensor to detect the amount of torque being applied to the steering column shaft and the amount of current to command to the EPS motor. The PSCM receives serial data from the engine control module (ECM) to determine vehicle speed. At low speeds more assist is provided for easy turning during parking maneuvers. At high speeds, less assist is provided for improved road feel and directional stability. The PSCM nor the EPS motor are designed to handle 58 amps continuously. The PSCM will go into overload protection mode to avoid system thermal damage. In this mode the PSCM will limit the amount of current commanded to the EPS motor which reduces steering assist levels. The PSCM also chooses which steering calibration to use when the ignition is turned ON, based on the production map number stored in the BCM. The PSCM contains all 8 of the steering calibrations which are different in relation to the vehicles RPO's. The PSCM has the ability to detect malfunctions within the EPS system. Any malfunction detected will cause the IPC message center to display PWR STR (or Power Steering) warning message.

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-Some Vehicle Models

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 tilt or tilt/telescoping functions

Driver Safety

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

Ignition Lock Cylinder Control Actuator

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

Steering Wheel Controls Description and Operation

The audio steering wheel control switches duplicate the function of the primary controls of the associated component, through a network of multiple momentary contact switches and a series of resistors. The radio supplies voltage to the switches and monitors the return signal for a specific voltage drop to occur unique to the one pressed. The radio then identifies the switch selected to activate the feature, otherwise sends a serial data message that is received by the component controlled, activating the feature.

Suspension Description and Operation

Front Suspension

The front suspension has 2 primary purposes:

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

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

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

This up and down motion of the steering knuckle as the vehicle travels over bumps is absorbed predominantly by the coil spring. This spring is retained under tension over the strut assembly. A strut is used in conjunction with this system in order to dampen out the oscillations of the coil spring. A strut is a basic hydraulic cylinder. The strut is filled with oil and has a moveable shaft that connects to a piston inside the strut. Valves inside the shock absorber offer resistance to oil flow and consequently inhibit rapid movement of the piston and shaft. Each end of the shock absorber is connected in such a fashion to utilize this recoil action of a spring alone. Each end of the strut is designed as the connection point of the suspension system to the vehicle and acts as the coil spring seat. This allows the strut to utilize the dampening action to reduce the recoil of a spring alone. The lower control arm is allowed to pivot at the vehicle frame in a vertical fashion. The ball joint allows the steering knuckle to maintain the perpendicular relationship to the road surface.

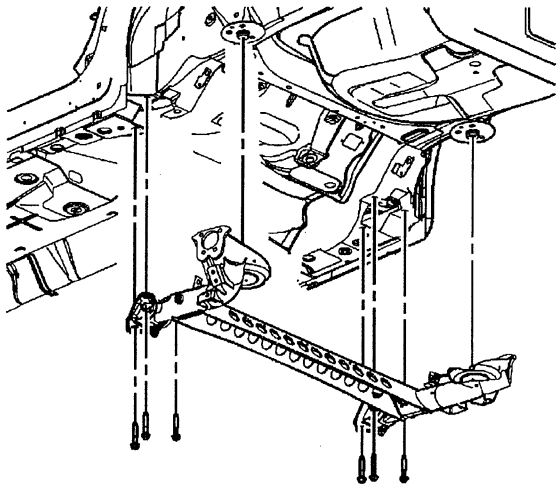
Front suspensions systems utilize a stabilizer shaft. The stabilizer bar connects between the left and right lower control arm assemblies through the stabilizer link and stabilizer shaft insulators. This bar controls the amount of independent movement of the suspension when the vehicle turns. Limiting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

Rear Suspension

This vehicle has a semi-independent twist-beam rear suspension system consisting of the following components:

- An axle with integral trailing arms
- A V shaped twisting cross beam
- Two coil springs
- Two standard shock absorbers
- An optional integrated stabilizer bar

Axle Assembly

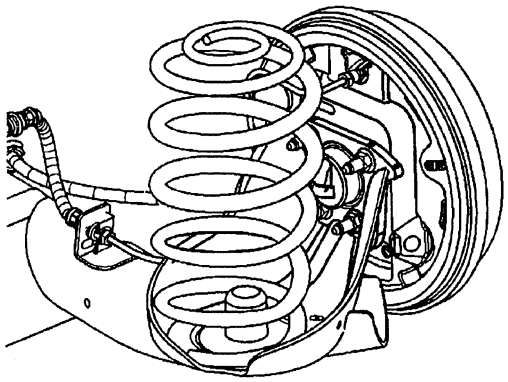


The axle assembly attaches to the underbody through a rubber bushing and bracket located at the front of each integral trailing arm. The brackets are bolted to the underbody side rails. The axle structure itself maintains the geometrical relationship of the wheels relative to the centerline of the body. The optional stabilizer shaft is welded to the inside of the "V" shaped axle beam and is non-serviceable.

Rear axle to vehicle alignment is achieved through alignment holes located in both the left and right axle bracket and underbody. Whenever the rear axle is removed for service, it is important that the rear axle is re-installed in its proper position relative to the centerline of the vehicle. Use two 12 mm rods to achieve this alignment. Insert each rod through the axle bracket into the underbody, then tighten the bracket bolts.

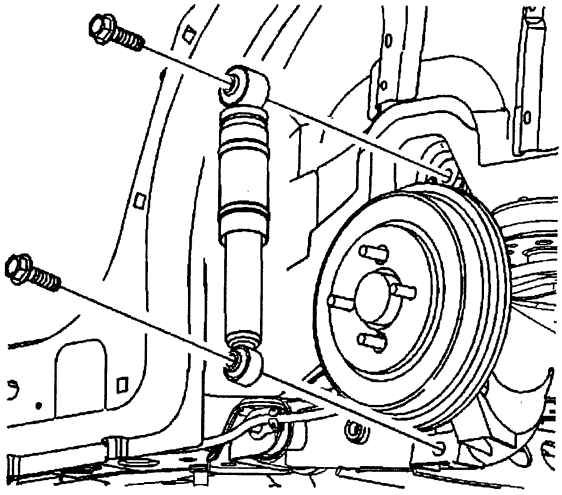
Rear camber and tow are not adjustable. Replace any damaged suspension components as necessary.

Coil Springs



The coil springs support the weight of the vehicle in the rear. Two spring rates exist on this vehicle, base and up-level, depending on the suspension option code. Rubber insulators isolate the coil spring at the upper and lower spring seat.

Shock Absorber



The shock absorbers are bolted to the rear axle and the vehicle underbody. The shock absorbers are non-adjustable and non-refillable. Service of the shocks requires replacement of the shock assembly.

Wheel Bearing/Hub Assembly

A single hub and bearing assembly is bolted to both ends of the rear axle assembly. The hub and bearing assembly is a sealed unit that eliminates the need for wheel bearing adjustment or periodic maintenance. On ABS equipped vehicles, the wheel speed sensors are integrated into the wheel bearing assemblies.

Although the rear suspension components are lubricated for life and require no routine lubrication, they should be inspected periodically for damage and wear.

Wheels and Tires

General Description

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

The following factors have an important influence on tire life:

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

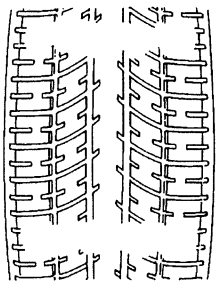
The following factors increase tire wear:

- Heavy cornering
- Excessively rapid acceleration
- Heavy braking

Tread Wear Indicators Description

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

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



Metric Wheel Nuts and Bolts Description

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

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

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

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

Tire Inflation Description

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

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

Inspect the tire pressure when the following conditions apply:

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

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

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

Inflation Pressure Conversion (Kilopascals to PSI)

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

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

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

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

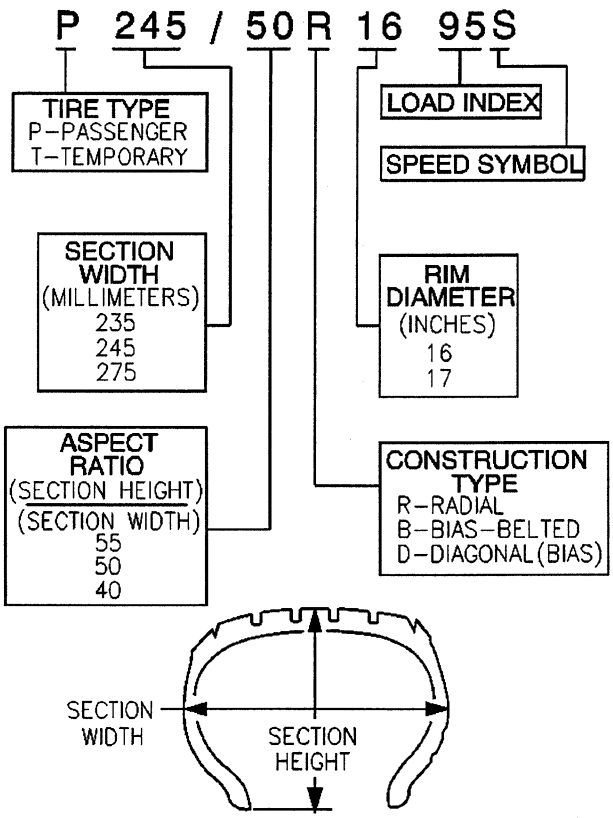
- A tire squeal on turns
- Hard steering
- Rapid wear and uneven wear on the edge of the tread
- Tire rim bruises and tire rim rupture
- Tire cord breakage
- High tire temperatures
- Reduced vehicle handling
- High fuel consumption
- Soft riding

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

- Uneven braking
- Steering lead
- Reduced vehicle handling

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

P-Metric Sized Tires Description



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

Driveline/Axle

Wheel Driveshafts

Wheel drive shafts are flexible assemblies consisting of an inner tripot joint and an outer constant velocity joint connected by an axle shaft. The inner joint is completely flexible, and can plunge in and out. The outer joint is also flexible, but cannot plunge in and out. These drive axles are used to transmit rotational force from the transaxle to the front tire and wheel assemblies.

Seal and Clamp

The wheel drive shafts use inboard and outboard joint seals made of thermoplastic material, and clamps made of stainless steel. The functions of the seals are as follows:

- The seals protect the internal parts of the inboard and outboard joints.
  - They protect the joint lubricating grease from surrounding detrimental atmospheric conditions; such as extreme temperatures, ozone gas, etc.
  - They protect the joint lubricating grease from foreign materials; such as stones, dirt, water, salt, etc.
- The seals facilitate angular and axial movement of the inboard joint.
- The seals facilitate angular movement of the outboard joint.

The function of the clamps is as follows:

- Provide a leak proof connection at both the housing and the axle shaft for the inboard and outboard joints.
- The thermoplastic material performs well against normal handing, operational wear and conditions. This material however, is not strong enough to withstand abusive handling or damage due to objects such as sharp tools or the sharp edge of any other surrounding component on the vehicle.

Inner Joint

The inner joints are of the tripot design without an over-extension limitation retainer. If equipped with an automatic transmission, the inner joint uses a female spline which is installed over a stub shaft protruding from the transaxle. If equipped with a manual transmission, the inner joint incorporates a male spline which interlocks with the transaxle using snap rings.

Outer Joint

The outer joints are of the Rzeppa, constant velocity joint design. The shaft end which mates with the wheel bearing and hub assembly, incorporates a helical spline to assure a tight, press-type fit. This design assures that no end play will exist between the hub bearing and the drive shaft assembly for added durability and reduced bearing noise.

Intermediate Drive Shaft

The intermediate drive shaft (IDS) is used with RPO LSJ, to permit the use of equal length wheel drive shafts, and thus eliminate torque steer during heavy acceleration. The IDS incorporates a male spine which mates to the transaxle. The IDS is supported and maintained in position by a sealed bearing mounted within a bracket that is bolted to the engine block. The IDS incorporates a tone wheel which is used by the vehicle speed sensor (VSS).

Vehicle Speed Sensor

On RPO LSJ equipped vehicles, the vehicle speed sensor (VSS) is mounted to a bracket which is in turn mounted to the IDS bracket. The IDS bracket is machined to a precise thickness and the VSS bracket is manufactured to a precise thickness to position the VSS with the correct air-gap to the tone wheel on the IDS. The VSS to tone wheel air-gap is non-adjustable.

Braking System Description and Operation

Hydraulic Brake System Description and Operation

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir

Contains supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.

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

Hydraulic Brake Pressure Balance Control System

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

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

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

Converts hydraulic input pressure into mechanical output force.

