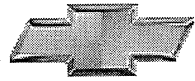
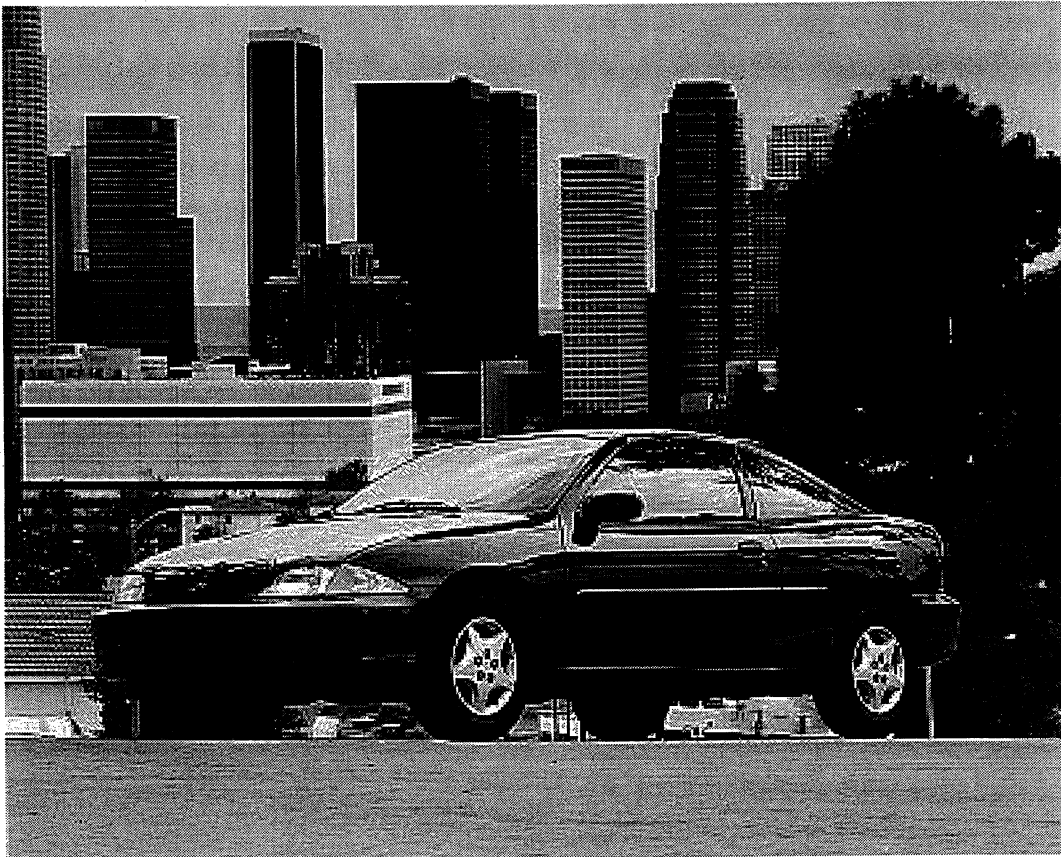