System Operation

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

Brake Assist System Description and Operation

System Component Description

The brake assist system consists of the following:

Brake Pedal

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

Brake Pedal Pushrod

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

Vacuum Brake Booster

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

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

Vacuum Source

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

Vacuum Source Delivery System

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

System Operation

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

Disc Brake System Description and Operation

System Component Description

The disc brake system consists of the following components:

Disc Brake Pads

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

Disc Brake Rotors

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

Disc Brake Pad Hardware

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

Disc Brake Caliper Hardware

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

System Operation

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

Drum Brake System Description and Operation

System Component Description

The drum brake system consists of the following:

Drum Brake Shoes

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

Brake Drums

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

Drum Brake Hardware

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

Drum Brake Adjusting Hardware

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

System Operation

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

Park Brake System Description and Operation

System Component Description

The park brake system consists of the following:

Park Brake Lever Assembly

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

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

Park Brake Cables

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

Park Brake Cable Equalizer

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

Park Brake Apply Lever

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

Park Brake Actuator/Adjuster

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

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

Drum Brake Shoes

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

System Operation

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

ABS Description and Operation

Antilock Brake System

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

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

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

Engine Description and Operation

Engine Mechanical – 2.2L – L61

General Specifications

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

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

Application	Specification	
	Metric	English
• Valve Lifters - Valve Lifter-to-Bore Clearance - Stationary Lash Adjuster	0.013-0.051 mm	3.2210-3.2299 in
• Valve Springs - Valve Spring Load - Closed - [commat]22.5 mm	245.0-271.0 N. - Eng Spec.	
• Valve Springs - Valve Spring Load - Open - [commat]32.5 mm	525.0-575.0 N. - Eng Spec.	

Fastener Tightening Specifications

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

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

Engine Component Description

Cylinder Block

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

Crankshaft

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

Connecting Rod and Piston

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

Oil Pan

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

Balance Shaft Assembly

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

Cylinder Head

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

Valves

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

Camshaft

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

Valve Lifters

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

Camshaft Cover

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

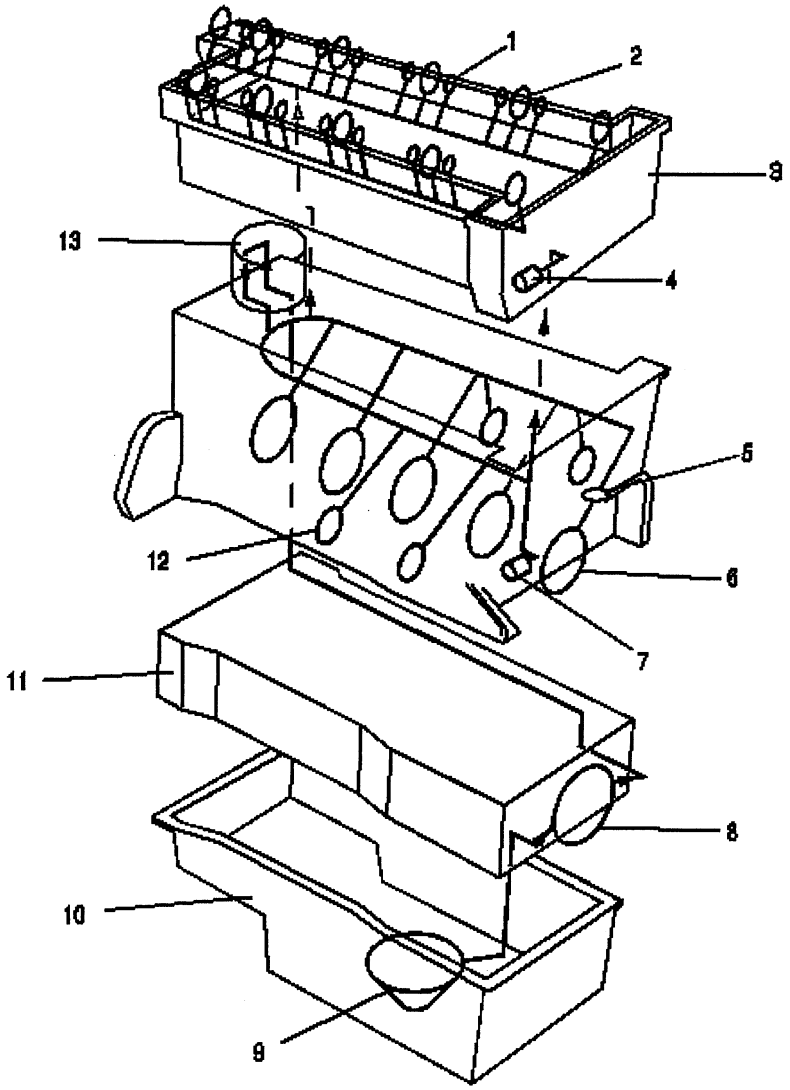
Camshaft Drive

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

Intake and Exhaust Manifold

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

Lubrication Description



(1) Hydraulic Lifter
(2) Cam Bearing
(3) Cylinder Head
(4) Timing Chain Tensioner
(5) Cam Drive Chain Oil Nozzle
(6) Crankshaft Bearing
(7) Balance Shaft Chain Tensioner
(8) Oil Pump

(9) Oil Pick Up
(10) Oil Pan
(11) Bedplate
(12) Balance Shaft Bearings
(13) Oil Filter

Oil is applied under pressure to the crankshaft, connecting rods, balance shaft assembly, camshaft bearing surfaces, valve lifters and timing chain hydraulic tensioner. All other moving parts are lubricated by gravity flow or splash. Oil enters the gerotor type oil pump thorough a fixed inlet screen. The oil pump is driven by the crankshaft. The oil pump body is within the engine front cover. The pressurized oil from the pump passes through the oil filter. The oil filter is located on the right (front) side of the engine block. The oil filter is housed in a casting that is integrated with the engine block. The oil filter is a disposable cartridge type. A by-pass valve in the filter cap allows continuous oil flow in case the oil filter should become restricted. Oil then enters the gallery where it is distributed to the balance shafts, crankshaft, camshafts and camshaft timing chain oiler nozzle. The connecting rod bearings are oiled by constant oil flow passages through the crankshaft connecting the main journals to the rod journals. A groove around each upper main bearing furnishes oil to the drilled crankshaft passages. The pressurized oil passes through the cylinder head restrictor orifice into the cylinder head and then into each camshaft feed gallery. Cast passages feed each hydraulic element adjuster and drilled passages feed each camshaft bearing surface. An engine oil pressure switch or sensor is installed at the end. Oil returns to the oil pan through passages cast into the cylinder head. The timing chain lubrication drains directly into the oil pan.

Drive Belt System Description

The drive belt system consists of the following components:

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

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

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

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

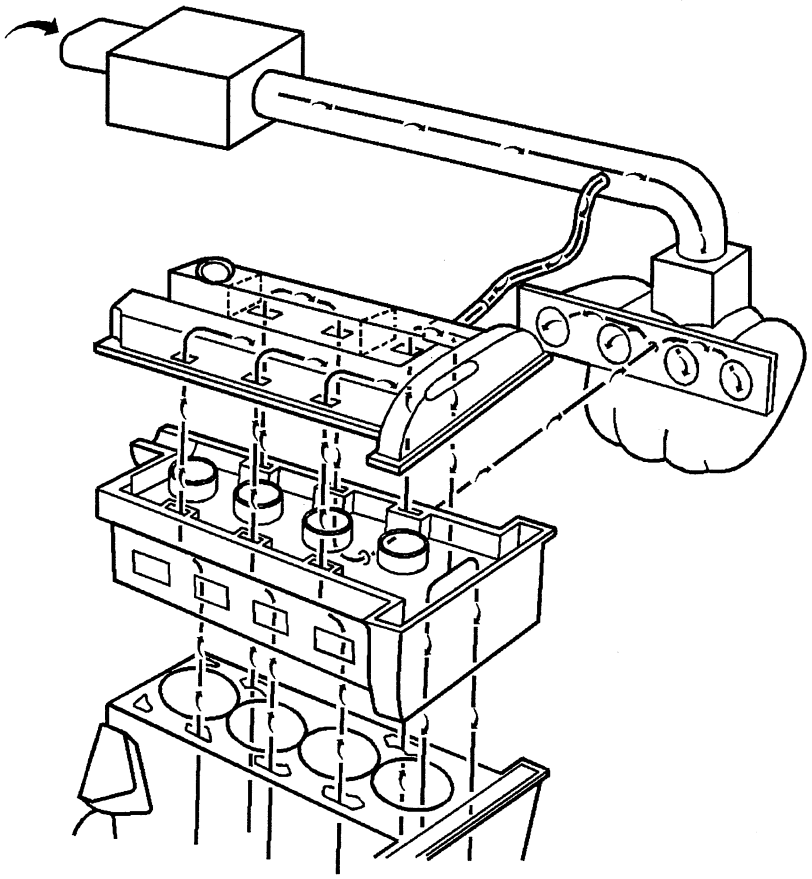
The drive belt system may have an idler pulley, which is used to add wrap to the adjacent pulleys. Some systems use an idler pulley in place of an accessory drive component when the vehicle is not equipped with the accessory.

Crankcase Ventilation System Description

General Description

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

Operation



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

Results of Incorrect Operation

A plugged orifice may cause the following conditions:

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

A leaking orifice may cause the following conditions:

- Rough idle
- Stalling
- High idle speed

Engine Mechanical – 2.4L

General Specifications

Application	Specification	
	Metric	English
General Data		
• Engine Type	Inline 4 Cylinder	
• Displacement	2.4 L	146 CID
• RPO	LE5	
• Liter (VIN)	B	
• Bore	87.992-88.008 mm	3.4668-3.4675 in
• Stroke	98 mm	3.861 in
• Compression Ratio	10:01	
Balance Shaft		
• Bearing Clearance	0.030-0.063 mm	0.0012-0.0025 in
• Bearing Diameter - Inside - Carrier	20.050-20.063 mm	0.7894-0.7899 in
• Bearing Diameter - Outside - Carrier	41.975-41.995 mm	1.6526-1.6534 in
• Bearing Journal Diameter	20.000-20.020 mm	0.7874-0.7882 in
• Bushing Clearance	0.033-0.102 mm	0.0013-0.0040 in
• Bushing Diameter - Inside	36.776-36.825 mm	1.4479-1.4498 in
• Bushing Journal Diameter	36.723-36.743 mm	1.4458-1.4466 in
• End Play	0.100-0.300 mm	0.0020-0.0118 in
Block		
• Balance Shaft Bearing Bore Diameter - Carrier	42.000-42.016 mm	1.6535-1.6542 in
• Balance Shaft Bushing Bore Diameter	40.763-40.776 mm	1.6048-1.6054 in
• Crankshaft Main Bearing Bore Diameter	64.068-64.082 mm	2.5224-2.5229 in
• Cylinder Bore Diameter	87.992-88.008 mm	3.4668-3.4675 in
• Cylinder Bore Out-of-Round - Maximum	0.010 mm	0.0004 in
• Cylinder Bore Taper - Maximum	0.010 mm	0.0004 in
• Cylinder Head Deck Surface Flatness - Transverse	0.030 mm	0.0012 in
• Cylinder Head Deck Surface Flatness - Longitude	0.050 mm	0.002 in
• Cylinder Head Deck Surface Flatness - Overall	0.08 mm	0.0031 in
Camshaft		
• Camshaft End Play	0.040-0.144 mm	0.0016-0.0057 in
• Camshaft Journal Diameter	26.935-26.960 mm	1.0604-1.0614 in
• Camshaft Thrust Surface	21.000-21.052 mm	0.8268-0.8252 in
Connecting Rod		
• Connecting Rod Bearing Clearance	0.029-0.069 mm	0.0011-0.0027 in
• Connecting Rod Bore Diameter - Bearing End	52.118-52.134 mm	2.0519-2.05252 in
• Connecting Rod Bore Diameter - Pin End	20.007-20.021 mm	0.7877-0.7882 in
• Connecting Rod Side Clearance	0.070-0.370 mm	0.0028-0.0146 in
• Connecting Rod Straightness - Bend - Maximum	0.021 mm	0.0083 in
• Connecting Rod Straightness - Twist - Maximum	0.04 mm	0.0157 in
Crankshaft		
• Connecting Rod Journal Diameter	49.000-49.014 mm	1.9291-1.9297 in
• Crankshaft End Play	0.050-0.380 mm	0.0012-0.0150 in
• Crankshaft Main Bearing Clearance	0.031-0.067 mm	0.0012-0.0026 in
• Crankshaft Main Journal Diameter	55.994-56.008 mm	2.2045-2.2050 in

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

Application	Specification	
	Metric	English
• Valve Springs - Valve Spring Load - Closed - @22.5 mm	525.0-575.0 N. - Eng Spec.	
• Valve Springs - Valve Spring Load - Open - @32.5 mm	245.0-271.0 N. - Eng Spec.	

Fastener Tightening Specifications

Application	Specification	
	Metric	English
A/C Compressor to Block Bolt	20 N·m	15 lb ft
Balance Shaft Adjustable Chain Guide Bolt	15 N·m	11 lb ft
Balance Shaft Bearing Carrier to Block Bolt	10 N·m	89 lb in
Balance Shaft Fixed Chain Guide Bolt	15 N·m	11 lb ft
Balance Shaft Sprocket Bolt	50 N·m	37 lb ft
Block Core Plug	40 N·m	30 lb ft
Block Heater Bolt	10 N·m	89 lb in
Cam Cover to Cylinder Head Bolt	10 N·m	89 lb in
Cam Cover to Ground Cable Bolt	10 N·m	89 lb in
Cam Cover to Ground Cable Stud	10 N·m	89 lb in
Camshaft Cap Bolt	10 N·m	89 lb in
Camshaft Position Actuator Solenoid Valve Bolt	10 N·m	89 lb in
Camshaft Position Sensor Bolt	10 N·m	89 lb in
Camshaft Timing Chain Tensioner	75 N·m	55 lb ft
Chain Guide Plug	90 N·m	59 lb ft
Connecting Rod Bolt		
First Pass	25 N·m	18 lb ft
Final Pass	100 degrees	
Crankshaft Bearings - Lower Crankcase to Block - Bedplate		
First Pass	20 N·m	15 lb ft
Final Pass	70 degrees	
Crankshaft Position Sensor Bolt	10 N·m	89 lb in
Crankshaft Balancer Bolt		
First Pass	100 N·m	74 lb ft
Final Pass	125 degrees	
Cylinder Head Bolt		
First Pass	30 N·m	22 lb ft
Final Pass	155 degrees	
Cylinder Head Front Chaincase Bolt	35 N·m	26 lb ft
Cylinder Head Oil Gallery Plug	35 N·m	26 lb ft
Drive Belt Tensioner Bolt	45 N·m	33 lb ft
EGR Cover Bolt	25 N·m	18 lb ft
Engine Coolant Temperature Sensor	20 N·m	15 lb ft
Engine Lift Bracket Front Bolt	25 N·m	18 lb ft
Engine Lift Bracket Rear Bolt	25 N·m	18 lb ft
EVAP Canister Valve Bolt	22 N·m	16 lb ft
Exhaust Camshaft Position Actuator		
First Pass	30 N·m	22 lb ft
Final Pass	100 degrees	
Exhaust Manifold to Cylinder Head Nut	14 N·m	124 lb in
Exhaust Manifold to Cylinder Head Stud	10 N·m	89 lb in
Exhaust Manifold Pipe Flange Stud	16 N·m	12 lb ft
Flywheel Bolt - Automatic Transmission		
First Pass	53 N·m	39 lb ft
Final Pass	25 degrees	

Application	Specification	
	Metric	English
Flywheel Bolt - Manual Transmission		
First Pass	53 N·m	39 lb ft
Final Pass	25 degrees	
Front Cover to Block Bolt	25 N·m	18 lb ft
Front Lift Bracket Bolt	25 N·m	18 lb ft
Fuel Pipe Bracket Bolt	10 N·m	89 lb in
Fuel Rail Bracket Stud	10 N·m	89 lb in
Generator to Block Bolt	23 N·m	17 lb ft
Heat Shield to Exhaust Manifold Bolt	22 N·m	16 lb ft
Ignition Coil Bolt	10 N·m	89 lb in
Intake Camshaft Position Actuator		
First Pass	30 N·m	22 lb ft
Final Pass	100 degrees	
Intake Camshaft Rear Cap Bolt	25 N·m	18 lb ft
Intake Manifold to Cylinder Head Bolt	10 N·m	89 lb in
Intake Manifold to Cylinder Head Nut	10 N·m	89 lb in
Intake Manifold to Cylinder Head Stud	6 N·m	53 lb in
Knock Sensor Bolt	25 N·m	18 lb ft
Lower Crankcase to Block Perimeter Bolt	25 N·m	18 lb ft
Oil Cooler Bolts	22 N·m	16 lb ft
Oil Filter Housing Cover	22 N·m	16 lb ft
Oil Gallery Gerotor Cover - Rear Bolt	6 N·m	53 lb in
Oil Gallery Plug	35 N·m	26 lb ft
Oil Gallery Plug - Rear	60 N·m	44 lb ft
Oil Level Indicator Tube to Intake Manifold Bolt	10 N·m	89 lb in
Oil Pan Drain Plug	25 N·m	18 lb ft
Oil Pan to Block Bolts	25 N·m	18 lb ft
Oil Pressure Switch	22 N·m	16 lb ft
Oil Pump Cover Bolt	6 N·m	53 lb in
Oil Pump Pressure Relief Valve Plug	40 N·m	30 lb ft
Oxygen Sensor	42 N·m	31 lb ft
Piston Oil Squirter	15 N·m	11 lb ft
Power Steering Pump Bolt	25 N·m	18 lb ft
Spark Plug	20 N·m	15 lb ft
Starter Motor to Block Bolt	53 N·m	39 lb ft
Thermostat Housing to Block Bolts	10 N·m	89 lb in
Throttle Body Bolt	10 N·m	89 lb in
Throttle Body Nut	10 N·m	89 lb in
Throttle Body Stud	6 N·m	53 lb in
Timing Adjustable Chain Guide Bolt	10 N·m	89 lb in
Timing Chain Oil Nozzle Bolt	10 N·m	89 lb in
Timing Fixed Chain Guide Bolt	15 N·m	11 lb ft
Timing Upper Chain Guide Bolt	10 N·m	89 lb in
Vent Tube to Cylinder Head	15 N·m	11 lb ft
Water Jacket Drain Plug	20 N·m	15 lb ft
Water Pipe Support Bracket Bolt	10 N·m	89 lb in
Water Pump Access Cover Bolt	7 N·m	62 lb in
Water Pump/Balance Shaft Chain Tensioner Bolt	10 N·m	89 lb in
Water Pump Bolts	25 N·m	18 lb ft
Water Pump Sprocket Bolt	10 N·m	89 lb in

Engine Component Description

Cylinder Block

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

Crankshaft

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

Connecting Rod and Piston

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

Oil Pan

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

Balance Shaft Assembly

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

Cylinder Head

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

Valves

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

Camshaft

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

Valve Lifters

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

Camshaft Cover

The camshaft cover has a steel crankcase ventilation baffling incorporated. The camshaft cover has mounting locations for the ignition system.

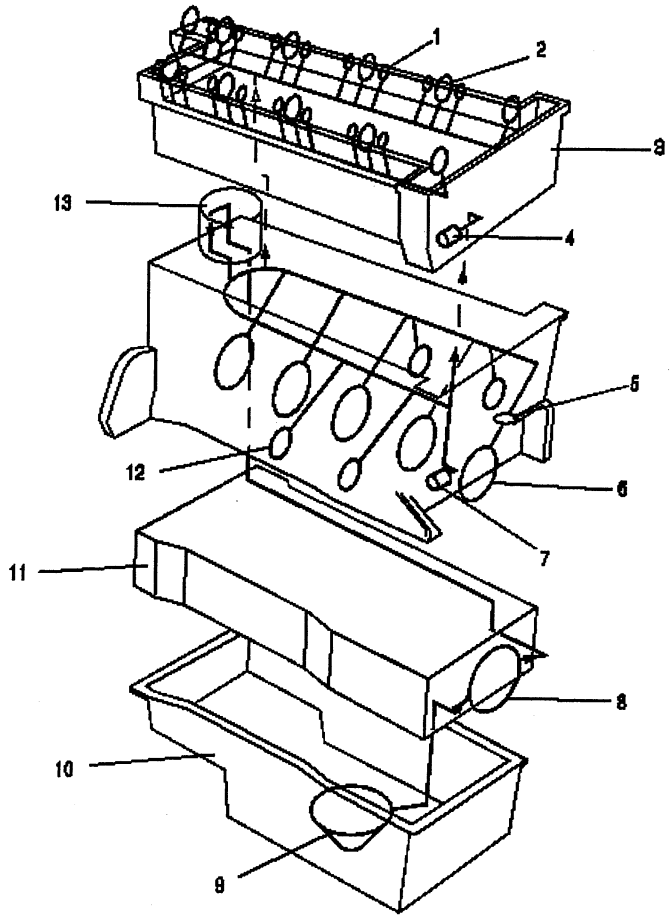
Camshaft Drive

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

Intake and Exhaust Manifold

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

Lubrication Description



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

Oil is applied under pressure to the crankshaft, connecting rods, balance shaft assembly, camshaft bearing surfaces, valve lifters and timing chain hydraulic tensioner. All other moving parts are lubricated by gravity flow or splash. Oil enters the gerotor type oil pump thorough a fixed inlet screen. The oil pump is driven by the crankshaft. The oil pump body is within the engine front cover. The pressurized oil from the pump passes through the oil filter. The oil filter is located on the right (front) side of the engine block. The oil filter is housed in a casting that is integrated with the engine block. The oil filter is a disposable cartridge type. A by-pass valve in the filter cap allows continuous oil flow in case the oil filter should become restricted. Oil then enters the gallery where it is distributed to the balance shafts, crankshaft, camshafts and camshaft timing chain oiler nozzle. The connecting rod bearings are oiled by constant oil flow passages through the crankshaft connecting the main journals to the rod journals. A groove around each upper main bearing furnishes oil to the drilled crankshaft passages. The pressurized oil passes through the cylinder head restrictor orifice into the cylinder head and then into each camshaft feed gallery. Cast passages feed each hydraulic element adjuster and drilled passages feed each camshaft bearing surface. An engine oil pressure switch or sensor is installed at the end. Oil returns to the oil pan through passages cast into the cylinder head. The timing chain lubrication drains directly into the oil pan.

Engine Cooling

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Coolant Heater Bolt	10 N·m	89 lb in
Coolant Reservoir Bolt	9 N·m	80 lb in
Condenser Bolt (11516490)	20 N·m	15 lb ft
Exhaust Heat Shield Stud	22 N·m	167 lb ft
Radiator Bracket Upper Bolt	9 N·m	80 lb in
Radiator Support Lower Bolt	34 N·m	25 lb ft
Thermostat Housing Bolt	10 N·m	89 lb in
Thermostat Housing Cover Bolt	10 N·m	89 lb in
Water Pump Access Plate Bolt	10 N·m	89 lb in
Water Pump Bolt	25 N·m	18 lb ft
Water Pump Sprocket Bolt	10 N·m	89 lb in

Cooling System Description and Operation

Coolant Heater

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

Cooling System

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

Cooling Cycle

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

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

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

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

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

Coolant

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

Radiator

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

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

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

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

Pressure Cap

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

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

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

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

Coolant Recovery System

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

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

Air Baffles and Seals

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

Water Pump

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

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

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

Thermostat

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

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

Engine Oil Cooler

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

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

Transmission Oil Cooler

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

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

Engine Electrical

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Battery Hold-Down Retainer Bolt	25 N·m	18 lb ft
Generator Bolt	22 N·m	16 lb ft
Generator Terminal Nut	20 N·m	15 lb ft
Junction Block Terminal Nut	15 N·m	11 lb ft
Negative Battery Cable Bolt	20 N·m	15 lb ft
Negative Battery Cable Nut	15 N·m	11 lb ft
Positive Battery Cable Nut	15 N·m	11 lb ft
Positive/Negative Battery Cable Ground Nut	10 N·m	89 lb in
Starter Bolt	40 N·m	30 lb ft
Starter Solenoid Nut	17 N·m	13 lb ft
Starter Solenoid S Terminal Nut	3 N·m	27 lb in

Battery Usage

Application	Specification
Cold Cranking Amperage (CCA)	600 A
Reserve Capacity	90 min.
Replacement Model Number	90-6YR

Generator Usage

Application	Specification
2.2L (L61), 2.4L (LE5)	
Generator Model	Denso SC0
Rated Output	130 A
Load Test Output	91 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.

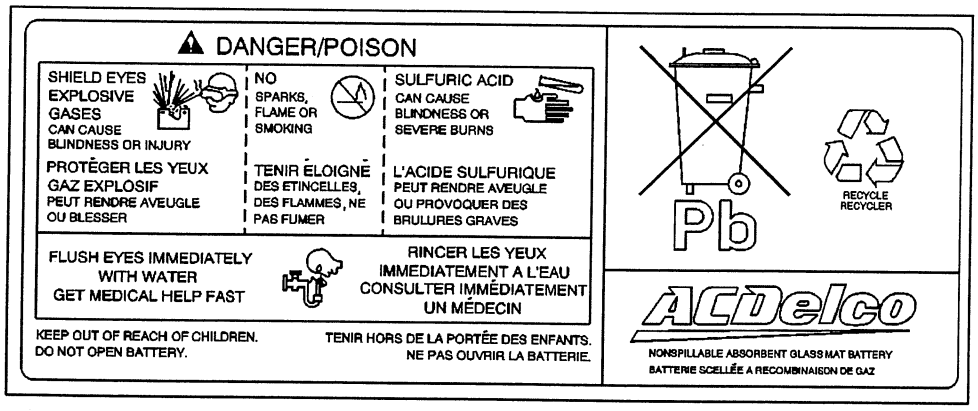
Important

Because of the materials used in the manufacture of automotive lead-acid batteries, dealers and service shops that handle them are subject to various regulations issued by OSHA, EPA, DOT, and various state or local agencies. Other regulations may also apply in other locations. Always know and follow these regulations when handling batteries.