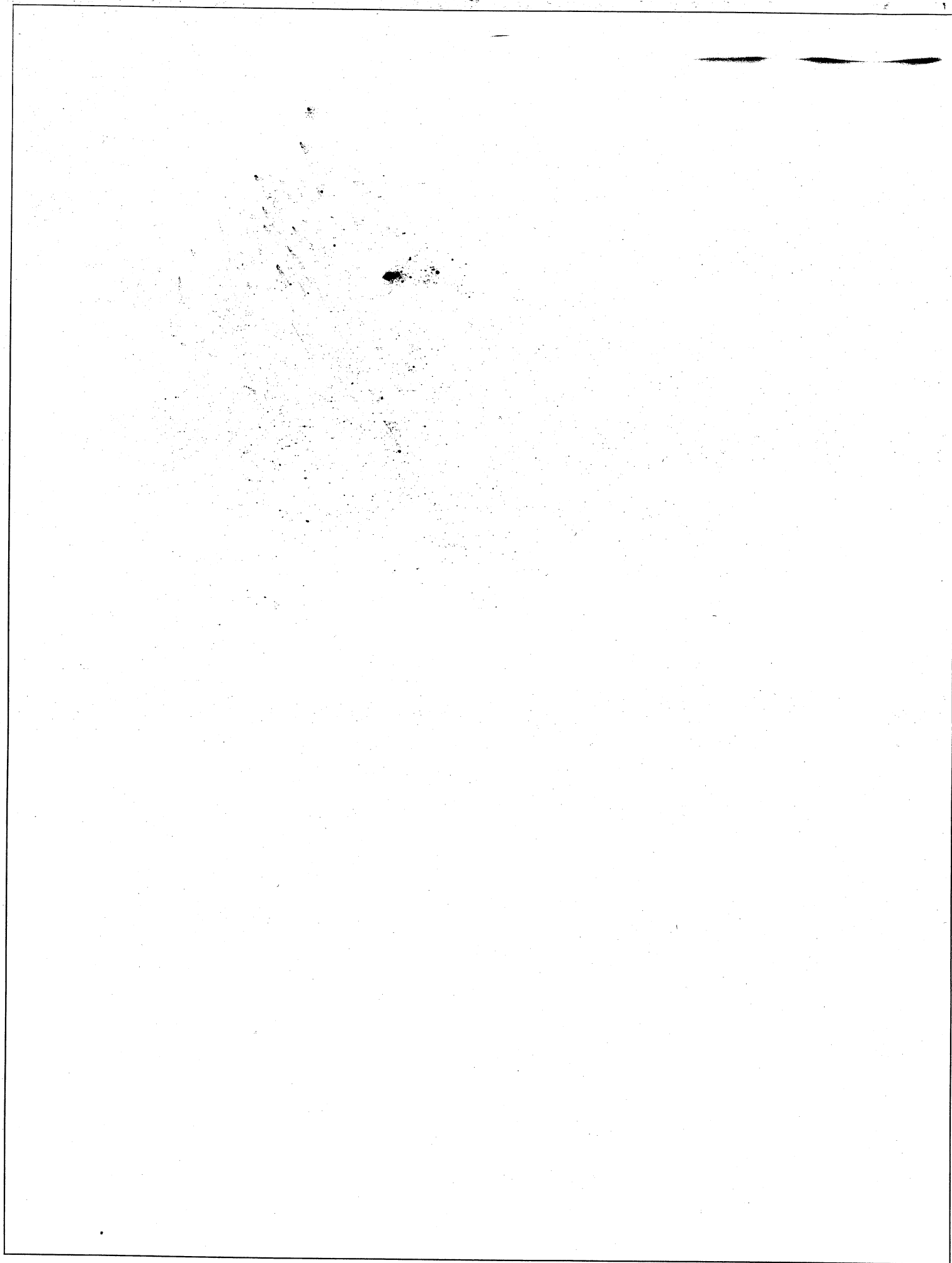
# Chevrolet



# Cavalier



# 2000



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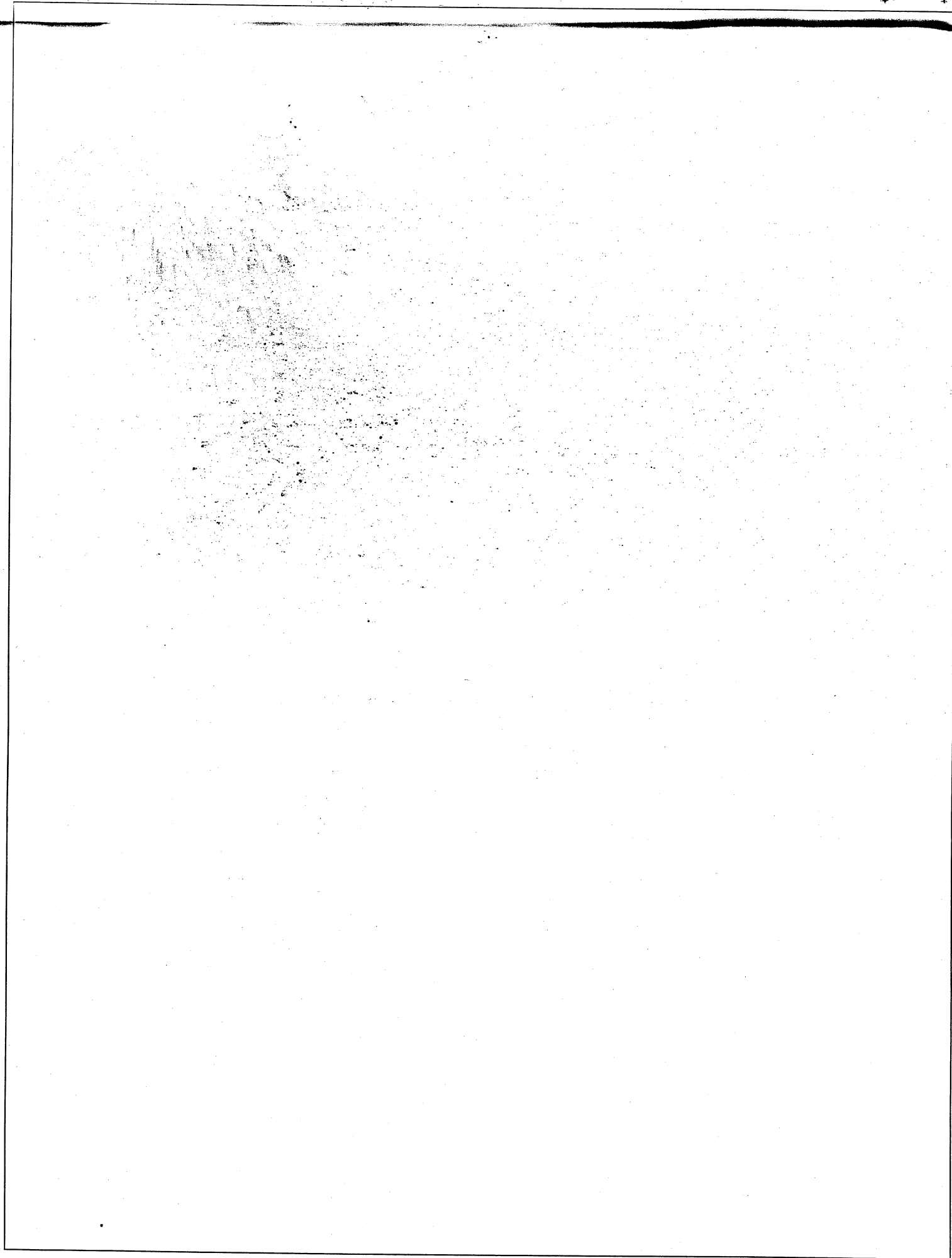
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## Product Information