Batteries that are no longer wanted must be disposed of by an approved battery recycler and must never be thrown in the trash or sent to a landfill.

Batteries that are not part of the vehicle itself, not the battery under the hood, must only be transported on public streets for business purposes via approved hazardous material transportation procedures.

Battery storage, charging and testing facilities in repair shops must meet various requirements for ventilation, safety equipment, material segregation, etc.



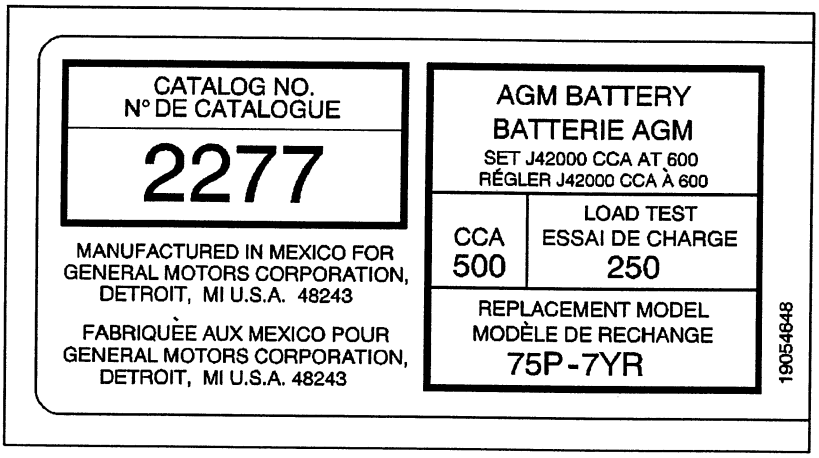
The maintenance free absorbent glass mat (AGM) battery is the standard original equipment battery. The battery is completely sealed except for one vent port in the end of the cover. The vent port allows the small amount of gas that is produced in the battery to escape when pressures exceed 2 psi. The AGM battery is a lead-acid battery that is similar to current batteries. They use glass mats that absorb electrolyte that are pressed between the plates instead of immersing the plates in electrolyte. This allows a smaller, lighter battery with the same amount of power which is less susceptible to heat.

The battery has 3 functions as a major source of energy:

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

The battery specification label (see typical figure) contains information about the following:

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



Battery Ratings

A battery has 2 ratings:

- Reserve capacity (RC)
- Cold cranking amperage (CCA)

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

The reserve capacity (RC) is an indication of the battery's ability to produce a relatively low amount of current over a long period of time. The RC rating is the amount of time in minutes it takes a fully charged battery at 27°C (80°F) to reach a terminal voltage of 10.5 volts when it is being discharged at a constant rate of 25 amps. 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 underhood fuse block and the rear fuse block. The underhood fuse block provides a cable connection for the generator and a cable connection for the starter.

Starting System Description and Operation

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

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

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

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

Circuit Description

Moving the ignition switch to the START position signals the body control module (BCM) through discrete inputs from the ignition transducer that engine crank has been requested. The BCM verifies that theft is not active and sends a serial data message to the engine control module (ECM)/powertrain control module (PCM) requesting engine start. The ECM/PCM receives a 12-volt signal from the park/neutral position (PNP) switch or clutch pedal start switch notifying that it is safe to start the engine. There is a splice on this circuit in the fuse block-underhood that supplies power for the starter relay coil. The starter relay coil control circuit is then grounded by the ECM/PCM closing the switch in the starter relay suppling 12 volts to the S-terminal of the starter. Ground is supplied through the engine block.

Charging System Description and Operation

Electrical Power Management (EPM) Overview

The electrical power management (EPM) system is designed to monitor and control the charging system and send diagnostic messages to alert the driver of possible problems with the battery and generator. This EPM system primarily utilizes existing on-board computer capability to maximize the effectiveness of the generator, to manage the load, improve battery state-of-charge (SOC) and life, and minimize the system's impact on fuel economy. The EPM system performs 3 functions:

- It monitors the battery voltage and estimates the battery condition.
- It takes corrective actions by adjusting the regulated voltage.
- It performs diagnostics and driver notification.

The battery's condition is estimated during key-off and during key-on. During key-off the SOC of the battery is determined by measuring the open-circuit voltage. The SOC is a function of the acid concentration and the internal resistance of the battery, and is estimated by reading the battery open circuit voltage when the battery has been at rest for several hours.

The SOC can be used as a diagnostic tool to tell the customer or the dealer the condition of the battery. Throughout key-on, the algorithm continuously estimates SOC based on adjusted net amp hours, battery capacity, initial SOC, and temperature.

While running, the battery's degree of discharge is primarily determined by a battery current sensor, which is integrated to obtain net amp hours.

In addition, the EPM function is designed to perform regulated voltage control (RVC) to improve battery SOC, battery life, and fuel economy. This is accomplished by using knowledge of the battery's SOC and temperature to set the charging voltage to an optimum battery voltage level for recharging without detriment to battery life.

The Charging System Description and Operation is divided into 3 sections. The first section describes the charging system components and their integration into the electrical power management (EPM). The second section describes charging system operation. The third section describes the instrument panel cluster (IPC) operation of the charge indicator, driver information center (DIC) messages, and voltmeter operation.

Charging System Components

Generator

The generator is a serviceable component. If there is a diagnosed failure of the generator it must be replaced as an assembly. The engine drive belt drives the generator. When the rotor is spun it induces an alternating current (AC) into the stator windings. The AC voltage is then sent through a series of diodes for rectification. The rectified voltage has been converted into a direct current (DC) for use by the vehicles electrical system to maintain electrical loads and the battery charge. The voltage regulator integral to the generator controls the output of the generator. It is not serviceable. The voltage regulator controls the amount of current provided to the rotor. If the generator has field control circuit failure, the generator defaults to an output voltage of 13.8 volts.

Body Control Module (BCM)

The body control module (BCM) is a GM LAN device. It communicates with the engine control module (ECM) and the instrument panel cluster (IPC) for electrical power management (EPM) operation. The BCM determines the output of the generator and sends the information to the ECM for control of the generator field control circuit. It monitors the generator field duty cycle signal circuit information sent from the ECM for control of the generator. It monitors a battery current sensor, the battery positive voltage circuit, and estimated battery temperature to determine battery state-of-charge (SOC). The BCM performs idle boost and load management operations.

Battery Current Sensor

The battery current sensor is a serviceable component that is connected to the negative battery cable at the battery. The battery current sensor is a 3-wire hall effect current sensor. The battery current sensor monitors the battery current. It directly inputs to the BCM. It creates a 5-volt pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. Between 0-5 percent and 95-100 percent are for diagnostic purposes.

Engine Control Module (ECM)

The ECM directly controls the generator field control circuit input to the generator. It monitors the generators generator field duty cycle signal circuit and sends the information to the BCM. The ECM will override the BCM control of the generator when one of the following conditions are met:

- The engine cooling fans are on high speed.
- There is a high fuel demand.
- The calculated ambient air temperature is less that 0°C (32°F).

Instrument Panel Cluster (IPC)

The IPC provides a means of customer notification in case of a failure and a voltmeter. There are 2 means of notification, a charge indicator and a driver information center (DIC) message of SERVICE CHARGING SYSTEM and CHARGING SYSTEM FAULT.

Charging System Operation

The purpose of the charging system is to maintain the battery charge and vehicle loads. There are 6 modes of operation and they include:

- Charge Mode
- Fuel Economy Mode
- Voltage Reduction Mode
- Start-up Mode
- Windshield Deice Mode
- Battery Sulfation Mode

The engine control module (ECM) controls the generator through the generator L-terminal control circuit. The signal is a 5-volt pulse width modulation (PWM) signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-95 percent. Between 0-5 percent and 95-100 percent are for diagnostic purposes. The following table shows the commanded duty cycle and output voltage of the generator:

Commanded Duty Cycle	Generator Output Voltage
10%	11 V
20%	11.56 V
30%	12.12 V
40%	12.68 V
50%	13.25 V
60%	13.81 V
70%	14.37 V
80%	14.94 V
90%	15.5 V

The generator provides a feedback signal of the generator voltage output through the generator field duty cycle signal circuit to the ECM. This information is sent to the body control module (BCM). The signal is a 12-volt PWM signal of 128 Hz with a duty cycle of 0-100 percent. Normal duty cycle is between 5-99 percent. Between 0-5 percent and 100 percent are for diagnostic purposes.

Charge Mode

The BCM will enter Charge Mode when ever one of the following conditions are met:

- The interpreted fuel rate is greater than 21 g/s and the throttle position is greater than 90 percent.
- The headlamps are ON, low or high beam.
- The wipers are ON for more than 8 seconds.
- The electric cooling fans are on high speed.
- The rear defogger is ON.

Once one of these conditions are met, the generator battery control module will set the targeted generator output voltage to 13.4 volts and then ramp that voltage up to 14.5 volts at a rate of 50 mV per second.

Fuel Economy Mode

The BCM will enter Fuel Economy Mode when the calculated ambient air temperature is above 0°C (32°F), the calculated battery current is less than 15 amps and greater than -8 amps, and the battery state-of-charge (SOC) is greater than 80 percent. Its targeted generator output voltage is 13 volts. The BCM will exit this mode once the criteria are met for Charge Mode.

Voltage Reduction Mode

The BCM will enter Voltage Reduction Mode when the calculated ambient air temperature is above 0°C (32°F); the calculated battery current is less than 2 amps and greater than -7 amps, and the generator field duty cycle is less than 99 percent. Its targeted generator output voltage is 12.9 volts. The BCM will exit this mode once the criteria are met for Charge Mode.

Start-up Mode

After the engine has started, the BCM sets a targeted generator output voltage of 14.5 volts for 20 seconds.

Windshield Deice Mode

After the engine has run for more than 10 seconds, the BCM sets a targeted generator output voltage of 13.8 volts if the calculated ambient air temperature is less that 0°C (32°F). The BCM will stay in this mode until the engine coolant temperature (ECT) reaches 75°C (167°F) for 10 minutes.

Battery Sulfation Mode

The BCM will enter this mode when the interpreted generator output voltage is less than 13.2 volts for 45 minutes. Once in this mode, the BCM will set a targeted output voltage of 13.8 volts for 5 minutes. The BCM will then determine which mode to enter depending on voltage requirements.

Instrument Panel Cluster (IPC) Operation

Charge Indicator Operation

The instrument panel cluster (IPC) illuminates the charge indicator in the message center when the one or more of the following occurs:

- The engine control module (ECM) detects that the generator output is less than 11 volts or greater than 16 volts. The IPC receives a serial data message from the ECM requesting illumination.
- The IPC determines that the system voltage is less than 11 volts or greater than 16 volts for more than 30 seconds. The IPC receives a serial data message from the body control module (BCM) indicating there is a system voltage range concern.
- The IPC performs the displays test at the start of each ignition cycle. The indicator illuminates for approximately 3 seconds.
- The ignition is ON, with the engine OFF.

Charging System Failure

The BCM and the ECM will send a serial data message to the IPC for the CHARGING SYSTEM FAILURE message to be displayed. It is commanded ON when a charging system DTC is a current DTC. The message is turned OFF when the conditions for clearing the DTC have been met.

Battery Voltage

The IPC displays the system voltage as received from the BCM over the serial data circuit. If there is no communication with the BCM, then the display will read all dashes until communication is restored.

Battery Saver Active

The BATTERY SAVER ACTIVE message will display on the driver information center (DIC) when the vehicle enters a load shed 2 event. Refer to for load shed 2 setting criteria.

Engine Controls

Fuel System Specifications – All Engines

If your vehicle has the 2.2L or 2.4L L4 engine, use regular unleaded gasoline with a posted octane of 87 or higher. If the octane is less than 87, you may get a heavy knocking noise when you drive. If this occurs, use a gasoline rated at 87 octane or higher as soon as possible. Otherwise, you might damage your engine. A little pinging noise when you accelerate or drive uphill is considered normal. This does not indicate a problem exists or that a higher-octane fuel is necessary. If you are using 87 octane or higher-octane fuel and hear heavy knocking, your engine needs service.

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

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

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

Notice

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

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

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

Engine Controls - 2.2L (L61)

Ignition System Specifications

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

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Cable Bracket Bolts	10 N·m	89 lb in
Accelerator Pedal Retaining Nuts	10 N·m	89 lb in
Air Cleaner Assembly Attaching Nut	10 N·m	89 lb in
Air Cleaner Intake Duct Assembly Bolt	10 N·m	89 lb in
Air Cleaner Intake Duct Clamp	5 N·m	44 lb in
Air Cleaner Outlet Resonator Clamp	5 N·m	44 lb in
Bypass Valve Actuator Bolt	10 N·m	89 lb in
CKP Sensor Bolt	8 N·m	71 lb in
Engine Control Module (ECM) Harness Connector Bolt	4 N·m	35 lb in
Engine Coolant Temperature (ECT) Sensor	10 N·m	89 lb in
EVAP Canister Purge Valve Mounting Bracket Nut	8 N·m	71 lb in
EVAP Canister Retaining Bolt	10 N·m	89 lb in
Fuel Filler Hose Clamp	4.5 N·m	40 lb in
Fuel Filler Pipe Attaching Screw	10 N·m	89 lb in
Fuel Filler Pipe Lower Retaining Bolt	10 N·m	89 lb in
Fuel Filter Retaining Bolt	10 N·m	89 lb in
Fuel Rail Studs	10 N·m	89 lb in
Fuel Supply Line Fitting	10 N·m	89 lb in
Fuel Tank Strap Bolts	25 N·m	18 lb ft
Heated Oxygen Sensor (HO2S) 1	30 N·m	22 lb ft
Heated Oxygen Sensor (HO2S) 2	41 N·m	30 lb ft
Idle Air Control (IAC) Valve Screw	3 N·m	27 lb in
Ignition Coil Housing Retaining Bolts	10 N·m	89 lb in
Ignition Control Module (ICM) Screws	1.5 N·m	13 lb in
Knock Sensor (KS)	25 N·m	18 lb ft
Mass Air Flow Sensor Bolt	10 N·m	89 lb in
Rear Brake Hose Bracket	10 N·m	89 lb in
Spark Plugs	20 N·m	15 lb in
Throttle Body Attaching Bolts	10 N·m	89 lb in
Throttle Position (TP) Sensor Mounting Screw	2 N·m	18 lb in

Engine Controls - 2.4L

Ignition System Specifications

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

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Pedal Bolt	10 N·m	89 lb in
Air Cleaner Intake Duct Bolt	10 N·m	89 lb in
Air Cleaner Nut	10 N·m	89 lb in
Air Cleaner Outlet Duct Clamp	5 N·m	44 lb in
Camshaft Position (CMP) Actuator Solenoid Valve Bolt	10 N·m	89 lb in
Camshaft Position (CMP) Sensor Bolt	10 N·m	89 lb in
Crankshaft Position (CKP) Sensor Bolt	10 N·m	89 lb in
Engine Coolant Temperature (ECT) Sensor	10 N·m	89 lb in
Evaporative Emission (EVAP) Canister Purge Valve Bracket Nut	18 N·m	13 lb ft
Evaporative Emission (EVAP) Canister Bolt	10 N·m	89 lb in
Exhaust Manifold Heat Shield Stud	22 N·m	16 lb ft
Fuel Fill Hose Clamp	4.5 N·m	40 lb in
Fuel Fill Pipe Bolt	10 N·m	89 lb in
Fuel Fill Pipe Lower Bolt	10 N·m	89 lb in
Fuel Filter Bracket Bolt	10 N·m	89 lb in
Fuel Rail Bolt	10 N·m	89 lb in
Fuel Tank Strap Bolt	25 N·m	18 lb ft
Heated Oxygen Sensor (HO2S)	42 N·m	31 lb ft
Ignition Coil Bolt	10 N·m	89 lb in
Knock Sensor (KS)	25 N·m	18 lb ft
Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Screw	10 N·m	89 lb in
Rear Brake Hose Bracket Nut	10 N·m	89 lb in
Spark Plug	20 N·m	15 lb in
Throttle Body Bolt	10 N·m	89 lb in

Exhaust System

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Cleaner Bracket Nut	25 N·m	18 lb ft
Catalytic Converter Nut	46 N·m	34 lb ft
Exhaust Heat Shield Nut	10 N·m	89 lb in
Exhaust Manifold Heat Shield Stud	22 N·m	16 lb ft
Exhaust Manifold Nut	14 N·m	10 lb ft
Exhaust Muffler Nut	46 N·m	37 lb ft
Wheel Drive Shaft Heat Shield-to-Engine Block Bolt	30 N·m	22 lb ft
Wheel Drive Shaft Heat Shield-to-Transaxle Mount Bracket Bolt	10 N·m	89 lb in

Exhaust System Description

Important

Use of non-OEM parts may cause driveability concerns.

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

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

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

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

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

The exhaust system may be comprised of the following components:

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

Resonator

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

Catalytic Converter

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

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

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

The catalyst in the converter is not serviceable.

Muffler

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

Transmission/Transaxle Description and Operation

Manual Transmission - Getrag 5-Speed

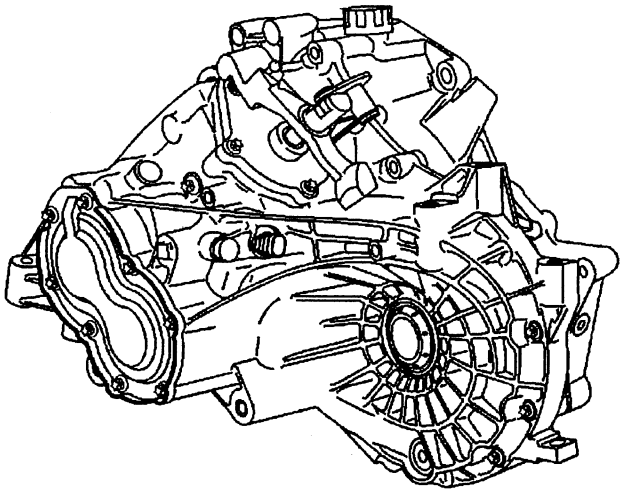
Fastener Tightening Specifications

Application	Specification	
	Metric	English
Drain Plugs	38 N·m	28 lb ft
Front Transmission Mount Bolts	50 N·m	37 lb ft
Front Transmission Mount Through Bolt	100 N·m	74 lb ft
Heat Shield to Engine Block Bolt	30 N·m	22 lb ft
Heat Shield to Transmission Mount Bolt	10 N·m	89 lb in
Intermediate Shaft Bolt	100 N·m	74 lb ft
Rear Cover Bolts	25 N·m	18 lb ft
Rear Transmission Mount Bracket to Transmission Bolts	60 N·m	44 lb ft
Rear Transmission Mount Through Bolt	100 N·m	74 lb ft
Rear Transmission Mount to Frame Bolts	60 N·m	44 lb ft
Reverse Lockout Bolt	6 N·m	53 lb in
Reverse Switch	18 N·m	13 lb ft
Ring Gear	90 N·m	66 lb ft
Side Transmission Mount Bolts	45 N·m	33 lb ft
Side Transmission Mount to Mid-Rail Bolts	34 N·m	25 lb ft
Shaft Bolts	100 N·m	74 lb ft
Shift Cable Attachment Nut	10 N·m	89 lb in
Shift Control Nuts	25 N·m	18 lb ft
Shifter Guide Bolt	25 N·m	18 lb ft
Shifter Retaining Bolts	25 N·m	18 lb ft
Speed Sensor	12 N·m	106 lb in
Transmission Housing Bolts	27 N·m	20 lb ft
UBEC Bracket Bolts	25 N·m	18 lb ft
UBEC Bracket Nuts	10 N·m	89 lb in
UBEC Positive Post	10 N·m	89 lb in

Lubrication Specifications

Application	Specification	
	Metric	English
DEXRON®III	1.7 liters	1.8 quarts

Transmission General Description



The Getrag 5 Speed is a 5 speed manual transmission assembly.

Important

Use only DEXRON®III Automatic Transmission Lubricant for this manual transmission assembly. Other lubricants or additives may affect the shift performance.

The Getrag 5 Speed manual transmission has the following features:

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

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

Clutch

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Clutch Actuator Bolts	10 N·m	89 lb in
Clutch Cover to Flywheel Bolts	30 N·m	22 lb ft
Clutch Pedal Bracket Nuts	10 N·m	89 lb in
Clutch Pedal Pivot Nut	10 N·m	89 lb in
Coolant Reservoir Attaching Nut	15 N·m	11 lb ft

Hydraulic Clutch Description

Clutch Spin Down Time

Check the clutch spin down time as follows:

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

Clutch Driving Members

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

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

Clutch Driven Members

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

Hydraulic Clutch Fluid

Notice

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

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

Hydraulic Clutch Operating Members

The clutch system consists of the following components:

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

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

Automatic Transaxle - 4T45-E

Transmission General Specifications

Name	Hydra-Matic® 4T45-E
RPO Codes	MN5 - 4T45-E
Production Location	Windsor, Ontario, Canada
Vehicle Platform Engine/Transmission Usage	TA SUV
Transmission Drive	Transverse Mounted Front Wheel Drive
Maximum Engine Torque	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® VI
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	75.1 kg (165.6 lbs)
Transmission Weight Wet	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

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	89 lb in
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 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
Pump, Valve Body, Channel Plate to Case - M6 x 1.0 x 103.0 - Qty 1	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 Mount Bracket Bolts	120 N·m	89 lb ft
Transmission Mount - Front	130 N·m	96 lb ft
Transmission Mount - Rear	122 N·m	90 lb ft
Transmission Mount - Side	66 N·m	49 lb ft
Transmission Mount Thrubolt - Front	75 N·m	55 lb ft
Transmission Mount Thrubolt - Rear	120 N·m	89 lb ft
Transmission Mount Thrubolt - Side	55 N·m	41 lb ft
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

Application	Specification	
	Metric	English
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

Fluid Capacity Specifications - Approximate

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

Transmission General Description

The 4T45-E is a fully automatic front wheel drive electronically controlled transmission. The 4T45-E provides four forward ranges including overdrive and one reverse gear range. The PCM controls shift points by means of two shift solenoids. A vane type pump supplies the oil pressure. The PCM regulates oil pressure by means of the Pressure Control Solenoid (PCS).

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

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

Transmission Component and System Description

The mechanical components of this unit are as follows:

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

The electrical components of this unit are as follows:

- Two shift solenoid valves, 1-2 and 2-3
- A torque converter clutch pulse width modulated (TCC PWM) solenoid valve
- A transmission pressure control (PC) solenoid valve
- An automatic transmission fluid temperature (TFT) sensor

- Two speed sensors: input and output speed sensor
- An automatic transmission fluid pressure (TFP) manual valve position switch assembly
- An automatic transmission wiring harness assembly
- A park/neutral position switch

Adapt Function

Transmission Adapt Function

The 4T45-E transmission uses a line pressure control system, which has the ability to continuously adapt the system's line pressure. This compensates for normal wear of the following parts:

- The clutch fiber plates
- The seals
- The springs

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

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

Automatic Transmission Shift Lock Control Description and Operation

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

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

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

Abbreviations and Meanings

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

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

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

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

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

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

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

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

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

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

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

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Conversion - English/Metric

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

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

Equivalents - Decimal and Metric

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

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

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Fasteners

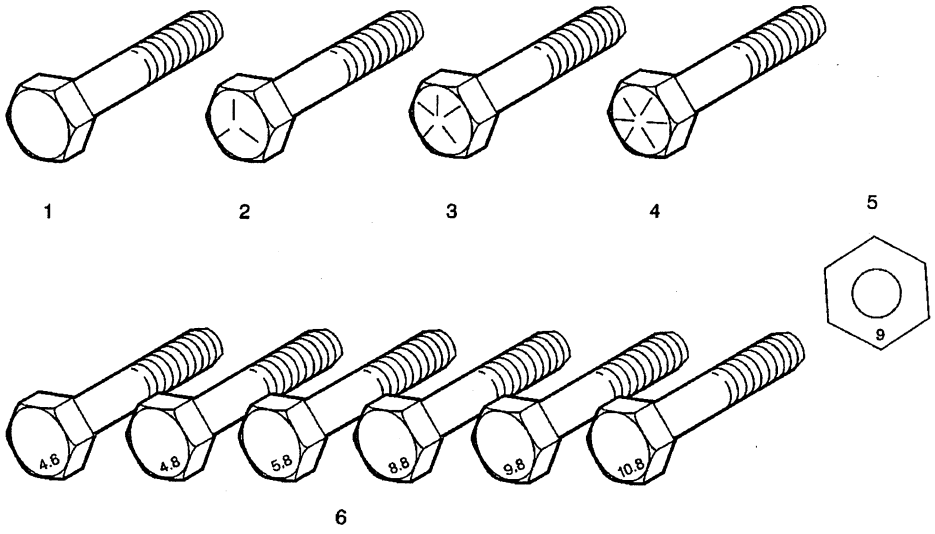
Metric Fasteners

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

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

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

Fastener Strength Identification



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

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

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

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

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

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

Prevailing Torque Fasteners

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

All Metal Prevailing Torque Fasteners

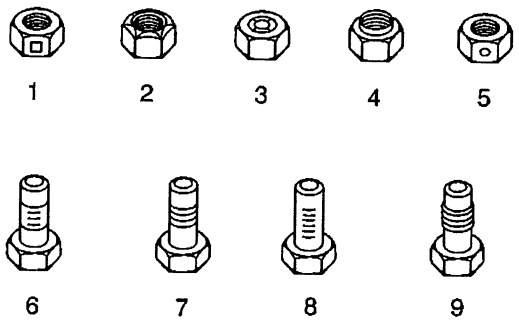
These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

Nylon Interface Prevailing Torque Fasteners

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

Adhesive Coated Fasteners

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



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

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

A prevailing torque fastener may be reused ONLY if:

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

Metric Prevailing Torque Fastener Minimum Torque Development

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

English Prevailing Torque Fastener Minimum Torque Development

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

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Codes listed in the shaded column titled Ref. Only RPO Code are for internal use only and should not be ordered.

Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
		Air bags, frontal, driver and right front passenger **1 - Always use safety belts and proper child restraints, even with air bags. Children are safer when properly secured in a rear seat. See the Owner's Manual for more safety information.**	S[1]	S[1]	S[1]
		Air conditioning	S	S	S
		Cargo convenience net, trunk	S	S	S
		Console, floor, includes dual power outlets and dual front and rear cupholders	S	S	S
		Cruise control	S	S	S
		Defogger, rear-window, electric	S	S	S
		Door locks, power	S	S	S
		Door locks, child security, rear	S	S	S
		Driver Information Center	S	S	S
		Floormats, carpeted, front and rear	S	S	S
		Floormat, carpeted, cargo area	S	S	S
		Glovebox, auxiliary	S	S	S
		Keyless entry, remote (RKE)	S	S	S
		LATCH system, (Lower Anchors and Top tethers for CHildren)	S	S	S
		Map pocket, driver seatback	S	S	S
		Safety belts, 3-point, front, height-adjustable	S	S	S
		Seats, front Cloth buckets, includes 60/40 split-folding rear seat	S	S	S
		Seat adjuster, manual, driver 6-way (fore/aft, height adjuster and recline) and passenger 4-way (fore/aft and recline)	S	--	--
AJ6		**Seat adjuster**, power, driver 8-way (fore/aft, height adjuster, seat cushion tilt, lumbar and manual recline) and manual passenger, 4-way (fore/aft and recline) **1 - Requires a Fleet or Federal Government order type.**	A[1]	S	S
		Seat, front passenger, flat-folding	S	S	S
	U1C	**Sound system,** ETR AM/FM stereo with CD player, includes seek-and-scan and digital clock	S	--	--

Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
US8		**Sound system,** ETR AM/FM stereo with CD player and MP3 playback, includes Radio Data System, seek-and-scan, digital clock, auto-tone control, automatic volume, TheftLock and auxiliary input jack **1 - Retail orders require (UE1) OnStar or (U2K) Sound system feature, XM Satellite Radio.**	A[1]	S	S
		Sound system feature, 6-speakers	S	S	--
		Steering column, tilt	S	S	S
	N24	**Steering wheel**, urethane, includes switches for DIC and cruise controls	S	S	--
		Theft-deterrent system, PASS-Key III+	S	S	S
		Windows, power	S	S	S
		Daytime running lamps	S	S	S
		Glass, deep-tint, 2nd row doors, quarter windows and rear	S	S	S
		Mirrors, outside rearview, power, Black	S	--	--
		Mirrors, outside rearview, power, with satin chrome cap	--	S	--
		Satin Chrome Appearance Package, includes satin chrome grille, outside mirrors, liftgate applique, door handles and roof-mounted side rails (when equipped) **1 - Does not include outside mirrors or side rails.**	S[1]	S	--
		Tires, P215/55R16, all-season, blackwall	S	S	--
		Wheels, 16" (40.6 cm) steel, includes full bolt-on wheel covers	S	--	--
QG9		**Wheels,** 16" (40.6 cm), aluminum, machined-face **1 - Requires a Fleet or Federal Government order type.**	A[1]	S	--
		Wiper, rear	S	S	S
		Wipers, front, intermittent, speed-sensitive	S	S	S
		Battery rundown protection	S	S	S
	J41	**Brakes,** front disc/rear drum	S	S	--
	L61	**Engine,** ECOTEC 2.2L DOHC, 16-valve, 4-cylinder, SFI (143 HP [106.6 kW] @ 6000 rpm, 155 lb.-ft. [209.3 N-m] @ 4000 rpm)	S	S	--
		Steering, electric, variable	S	S	S
	FE1	**Suspension**, Touring	S	S	--
	MM5	**Transmission,** 5-speed manual	S	S	S

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*Indicates availability of feature on multiple models. For example, it indicates feature availability on 2WD and 4WD Models or Rear wheel drive and All-wheel drive Models.

Codes listed in the shaded column titled Ref. Only RPO Code are for internal use only and should not be ordered.

Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
	DD8	**Mirror,** inside rearview, auto dimming with compass **1 - Included and only available with (UE1) OnStar.**	A[1]	A[1]	■
	VY7	**Shift knob,** leather-wrapped **1 - Included and only available with (**2) Seats, Leather seating surfaces.**	--	A[1]	■
UQ3		**Sound system feature,** 7-speakers, Pioneer premium amplified system with tweeters and rear subwoofer speaker **1 - Requires (U2K) Sound system feature, XM Satellite Radio and (US8) Sound system, ETR AM/FM stereo with CD player.**	A[1]	A	■
	NP5	**Steering wheel,** leather-wrapped, with mounted audio controls **1 - Included and only available with (**2) Seats, Leather seating surfaces.**	--	A[1]	■
T37		**Fog lamps,** front	--	A	■
		Mirrors, outside rearview, power, with bright chrome cap **1 - Included and only available with (B57) Bright Chrome Appearance Package.**	--	A[1]	■
B57		**Bright Chrome Appearance Package**, includes bright chrome grille, outside mirrors, liftgate applique, door handles and roof-mounted side rails (when equipped)	--	A	■
		Tires, P215/50R17, all-season, blackwall	--	--	■
		Wheels, 17" (43.2 cm) aluminum, painted	--	--	■
JM4		**Brakes,** 4-wheel antilock, front disc/rear drum **1 - Required when (UE1) OnStar is ordered.**	A[1]	A[1]	■
LE5		**Engine**, ECOTEC 2.4L DOHC, 4-cylinder, SFI, (172 HP [128.3 kW] @ 6200 rpm, 162 lb-ft [218.7 N-m] @ 5000 rpm)	--	A	■
		Exhaust tip, 3.5" chrome, bright **1 - Included and only available with (LE5) Engine, ECOTEC 2.4L DOHC.**	--	A[1]	■
	FE3	**Suspension**, Sport	--	--	■

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Codes listed in the shaded column titled Ref. Only RPO Code are for internal use only and should not be ordered.

Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
	DD8	**Mirror,** inside rearview, auto dimming with compass **1 - Included and only available with (UE1) OnStar.**	A[1]	A[1]	■
	VY7	**Shift knob,** leather-wrapped **1 - Included and only available with (**2) Seats, Leather seating surfaces.**	--	A[1]	■
UQ3		**Sound system feature,** 7-speakers, Pioneer premium amplified system with tweeters and rear subwoofer speaker **1 - Requires (U2K) Sound system feature, XM Satellite Radio and (US8) Sound system, ETR AM/FM stereo with CD player.**	A[1]	A	■
	NP5	**Steering wheel,** leather-wrapped, with mounted audio controls **1 - Included and only available with (**2) Seats, Leather seating surfaces.**	--	A[1]	■
T37		**Fog lamps,** front	--	A	■
		Mirrors, outside rearview, power, with bright chrome cap **1 - Included and only available with (B57) Bright Chrome Appearance Package.**	--	A[1]	■
B57		**Bright Chrome Appearance Package,** includes bright chrome grille, outside mirrors, liftgate applique, door handles and roof-mounted side rails (when equipped)	--	A	■
		Tires, P215/50R17, all-season, blackwall	--	--	■
		Wheels, 17" (43.2 cm) aluminum, painted	--	--	■
JM4		**Brakes,** 4-wheel antilock, front disc/rear drum **1 - Required when (UE1) OnStar is ordered.**	A[1]	A[1]	■
LE5		**Engine,** ECOTEC 2.4L DOHC, 4-cylinder, SFI, (172 HP [128.3 kW] @ 6200 rpm, 162 lb-ft [218.7 N-m] @ 5000 rpm)	--	A	■
		Exhaust tip, 3.5" chrome, bright **1 - Included and only available with (LE5) Engine, ECOTEC 2.4L DOHC.**	--	A[1]	■
	FE3	**Suspension,** Sport	--	--	■

ADDITIONAL OPTIONS					
Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
ASF		**Air bags,** side head curtain, front and rear **1 - Requires (JM4) Brakes, 4-wheel antilock, front disc/rear drum. Always use safety belts and proper child restraints, even with air bags. Children are safer when properly secured in a rear seat. See the Owner's Manual for more safety information.** **2 - Always use safety belts and proper child restraints, even with air bags. Children are safer when properly secured in a rear seat. See the Owner's Manual for more safety information.**	A[1]	A[1]	A[2]
B50		**Regular production accessory**, Premium floormats, front and rear, includes thicker mats and HHR embroidery (SPO-supplied, dealer-installed)	--	A	A
B41		**Regular production accessory**, Premium cargo mat, rear, includes thicker mat and HHR embroidery (SPO-supplied, dealer-installed)	--	A	A
UE1		**OnStar**, 1-year Safe and Sound Service, includes automatic notification of air bag deployment, stolen vehicle tracking, emergency services, roadside assistance, remote door unlock, remote horn and lights, GM Goodwrench remote diagnostics, AccidentAssist and online concierge. Drivers can also obtain the available voice-activated, hands-free personal calling service and virtual advisor that provides location-based traffic and weather reports and other personalized information. **1 - Retail orders require (ASF) Air bags, side head curtain, (US8) Sound system, ETR AM/FM stereo with CD player and MP3 playback and (JM4) Brakes, 4-wheel antilock. Includes (DD8) Mirror, inside rearview, auto-dimming. Fleet orders require (ASF) Air bags, side head curtain and (JM4) Brakes, 4-wheel antilock. Includes (DD8) Mirror, inside rearview, auto-dimming. Visit onstar.com for system information and details. Not available with a ship-to of Puerto Rico or the Virgin Islands.** **2 - Requires (ASF) Air bags, side head curtain and (JM4) Brakes, 4-wheel antilock.. Includes (DD8) Mirror, inside rearview, auto-dimming. Visit onstar.com for system information and details. Not available with a ship-to of Puerto Rico or the Virgin Islands.** **3 - Requires (ASF) Air bags, side head curtain. Includes (DD8) Mirror, inside rearview, auto-dimming. Visit onstar.com for system information and details. Not available with a ship-to of Puerto Rico or the Virgin Islands.**	A[1]	A[2]	A[3]
ATY		**Rear seat delete** **1 - Not available at start of production. Requires a Fleet or Federal Government order type and Cloth interior trim (14B) Gray. Not available with (NP5) Steering wheel, leather-wrapped, (CF5) Sunroof, power, (DD8) Mirror, inside rearview, auto-dimming, (ASF) Air bags, side head curtain and (UE1) OnStar.**	A[1]	--	--
		Remote vehicle starter system delete **1 - Requires Fleet order types (FBC), (FDR), (FLS) or Federal Government order type (SGO).**	A[1]	A[1]	A[1]
**2		**Seats**, leather seating surfaces, includes (KA1) Seats, heated, driver and front passenger **1 - Includes (NP5) Steering wheel, leather-wrapped with mounted audio controls and (VY7) Shift knob, leather-wrapped.**	--	A[1]	A