### Many New Features Enhance 2000 Cavalier

**DETROIT** — Chevrolet Cavalier receives a fresh new look for the 2000 model year along with a number of exterior, interior, mechanical and electrical enhancements.

"The more you know about Cavalier, the better it looks," said Steve Wagg, Chevrolet Cavalier brand manager. "We're enhancing the look and features of Cavalier to help it maintain its number one status for General Motors as the corporation's best-selling car line for 12 of the last 16 years."

For 2000, Cavalier models include a Coupe, Sedan, LS Sedan, Z24 Coupe and Z24 Convertible.

Chevy consumer research reveals that Cavalier owners take pride in the exterior styling of their cars. So Chevy designers enhanced the Cavalier look for the 2000 model year with new body-color fascias on all models, attractive new taillamps and forward-lighting headlamp lenses. Other new exterior enhancements include:

- 14- and 15-inch wheel covers
- 15- and 16-inch aluminum wheels
- Z24 rear spoiler with more aggressive appearance than previous model
- Hood and decklid Chevrolet "bowtie" badges.

Two new colors have been added for 2000 as well: Dark Colorado Green Metallic and Ultra Silver Metallic.

Cavalier's passenger environment has been improved with a number of thoughtful enhancements that make for more comfortable traveling. Features like a new instrument cluster, with high accuracy gauges, and an illuminated automatic shift indicator plate in the center console make it easy for the driver to monitor vital vehicle readings.

For 2000, Cavalier has a new line of radios. On the uplevel sound system, Radio Data System (RDS) technology is a standard feature. This new technology permits traffic and weather bulletins to interrupt radio, cassette and CD programming so important information won't be missed. Also, at the push of a button, it can switch the radio's clock to the correct time when changing time zones. All radios in Cavalier have thoughtfully been relocated above the HVAC controls for improved ergonomics and have increased power by 20 watts per channel.

Other new audio features include:

- Automatic radio theft-deterrent system with flashing LED (light-emitting diode) on the uplevel system
- New delayed radio operation continues to play the radio until the driver door is opened or ten minutes after the vehicle's ignition is turned off
- Optional dual-play cassette and CD player.

It seems a car can never have enough cup holders, that's why Cavalier engineers designed three cup holders into the new center console (one of which is removable and can accommodate today's "super-size" drinks) and two in the rear-seat armrest. The new center console also features a convenient coin holder and designated slots for audio cassettes and CD storage.

Functionally, a new standard antilock braking system has been incorporated to provide smoother operation when needed. A new manual transmission and shifter has a more precise shift feel and a smoother shift into reverse. And both Cavalier engines — the standard 2.2 liter L4 and optional 2.4 liter twin cam — have new Multec II fuel injectors for improved driveability, emissions and reliability. Traction Control is also available with the four-speed automatic transmission.

Electrical changes include a new content theft security alarm system packaged with the optional Remote Keyless Entry and power door locks. The new remote key fob includes a panic button, which blows the horn and flashes the interior dome light and exterior Daytime Running Lamps (DRL). A lockout protection feature, on vehicles with power door locks, prevents accidental lockout when the key is in the ignition.

Along with young, first-time buyers, Cavalier largely attracts women buyers who make up nearly 70 percent of its buyers. Safety is generally an important consideration for these individuals when shopping for a new vehicle. Cavalier meets that need with many standard safety and security features, including:

- Four-wheel, antilock braking system (ABS)
- Dual air bags\*
- Daytime Running Lamps (DRL)
- Reinforced safety-cage construction
- Child security rear-door locks (Sedan only)
- Adjustable upper safety belt anchors
- Power window lockout (Sedan only)
- Battery-rundown protection
- PASSlock® II theft-deterrent system
- Theatre lighting.

A few other standard features on 2000 Cavalier include:

- Air conditioning
- Rear window defogger
- Breakaway outside rearview mirrors, platinum-tip spark plugs that last up to 100,000 miles† and extended-life coolant that does not need to be changed for five years or 150,000 miles†.

### **Chevy Cavalier Convertible by BCBG Max Azria**

The Chevy Cavalier Convertible styled by BCBG's Max Azria is a one-of-a-kind concept vehicle that reflects the designer's "Bon Chic, Bon Genre" (good style, good attitude), sleek and simple design sensibility. It features a brushed-nickel exterior paint treatment and a white, Corvette-quality convertible top. Inside, white leather seats, a dashboard and carpet in graphite tones, and a satin-nickel finish on the gearshift create the feel of an ultimate cruising convertible. Retro rear wheel skirts complete the BCBG Cavalier Convertible's contemporary, yet timeless, look.

Designing the Cavalier was both a rewarding and educational experience for Azria. "I was surprised to see the design process GM uses for cars is exactly the same as the one we use for garments. So, I approached designing the Cavalier in the same way I do my designs: by getting to know my customer and studying what she wants."

Steve Wagg, Cavalier brand manager, said Azria is an ideal fit for the car. "Cavalier drivers are very style-conscious and trendsetting," said Wagg. "Max is one of the major trendsetters in American fashion. He encompasses all that is modern."

\* 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.

† Maintenance needs vary with different uses and driving conditions. See owner's manual for more information.



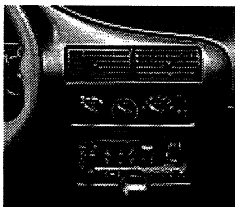
## What's New And Highlights

### Interior

- Redesigned instrument panel cluster
- High accuracy instrument panel gauges
- Center console with three front cup holders and two cup holders in the armrest for rear passengers
- Coin holder, cassette and CD storage in console
- Illuminated automatic transmission shift indicator in center console
- Radio is relocated above the HVAC controls for improved ergonomics
- Radio has increased power output to 50 watts (80 watts on uplevel dual playback compact disc and cassette systems)
- Redesigned radio face plate and controls
- Ashtray and cigarette lighter available as a dealer-installed accessory
- Air conditioning becomes standard on all models
- Recall odometer and radio displays without ignition "on"
- Low fuel and high coolant temperature warning through the check gauges telltale
- Radio Data System (RDS) with auto clock synchronization available with uplevel radio systems
- Automatic radio theft system with flashing LED (up-level system)
- Delayed Radio Operation feature provides continuous radio play when ignition is turned-off until driver door is open or after ten minutes elapsed time
- Available dual-play cassette and compact disc player
- Available value-priced compact disc player.

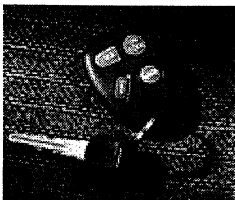
### Exterior

- Body-color painted fascias on all models
- Clear lens headlamp design with improved illumination relative to previous model
- New exterior colors: Dark Colorado Green Metallic and Ultra Silver Metallic
- 14" and 15" wheel covers
- 15" and 16" aluminum wheels
- Z24 rear spoiler features a more aggressive appearance
- New exterior badging.



### Sound Systems

Cavalier provides improved sound systems, some of which include the Radio Data System (RDS) that, when properly equipped, provides important traffic and weather information.



### Remote Keyless Entry System

The Remote Keyless Entry system now includes an anti-lockout protection feature to help prevent keys from being locked inside the vehicle.

### Safety and Security

- Standard solenoid-based antilock braking system for smoother operation and improved response relative to previous models
- Available PASSlock® II security system

## 2000 Chevrolet Cavalier Restoration Kit

- Remote Keyless Entry features an anti-lockout protection feature and a panic/car-locator button
- Rear defogger is standard on all models
- Enhanced content theft security system features anti-theft alarm and power door locks (standard with Remote Keyless Entry system).