ADDITIONAL OPTIONS					
Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
AJ6		**Seat adjuster**, power, driver 8-way (fore/aft, height adjuster, seat cushion tilt, lumbar and manual recline) and manual passenger, 4-way (fore/aft and recline) **1 - Requires a Fleet or Federal Government order type.**	A[1]	S	S
DT4		**Smoker's Package**	A	A	A
US8		**Sound system,** ETR AM/FM stereo with CD player and MP3 playback, includes Radio Data System, seek-and-scan, digital clock, auto-tone control, automatic volume, TheftLock and auxiliary input jack **1 - Retail orders require (UE1) OnStar or (U2K) Sound system feature, XM Satellite Radio.**	A[1]	S	S
US9		**Sound system,** ETR AM/FM stereo with 6-disc CD changer, in-dash and MP3 playback, includes Radio Data System, seek-and-scan, digital clock, auto-tone control, automatic volume and TheftLock	--	A	A
UQ3		**Sound system feature,** 7-speakers, Pioneer premium amplified system with tweeters and rear subwoofer speaker **1 - Requires (U2K) Sound system feature, XM Satellite Radio and (US8) Sound system, ETR AM/FM stereo with CD player.**	A[1]	A	■
U2K		**Sound system feature,** XM Satellite Radio features 67 channels of 100% commercial-free music included in its over 150 channels of the best in music, news, sports, talk, comedy, XM Instant Traffic and Weather, and more. Digital quality sound with coast-to-coast signal coverage. Three trial months - no obligation. **1 - Retail orders require (US8) Sound system, ETR AM/FM stereo with CD player and MP3 playback and (UQ3) Sound system feature, 7-speakers. Subscription fees apply. Available only in the 48 contiguous U.S.** **2 - Requires (UQ3) Sound system feature, 7-speakers. Subscription fees apply. Available only in the 48 contiguous U.S.** **3 - Subscription fees apply. Available only in the 48 contiguous U.S.**	A[1]	A[2]	A[3]
CF5		**Sunroof,** power	--	A	A
T37		**Fog lamps,** front	--	A	■
VK3		**License plate front mounting package**	A	A	A
BVE		**Regular production accessory**, Running boards, color-keyed to exterior (SPO-supplied, dealer-installed)	A	A	A
Q8H		**Regular production accessory,** Splash guards, molded, front and rear (SPO-supplied, dealer-installed)	A	A	A
VGG		**Regular production accessory**, Step pad, applied to rear bumper	A	A	A
T43		**Regular production accessory**, Spoiler, rear (SPO-supplied, dealer-installed) **1 - Only available with exterior colors (41U) Black, (63U) Sport Red Metallic, (67U) Silverstone Metallic or (69U) Daytona Blue Metallic.**	--	A[1]	A[1]
B57		**Bright Chrome Appearance Package**, includes bright chrome grille, outside mirrors, liftgate applique, door handles and roof-mounted side rails (when equipped)	--	A	■
G63		**Side rails**, roof mounted	--	A	A

ADDITIONAL OPTIONS					
Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
QG9		**Wheels,** 16" (40.6 cm), aluminum, machined-face **1 - Requires a Fleet or Federal Government order type.**	A[1]	S	--
QP2		**Wheels**, 17" (43.2 cm), forged aluminum, high polished	--	--	A
R6X		**(QP2) Wheels not desired**	--	--	A
JM4		**Brakes,** 4-wheel antilock, front disc/rear drum **1 - Required when (UE1) OnStar is ordered.**	A[1]	A[1]	■
FE9		**Emissions,** Federal requirements	A	A	A
NE1		**Emissions,** Maine, Massachusetts, New York or Vermont state requirements	A	A	A
YF5		**Emissions,** California state requirements	A	A	A
NB8		**Emissions override**, California, Massachusetts or New York (for vehicles ordered by dealers in states of California, Massachusetts or New York with Federal emissions) **1 - Requires (FE9) Emissions, Federal requirements.**	A[1]	A[1]	A[1]
NC7		**Emissions override,** Federal (for vehicles ordered by dealers in Federal emission states with California, New York, Vermont, Massachusetts or Maine emissions; may also be used by dealers in states of California, New York, Vermont, Massachusetts or Maine to order different state-specific emissions) **1 - Requires (YF5) Emissions, California state requirements or (NE1) Emissions, New York, Vermont, Massachusetts or Maine state requirements.**	A[1]	A[1]	A[1]
VCL		**Emissions Certification,** CFF (Clean Fuel Fleet) LEV (Low Emission Vehicle). Option (VCL) should ONLY be ordered to receive the CFF LEV certification. If (VCL) is not ordered, the vehicle will be produced with your normally selected emission system and may not be CFF LEV certified. Products ordered with the (VCL) option may not be certified to California emission requirements. Therefore, they may not be legal for registration in California, New York, Maine, Massachusetts and Vermont. Option (YF5) should be ordered for all vehicles ordered in California. Option (NE1) should be ordered for all vehicles ordered in Maine or Vermont. **1 - Requires (NB8) Emissions override, California, Massachusetts or New York. Not available in Vermont or Maine.**	A[1]	A[1]	A[1]
LE5		**Engine**, ECOTEC 2.4L DOHC, 4-cylinder, SFI, (172 HP [128.3 kW] @ 6200 rpm, 162 lb-ft [218.7 N-m] @ 5000 rpm)	--	A	■
K05		**Engine block heater**	A	A	A
MX0		**Transmission,** 4-speed automatic, includes (AP3) Remote vehicle starter system **1 - If the following order types (FBC), (FLS), (FDR) or (FGO) are ordered, (AP3) Remote vehicle starter system will not be included.**	A[1]	A[1]	A[1]

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Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
JM4		**Brakes,** 4-wheel antilock, front disc/rear drum			■
B57		**Bright Chrome Appearance Package**			■
LE5		**Engine**, ECOTEC 2.4L DOHC, 4-cylinder, SFI			■
		Exhaust			■
T37		**Fog lamps,** front			■
	DD8	**Mirror,** inside rearview			■
		Mirrors, outside rearview			■
	VY7	**Shift knob,** leather-wrapped			■
UQ3		**Sound system feature,** 7-speakers			■
	NP5	**Steering wheel,** leather-wrapped			■
	FE3	**Suspension**, Sport			■
		Tires, P215/50R17, all-season, blackwall			■
		Wheels, 17" (43.2 cm) aluminum			■

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Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
		Air bags, frontal, driver and right front passenger **1 - Always use safety belts and proper child restraints, even with air bags. Children are safer when properly secured in a rear seat. See the Owner's Manual for more safety information.**	S[1]	S[1]	S[1]
ASF		**Air bags,** side head curtain, front and rear **1 - Requires (JM4) Brakes, 4-wheel antilock, front disc/rear drum. Always use safety belts and proper child restraints, even with air bags. Children are safer when properly secured in a rear seat. See the Owner's Manual for more safety information.** **2 - Always use safety belts and proper child restraints, even with air bags. Children are safer when properly secured in a rear seat. See the Owner's Manual for more safety information.**	A[1]	A[1]	A[2]
		Air conditioning	S	S	S
		Cargo convenience net, trunk	S	S	S
		Console, floor, includes dual power outlets and dual front and rear cupholders	S	S	S
		Cruise control	S	S	S
		Defogger, rear-window, electric	S	S	S
		Door locks, power	S	S	S
		Door locks, child security, rear	S	S	S
		Driver Information Center	S	S	S
		Floormats, carpeted, front and rear	S	S	S
		Floormat, carpeted, cargo area	S	S	S
		Glovebox, auxiliary	S	S	S
B50		**Regular production accessory**, Premium floormats, front and rear, includes thicker mats and HHR embroidery (SPO-supplied, dealer-installed)	--	A	A
B41		**Regular production accessory**, Premium cargo mat, rear, includes thicker mat and HHR embroidery (SPO-supplied, dealer-installed)	--	A	A
		Keyless entry, remote (RKE)	S	S	S
		LATCH system, (Lower Anchors and Top tethers for CHildren)	S	S	S
		Map pocket, driver seatback	S	S	S
	DD8	**Mirror,** inside rearview, auto dimming with compass **1 - Included and only available with (UE1) OnStar.**	A[1]	A[1]	■

Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
UE1		**OnStar**, 1-year Safe and Sound Service, includes automatic notification of air bag deployment, stolen vehicle tracking, emergency services, roadside assistance, remote door unlock, remote horn and lights, GM Goodwrench remote diagnostics, AccidentAssist and online concierge. Drivers can also obtain the available voice-activated, hands-free personal calling service and virtual advisor that provides location-based traffic and weather reports and other personalized information. **1 - Retail orders require (ASF) Air bags, side head curtain, (US8) Sound system, ETR AM/FM stereo with CD player and MP3 playback and (JM4) Brakes, 4-wheel antilock. Includes (DD8) Mirror, inside rearview, auto-dimming. Fleet orders require (ASF) Air bags, side head curtain and (JM4) Brakes, 4-wheel antilock. Includes (DD8) Mirror, inside rearview, auto-dimming. Visit onstar.com for system information and details. Not available with a ship-to of Puerto Rico or the Virgin Islands.** **2 - Requires (ASF) Air bags, side head curtain and (JM4) Brakes, 4-wheel antilock.. Includes (DD8) Mirror, inside rearview, auto-dimming. Visit onstar.com for system information and details. Not available with a ship-to of Puerto Rico or the Virgin Islands.** **3 - Requires (ASF) Air bags, side head curtain. Includes (DD8) Mirror, inside rearview, auto-dimming. Visit onstar.com for system information and details. Not available with a ship-to of Puerto Rico or the Virgin Islands.**	A[1]	A[2]	A[3]
ATY		**Rear seat delete** **1 - Not available at start of production. Requires a Fleet or Federal Government order type and Cloth interior trim (14B) Gray. Not available with (NP5) Steering wheel, leather-wrapped, (CF5) Sunroof, power, (DD8) Mirror, inside rearview, auto-dimming, (ASF) Air bags, side head curtain and (UE1) OnStar.**	A[1]	--	--
	AP3	**Remote vehicle starter system** **1 - Included and only available with (MX0) Transmission, 4-speed automatic for retail orders only. If ordering order types (FLS), (FBC), (FDR) and (FGO), must order (AP3) and (MX0) Transmission, 4-speed automatic if remote start is desired.**	A[1]	A[1]	A[1]
		Remote vehicle starter system delete **1 - Requires Fleet order types (FBC), (FDR), (FLS) or Federal Government order type (SGO).**	A[1]	A[1]	A[1]
		Safety belts, 3-point, front, height-adjustable	S	S	S
		Seats, front Cloth buckets, includes 60/40 split-folding rear seat	S	S	S
**2		**Seats**, leather seating surfaces, includes (KA1) Seats, heated, driver and front passenger **1 - Includes (NP5) Steering wheel, leather-wrapped with mounted audio controls and (VY7) Shift knob, leather-wrapped.**	--	A[1]	A
		Seat adjuster, manual, driver 6-way (fore/aft, height adjuster and recline) and passenger 4-way (fore/aft and recline)	S	--	--
AJ6		**Seat adjuster**, power, driver 8-way (fore/aft, height adjuster, seat cushion tilt, lumbar and manual recline) and manual passenger, 4-way (fore/aft and recline) **1 - Requires a Fleet or Federal Government order type.**	A[1]	S	S
		Seat, front passenger, flat-folding	S	S	S
	VY7	**Shift knob,** leather-wrapped **1 - Included and only available with (**2) Seats, Leather seating surfaces.**	--	A[1]	■
DT4		**Smoker's Package**	A	A	A

Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
	U1C	**Sound system,** ETR AM/FM stereo with CD player, includes seek-and-scan and digital clock	S	--	--
US8		**Sound system,** ETR AM/FM stereo with CD player and MP3 playback, includes Radio Data System, seek-and-scan, digital clock, auto-tone control, automatic volume, TheftLock and auxiliary input jack **1 - Retail orders require (UE1) OnStar or (U2K) Sound system feature, XM Satellite Radio.**	A[1]	S	S
US9		**Sound system,** ETR AM/FM stereo with 6-disc CD changer, in-dash and MP3 playback, includes Radio Data System, seek-and-scan, digital clock, auto-tone control, automatic volume and TheftLock	--	A	A
		Sound system feature, 6-speakers	S	S	--
UQ3		**Sound system feature,** 7-speakers, Pioneer premium amplified system with tweeters and rear subwoofer speaker **1 - Requires (U2K) Sound system feature, XM Satellite Radio and (US8) Sound system, ETR AM/FM stereo with CD player.**	A[1]	A	■
U2K		**Sound system feature,** XM Satellite Radio features 67 channels of 100% commercial-free music included in its over 150 channels of the best in music, news, sports, talk, comedy, XM Instant Traffic and Weather, and more. Digital quality sound with coast-to-coast signal coverage. Three trial months - no obligation. **1 - Retail orders require (US8) Sound system, ETR AM/FM stereo with CD player and MP3 playback and (UQ3) Sound system feature, 7-speakers. Subscription fees apply. Available only in the 48 contiguous U.S.** **2 - Requires (UQ3) Sound system feature, 7-speakers. Subscription fees apply. Available only in the 48 contiguous U.S.** **3 - Subscription fees apply. Available only in the 48 contiguous U.S.**	A[1]	A[2]	A[3]
		Steering column, tilt	S	S	S
	N24	**Steering wheel**, urethane, includes switches for DIC and cruise controls	S	S	--
	NP5	**Steering wheel,** leather-wrapped, with mounted audio controls **1 - Included and only available with (**2) Seats, Leather seating surfaces.**	--	A[1]	■
CF5		**Sunroof,** power	--	A	A
		Theft-deterrent system, PASS-Key III+	S	S	S
		Windows, power	S	S	S

S = Standard Equipment A = Available -- (dashes) = Not Available
■ = Included in Equipment Group □ = Included in Equipment Group but upgradeable

*Indicates availability of feature on multiple models. For example, it indicates feature availability on 2WD and 4WD Models or Rear wheel drive and All-wheel drive Models.

Codes listed in the shaded column titled Ref. Only RPO Code are for internal use only and should not be ordered.

Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
		Daytime running lamps	S	S	S
T37		**Fog lamps,** front	--	A	■
		Glass, deep-tint, 2nd row doors, quarter windows and rear	S	S	S
VK3		**License plate front mounting package**	A	A	A
		Mirrors, outside rearview, power, Black	S	--	--
		Mirrors, outside rearview, power, with satin chrome cap	--	S	--
		Mirrors, outside rearview, power, with bright chrome cap **1 - Included and only available with (B57) Bright Chrome Appearance Package.**	--	A[1]	■
BVE		**Regular production accessory**, Running boards, color-keyed to exterior (SPO-supplied, dealer-installed)	A	A	A
Q8H		**Regular production accessory,** Splash guards, molded, front and rear (SPO-supplied, dealer-installed)	A	A	A
VGG		**Regular production accessory**, Step pad, applied to rear bumper	A	A	A
T43		**Regular production accessory**, Spoiler, rear (SPO-supplied, dealer-installed) **1 - Only available with exterior colors (41U) Black, (63U) Sport Red Metallic, (67U) Silverstone Metallic or (69U) Daytona Blue Metallic.**	--	A[1]	A[1]
		Satin Chrome Appearance Package, includes satin chrome grille, outside mirrors, liftgate applique, door handles and roof-mounted side rails (when equipped) **1 - Does not include outside mirrors or side rails.**	S[1]	S	--
B57		**Bright Chrome Appearance Package**, includes bright chrome grille, outside mirrors, liftgate applique, door handles and roof-mounted side rails (when equipped)	--	A	■
G63		**Side rails**, roof mounted	--	A	A
		Tires, P215/55R16, all-season, blackwall	S	S	--
		Tires, P215/50R17, all-season, blackwall	--	--	■
		Wheels, 16" (40.6 cm) steel, includes full bolt-on wheel covers	S	--	--
QG9		**Wheels,** 16" (40.6 cm), aluminum, machined-face **1 - Requires a Fleet or Federal Government order type.**	A[1]	S	--
		Wheels, 17" (43.2 cm) aluminum, painted	--	--	■
QP2		**Wheels**, 17" (43.2 cm), forged aluminum, high polished	--	--	A
R6X		**(QP2) Wheels not desired**	--	--	A

Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
		Wiper, rear	S	S	S
		Wipers, front, intermittent, speed-sensitive	S	S	S

S = Standard Equipment A = Available -- (dashes) = Not Available
■ = Included in Equipment Group □ = Included in Equipment Group but upgradeable

*Indicates availability of feature on multiple models. For example, it indicates feature availability on 2WD and 4WD Models or Rear wheel drive and All-wheel drive Models.

Codes listed in the shaded column titled Ref. Only RPO Code are for internal use only and should not be ordered.

Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
		Battery rundown protection	S	S	S
	J41	**Brakes,** front disc/rear drum	S	S	--
JM4		**Brakes,** 4-wheel antilock, front disc/rear drum **1 - Required when (UE1) OnStar is ordered.**	A[1]	A[1]	■
FE9		**Emissions,** Federal requirements	A	A	A
NE1		**Emissions,** Maine, Massachusetts, New York or Vermont state requirements	A	A	A
YF5		**Emissions,** California state requirements	A	A	A
NB8		**Emissions override**, California, Massachusetts or New York (for vehicles ordered by dealers in states of California, Massachusetts or New York with Federal emissions) **1 - Requires (FE9) Emissions, Federal requirements.**	A[1]	A[1]	A[1]
NC7		**Emissions override,** Federal (for vehicles ordered by dealers in Federal emission states with California, New York, Vermont, Massachusetts or Maine emissions; may also be used by dealers in states of California, New York, Vermont, Massachusetts or Maine to order different state-specific emissions) **1 - Requires (YF5) Emissions, California state requirements or (NE1) Emissions, New York, Vermont, Massachusetts or Maine state requirements.**	A[1]	A[1]	A[1]
VCL		**Emissions Certification,** CFF (Clean Fuel Fleet) LEV (Low Emission Vehicle). Option (VCL) should ONLY be ordered to receive the CFF LEV certification. If (VCL) is not ordered, the vehicle will be produced with your normally selected emission system and may not be CFF LEV certified. Products ordered with the (VCL) option may not be certified to California emission requirements. Therefore, they may not be legal for registration in California, New York, Maine, Massachusetts and Vermont. Option (YF5) should be ordered for all vehicles ordered in California. Option (NE1) should be ordered for all vehicles ordered in Maine or Vermont. **1 - Requires (NB8) Emissions override, California, Massachusetts or New York. Not available in Vermont or Maine.**	A[1]	A[1]	A[1]
	L61	**Engine,** ECOTEC 2.2L DOHC, 16-valve, 4-cylinder, SFI (143 HP [106.6 kW] @ 6000 rpm, 155 lb.-ft. [209.3 N-m] @ 4000 rpm)	S	S	--
LE5		**Engine**, ECOTEC 2.4L DOHC, 4-cylinder, SFI, (172 HP [128.3 kW] @ 6200 rpm, 162 lb-ft [218.7 N-m] @ 5000 rpm)	--	A	■
K05		**Engine block heater**	A	A	A

Free Flow RPO Code	Ref. Only RPO Code	Description	LS 1AT46	LT 1AS46	
			1LS	1LT	2LT
		Exhaust tip, 3.5" chrome, bright **1 - Included and only available with (LE5) Engine, ECOTEC 2.4L DOHC.**	--	A[1]	■
		Steering, electric, variable	S	S	S
	FE1	**Suspension**, Touring	S	S	--
	FE3	**Suspension**, Sport	--	--	■
	NW7	**Traction Control,** all-speed **1 - Included and only available with (JM4) Brakes, 4-wheel antilock, front disc/rear drum and (MX0) Transmission, 4-speed automatic.** **2 - Included and only available with (MX0) Transmission, 4-speed automatic.**	A[1]	A[1]	A[2]
	MM5	**Transmission,** 5-speed manual	S	S	S
MX0		**Transmission,** 4-speed automatic, includes (AP3) Remote vehicle starter system **1 - If the following order types (FBC), (FLS), (FDR) or (FGO) are ordered, (AP3) Remote vehicle starter system will not be included.**	A[1]	A[1]	A[1]

S = Standard Equipment A = Available – (dashes) = Not Available
■ = Included in Equipment Group □ = Included in Equipment Group but upgradeable

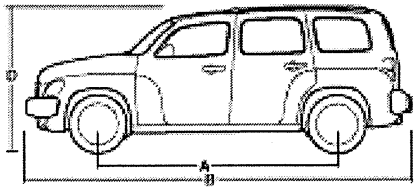
*Indicates availability of feature on multiple models. For example, it indicates feature availability on 2WD and 4WD Models or Rear wheel drive and All-wheel drive Models.

Decor Level	Seat Type	Seat Code	Seat Trim	Interior	
				Gray	Cashmere
LS, LT	Front bucket	AR9	Cloth	14B	32B
LT	Front bucket	AR9	Leather Seating Surfaces	142	322

Exterior Solid Paint	Color Code	Touch Up Paint Number	Interior	
			Gray	Cashmere
Sandstone Metallic	15U	WA-929L	--	A
Black	41U	WA-8555	A	A
Dark Silver Metallic	42U	WA-911L	A	A
Summit White[1]	50U	WA-8624	A	A
Sunburst Orange II Metallic	56U	WA-913L	A	A
Sport Red Metallic	63U	WA-817K	A	A
Silverstone Metallic	67U	WA-994L	A	A
Daytona Blue Metallic	69U	WA-304N	A	A
Majestic Amethyst Metallic	84U	WA-111B	A	--

1 - Not available until late summer.

All dimensions in inches (mm) unless otherwise stated.



	Specifications	1AT46 LS	1AS46 LT
A	**Wheelbase**	103.50 (2629)	103.50 (2629)
B	**Overall length**	176.20 (4475)	176.20 (4475)
C	**Body width**	69.10 (1755)	69.10 (1755)
D	**Overall height**	63.10 (1603)	63.10 (1603)
	Front track width	58.70 (1491)	58.70 (1491)
	Rear track width	58.70 (1491)	58.70 (1491)
	Head room, front	39.60 (1006)	39.60 (1006)
	Head room, rear	39.00 (991)	39.00 (991)
	Shoulder room, front	53.50 (1359)	53.50 (1359)
	Shoulder room, rear	52.70 (1339)	52.70 (1339)
	Leg room, front	40.60 (1031)	40.60 (1031)
	Leg room, rear	39.50 (1003)	39.50 (1003)

Published dimensions indicated are without optional equipment or accessories. Additional accessories or equipment ordered at the customer's request can result in a minor change in these dimensions.

	1AT46 LS	1AS46 LT
Capacities		
Fuel capacity, approximate, gallon (liters)	16 (61)	16 (61)
Seating capacity, max. (front/rear)	2/3	2/3

	**Wheels,** 16" (40.6 cm) steel, includes full bolt-on wheel covers
	QG9 **Wheels,** 16" (40.6 cm), aluminum, machined-face
	QP2 **Wheels**, 17" (43.2 cm), forged aluminum, high polished
	**Wheels**, 17" (43.2 cm) aluminum, painted

	U1C **Sound system,** ETR AM/FM stereo with CD player, includes seek-and-scan and digital clock
	US8 **Sound system,** ETR AM/FM stereo with CD player and MP3 playback, includes Radio Data System, seek-and-scan, digital clock, auto-tone control, automatic volume, TheftLock and auxiliary input jack
	US9 **Sound system,** ETR AM/FM stereo with 6-disc CD changer, in-dash and MP3 playback, includes Radio Data System, seek-and-scan, digital clock, auto-tone control, automatic volume and TheftLock

Option Code	Description
**2	Seats, leather seating surfaces
AJ6	Seat adjuster, power, driver 8-way
AP3	Remote vehicle starter system
ASF	Air bags, side head curtain
ATY	Rear seat delete
B41	Regular production accessory, Premium cargo mat
B50	Regular production accessory, Premium floormats
B57	Bright Chrome Appearance Package
BVE	Regular production accessory, Running boards
CF5	Sunroof, power
DD8	Mirror, inside rearview
DT4	Smoker's Package
FE1	Suspension, Touring
FE3	Suspension, Sport
FE9	Emissions, Federal requirements
G63	Side rails, roof mounted
J41	Brakes, front disc/rear drum
JM4	Brakes, 4-wheel antilock, front disc/rear drum
K05	Engine block heater
L61	Engine, ECOTEC 2.2L DOHC,
LE5	Engine, ECOTEC 2.4L DOHC, 4-cylinder, SFI
MM5	Transmission, 5-speed manual
MX0	Transmission, 4-speed automatic
N24	Steering wheel
NB8	Emissions override
NC7	Emissions override, Federal
NE1	Emissions, Maine, Massachusetts, New York or Vermont state requirements
NP5	Steering wheel, leather-wrapped
NW7	Traction Control, all-speed
Q8H	Regular production accessory, Splash guards
QG9	Wheels, 16" (40.6 cm)
QP2	Wheels, 17" (43.2 cm), forged aluminum, high polished
R6X	(QP2) Wheels not desired
T37	Fog lamps, front
T43	Regular production accessory, Spoiler, rear
U1C	Sound system, ETR AM/FM stereo with CD player
U2K	Sound system feature, XM Satellite Radio
UE1	OnStar
UQ3	Sound system feature, 7-speakers
US8	Sound system, ETR AM/FM stereo with CD player and MP3 playback
US9	Sound system, ETR AM/FM stereo with 6-disc CD changer, in-dash
VCL	Emissions Certification, CFF (Clean Fuel Fleet) LEV (Low Emission Vehicle).
VGG	Regular production accessory, Step pad
VK3	License plate front mounting package
VY7	Shift knob, leather-wrapped
YF5	Emissions, California state requirements