### Engines

- Body function computer with improved diagnostics for easy maintenance relative to previous models
- Fuel pump provides quieter performance and enhanced reliability (interim release) relative to previous models
- Increased engine cooling performance

### Models

- Cavalier Coupe
- Cavalier Sedan
- Cavalier LS Sedan
- Cavalier Z24 Coupe
- Cavalier Z24 Convertible (available through December, 1999).

### Marketplace

Cavalier is GM's passenger-car volume leader. Surprisingly equipped with many standard features, Cavalier offers value to the small car buyer. It's the kind of car for young-minded people with purchasing savvy who want a more attractive, high quality small vehicle.

The focus for 2000 Cavalier is on young, first-time car buyers female buyers in particular. This market is looking for dependable and reliable transportation, high value and a reasonable price.

### Competitors

- Ford Escort
- Plymouth/Dodge Neon
- Honda Civic

### Buyer Demographics

#### Coupe:

Median Age:	26 Years
Median Income:	\$45,000
Married:	32%
College Graduate:	35%
Purchaser:	Male 45%
	Female 65%
Children in Household:	45%

#### Sedan:

Median Age:	34.5 Years
Median Income:	\$45,000
Married:	57%
College Graduate:	45%
Purchaser:	Male 40%
	Female 60%
Children in Household:	45%

## Vehicle Overview

### Interior Overview

#### Key Standard Features\*

##### Cavalier Coupe/Sedan Model:

- **NEW** center console houses a side-mounted parking brake, three cup holders, driver or front-passenger armrest and storage area for cassette tapes, papers, etc., and two cup holders for rear seat passengers
- **NEW** instrument cluster features scratch-resistant cover
- Air conditioning with CFC-free refrigerant
- Driver and front-passenger air bags†
- Single-key lock system
- "Zoned" rear-window defogger defrosts center area of window first
- Side window defoggers
- Theatre lighting
- Fixed-interval intermittent windshield wipers
- Light-emitting diodes (LED) are used instead of light bulbs for all indicators except turn signals and high beams, and are designed for the life of the vehicle
- Rear-seat shoulder belt comfort guides
- Center console with cup holders, armrest and storage area including removable large bottom cup holder in console
- Cloth front bucket seats and full-folding rear seat
- Child security rear-door locks (Sedan only)
- ETR AM/FM stereo with seek-scan and digital clock
- Rear-seat heat ducts
- Courtesy, trunk and dome lamps.

##### Cavalier LS Model Adds The Following, In Addition To Or Replacing Standard Sedan Features:

- Cruise control
- Tilt-Wheel™ steering column
- ETR AM/FM stereo with seek-scan, digital clock and cassette
- Dual headliner-mounted reading lamps
- Tachometer and trip computer
- Dual, covered visor vanity mirrors with driver's map strap
- Remote mechanical trunk release
- Intermittent variable windshield wipers, allow the driver to match the wiper speed to weather conditions
- Luggage area cargo net
- Carpeted floor mats.

##### Cavalier Z24 Coupe Model Adds The Following, In Addition To Or Replacing Cavalier Coupe Features:

- ETR AM/FM stereo with seek-scan, compact disc player, digital clock TheftLock, speed-compensated volume and auto tone control
- Power windows with driver's Express-Down feature
- Power door locks
- Sport Cloth seating surfaces
- Easy-entry passenger seat
- Dual, headliner-mounted reading lamps
- Power trunk release.

**Cavalier Z24 Convertible Model Adds The Following, In Addition To Or Replacing Z24 Coupe Features:**

- Rearview mirror-mounted dual reading lamps
- Snug-fitting convertible top has a full headliner for a finished appearance and is designed to help reduce road and wind noise.

**Key Optional Features\***

- ETR AM/FM stereo with compact disc and remote cassette players, seek-scan, digital clock, TheftLock, speed-compensated volume, auto tone control and Radio Data System (RDS).

\* See Feature Availability chart for additional features.

† 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.

**Exterior/Structural Overview**

**Key Standard Features\***

**Cavalier Coupe/Sedan Model:**

- **NEW** Body-color painted front fascias add a fresh new look for all models
- **NEW** Rear taillamp design provides a sleek appearance
- **NEW** 14-inch wheel covers
- **NEW** Crystal lens front headlamps with improved performance and forward lighting capabilities
- **NEW** Exterior badging
- Daytime Running Lamps (DRL)
- P195/70R14 all-season tires
- Dual, breakaway sport mirrors are designed to be repositioned after minor impacts
- Stiff body structure allows suspension components to isolate road disturbances
- Corrosion protection has been incorporated throughout the vehicle. All exterior panels (except the roof) utilize two-sided galvanized steel.

**Cavalier LS Model Adds The Following, In Addition To Or Replacing Standard Sedan Features:**

- **NEW** 15-inch full wheel covers
- Body-color body-side moldings help protect against door dings and dents
- P195/65R-15 all-season touring tires
- Front mud guards.

**Cavalier Z24 Coupe Model Adds The Following, In Addition To Or Replacing Cavalier Coupe Features:**

- **NEW** Z24 rear spoiler with more aggressive appearance
- **NEW** 16-inch cast-aluminum wheels
- **NEW** Badging on front fenders
- Power outside rearview mirrors
- Z24-specific body-color front and rear fascias
- P205/55R-16 blackwall performance tires
- Unique Z24 rocker moldings
- Foglamps.

**Cavalier Z24 Convertible Model Adds The Following, In Addition To Or Replacing Z24 Coupe Features:**

- **NEW** 15-inch aluminum wheels
- Power convertible top with single-latch "logic stick" lever

## 2000 Chevrolet Cavalier Restoration Kit

- P195/65R-15 all-season touring tires
- Glass rear window with standard electric defogger provides good visibility and will not fade or yellow
- Three-piece boot cover gives a sleek, finished look when the top is lowered
- Specific rocker panels and front and rear reinforcements are welded prior to paint application so all body components receive full corrosion and paint protection.

### Exterior Paint

Total immersion phosphate electrodeposition (ELPO) process applies the first layer of primer/paint. Electric current is applied to the bodies while submerged in the paint bath to facilitate complete body coverage, even in hard-to-reach areas.

### Paint Colors

- **NEW** Dark Colorado Green Metallic
- **NEW** Ultra Silver Metallic
- Sandrift Metallic
- Bright White
- Aquamarine Blue Metallic
- Black
- Medium Sunset Gold Metallic
- Bright Red
- Cayenne Red Metallic.

### Z24 Convertible Model Top Colors:

- Arctic White
- Black
- Neutral

\* See Feature Availability chart 10 for additional features.

## Functional Overview

### Key Standard Features\*

#### Cavalier Coupe/Sedan Model:

- **NEW** Standard 4-wheel antilock brake system provides improved performance and smoother operation relative to previous model
- **NEW** Getrag 5-speed manual transmission and shifter provide a more precise shift feel and synchronized reverse gear mode relative to previous model
- **NEW** Fuel pump and fuel meter assembly provides quieter performance and enhanced reliability (interim availability) relative to previous model
- 2200 L4 engine with Sequential Fuel Injection (SFI)
- Power rack-and-pinion steering
- Battery-rundown protection automatically shuts off any interior or trunk lamps that are left on for more than 20 minutes (with ignition turned off)
- Stainless-steel exhaust system.

#### Cavalier LS Model Adds The Following, In Addition To Or Replacing Standard Sedan Features:

- **NEW** Electronically controlled 4-speed automatic transmission with Electronic Traction Control.

**Cavalier Z24 Coupe Model Adds The Following, In Addition To Or Replacing Cavalier Coupe Features:**

- 2.4-liter Twin Cam L4 engine with Sequential Fuel Injection (SFI)
- 5-speed manual transmission.

\* See Feature Availability chart for additional features.

**Optional Models/Packages**

**Bi-fuel Cavalier Sedan (interim availability)**

Gasoline and compressed natural gas (CNG) power the Bi-Fuel Cavalier Sedan, which was introduced in 1998. Its fueling system uses the CNG first for an estimated 160 miles and then automatically switches to gasoline, if necessary, for about 400 miles.\* Using a patented Hyperfill device, the CNG system includes a fuel tank which holds 6.9 gallons gasoline-equivalent @ 3,600 psi.

This system has undergone extensive testing and meets federal safety standards and Transitional Low Emission Vehicle (TLEV) standards in all 50 states.

Available for fleet owners and retail sale, the Bi-Fuel Cavalier Sedan is backed by the GM 3-year/36,000-mile† "Bumper to Bumper Plus" No-Deductible Limited Warranty and can be serviced at authorized GM dealers and facilities throughout America.

To accommodate the added weight of its fuel system, this Cavalier has an upgraded suspension system. The Bi-Fuel Cavalier has many of the same standard items of other Cavalier models, including:

- 2200L 4-cylinder engine
- 3-speed automatic transmission
- Driver and front-passenger air bags\*\*
- Power steering
- 4-wheel antilock brake system
- Stainless-steel exhaust.

\* Individual mileage may vary.

† Whichever comes first.

\*\* 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.

**Safety And Security\***

**Crash Avoidance Features**

- Daytime Running Lamps (DRL)
- 4-Wheel AntiLock Brake System (ABS)
- Clutch/starter interlock switch (manual transmission)
- Brake/transmission shift interlock (automatic transmission).

**Occupant Protection Features**

- Driver and front-passenger air bags†
- Reinforced safety-cage construction
- Front and rear crush zones
- Child security rear-door locks (Sedan only)
- Adjustable front shoulder safety belt guides (Sedan only)
- Rear shoulder safety belt comfort guides
- Safety belt cinch capability for child safety seats (Sedan only)
- Power window lockout (included with power windows).

## Security Features

- **NEW** PASSlock® II theft-deterrent system disables the ignition system if an attempt is made to start the car without a proper key
- **NEW** Remote Keyless Entry system allows the driver to lock or unlock doors, turn on interior lights and unlock the trunk from up to 30 feet away. Includes content theft alarm. Other features include:
  - Panic/car locator button
  - Locking and unlocking feedback
  - Radio personalization for up to four people
  - Interior lighted when approaching the car with unlock button or key fob
  - Includes the enhanced security system which gives you power door locks and an audible anti-theft alarm system
  - Laser-etched VIN plate.
  - Remote hood release allows access to engine compartment from inside the vehicle only
  - TheftLock security feature for cassette and compact disc players renders the unit inoperable if stolen
  - Enhanced theft security feature provides anti-theft alarm system and power door locks (standard when Remote Keyless Entry option is ordered).

\* For additional safety information, see the Chevrolet section of this Guide.

† 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.

## Sound Systems

- **NEW** Radio Data System (RDS) can be programmed to automatically interrupt tape or CD playing to provide important traffic, weather or emergency information (available on uplevel system only)
- **NEW** Sound system enhancements include relocating the radio above the HVAC controls for enhanced ergonomics. Other key improvements include:
  - Radio output increased to 50 watts on all models except uplevel dual playback units, which are rated at 80 watts
  - Improved chime sound quality through the radio
  - Automatic radio theft system with flashing LED (up-level system)
  - Retained radio power allows radio to continue playing with the engine off until the driver door is opened or 10 minutes elapse
  - Single unit dual play cassette/CD player.

## Coupe/Sedan

### Standard:

- ETR AM/FM stereo with seek-scan and digital clock.

### Optional:

- ETR AM/FM stereo with cassette player, seek-scan and digital clock
- ETR AM/FM stereo with compact disc player, seek-scan, digital clock TheftLock, speed-compensated volume and auto tone control
- ETR AM/FM stereo with compact disc and remote cassette players, seek-scan, digital clock, TheftLock, speed-compensated volume, auto tone control and Radio Data System (RDS).

## LS Sedan

### Standard:

- ETR AM/FM stereo with cassette player, seek-scan, digital clock.

### Optional:

- ETR AM/FM stereo with compact disc, seek-scan, digital clock TheftLock, speed-compensated volume, and auto tone control
- ETR AM/FM stereo with compact disc and remote cassette players, seek-scan, digital clock TheftLock, speed-compensated volume, auto tone control and Radio Data System (RDS).

## Z24 Coupe and Convertible

### Standard:

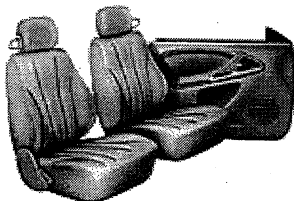
- ETR AM/FM stereo with compact disc player, seek-scan, digital clock TheftLock, speed-compensated volume, and auto tone control.

### Optional:

- ETR AM/FM stereo with compact disc and remote cassette players, seek-scan, digital clock TheftLock, speed-compensated volume, auto tone control and Radio Data System (RDS).

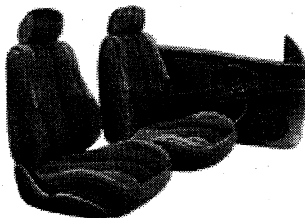
## Seats

- Adjustable front shoulder belt guide loops (Sedans only) make safety belts more comfortable for front-seat passengers
- Four-way seat adjusters and adjustable head restraints offer optimum comfort for all Cavalier seats.



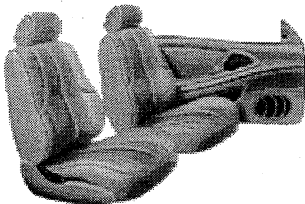
### Sedan, Coupe

- Standard cloth reclining front bucket seats with adjustable vinyl head restraints.



### LS Sedan, Z24 Coupe, Z24 Convertible

- Standard cloth reclining front bucket seats with adjustable cloth head restraints on LS Sedan
- Standard Sport Cloth reclining front bucket seats with adjustable cloth head restraints.



### Z24 Convertible

- Optional vinyl reclining front bucket seats (Arctic White only) with lumbar adjustment and adjustable head restraints.



### Additional Seating Features:

- Storage net on passenger seatback in LS and Z24 models provides additional storage for books, magazines, etc.
- Easy-entry passenger-seat standard on Z24 Coupe and available on Cavalier Coupe models
- Fold-down rear seat with trunk pass-through feature standard on all models.

### Interior Colors

- Graphite (Includes Red Inserts for Z24 models and Teal Inserts for LS)
- Neutral
- Medium Gray (LS and Z24 models)
- Arctic White\* (seat and door trim insert. Convertible only).

\* Does not include monotone color scheme.

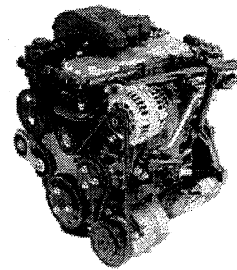
### Engines

#### 2200 L4 SFI Engine (LN2)

The 2200 L4 engine with Sequential Fuel Injection (SFI) is standard on Cavalier Coupe, Sedan, and LS Sedan models.

#### Technical Features of the 2200 L4 Engine:

- Valvetrain roller rocker arms use roller bearings to reduce friction
- Hydraulic roller valve lifters
- "Assembled" steel camshaft
- Induction system features two resonators and a large-volume air cleaner for quiet operation
- Sequential Fuel Injection (SFI)
- Cast-aluminum cylinder head
- Torque axis powertrain mount system
- Exhaust Gas Recirculation (EGR) system
- Low-maintenance features, including platinum-tip spark plugs and extended-life engine coolant.\*
- Maintenance needs vary with different uses and driving conditions. See the Owner's Manual for more information.



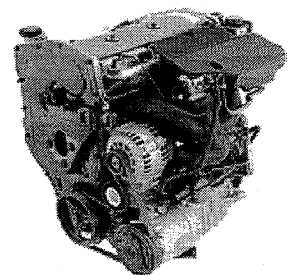
#### 2.4 Liter Twin Cam L4 Engine (LD9)

A 2.4-liter Twin Cam L4 engine with Sequential Fuel Injection is standard on Z24 Coupe and Z24 Convertible and is optional on LS Sedan.

#### Technical Features of the 2.4 Liter Twin Cam Engine:

- Dual overhead camshafts
- Cast-aluminum cylinder head
- Composite intake manifold
- Sequential Fuel Injection (SFI)
- Exhaust Gas Recirculation (EGR)
- "In-oil-pan" design balance shaft system
- Torque axis powertrain mount system
- Stainless-steel fuel injectors
- Direct-drive power steering pump
- Low-maintenance features, including platinum-tip spark plugs and extended-life engine coolant.\*

\* Maintenance needs vary with different uses and driving conditions. See the Owner's Manual for more information.

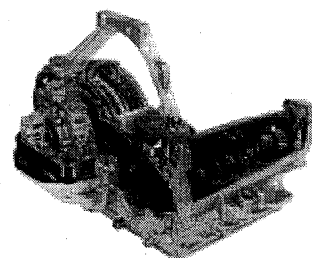


## Transmissions

### 3T40 3-Speed Automatic Transmission

The 3T40 transverse-mounted 3-speed automatic is optional on Cavalier Coupe and Cavalier Sedan. The 3T40 features wide-ratio gearing to maximize vehicle performance and hydraulic controls for smooth, accurate shift points. Other features include:

- Powertrain Control Module (PCM) collects information about the operating condition of the 3T40 and alerts the driver with a "Service Engine Soon" light if there is a deterioration that could cause the vehicle to exceed acceptable emissions levels
- Long-life automatic transmission fluid will not need to be replaced under normal operating conditions\*
- Premium input gear set allows for efficient lubrication flow, resulting in smooth operation and quiet shift characteristics
- Torque converter clutch features quiet, smooth operation
- Final-drive pinion gears are double-honed, improving surface finish which allows for better interface with the needle bearings, leading to improved durability.

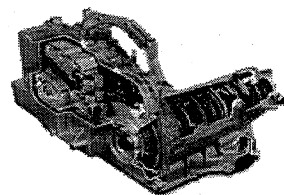


### 4T40-E 4-Speed Electronic Automatic Transmission

The 4T40-E is standard on LS Sedan and optional on all other models.

Technical Features of the 4T40-E Transmission:

- Fully integrated and synchronized Powertrain Control Module (PCM)
- 4T40-E is lightweight, contributing to overall fuel efficiency
- Chain-transfer two-axis configuration
- Special lightweight composite materials
- Long-life automatic transmission fluid\*
- Traction Control is standard with the 4T40-E



\* Maintenance needs vary with different uses and driving conditions. See the Owner's Manual for more information.

### 5-Speed Manual Transmission

A five-speed manual transmission is standard on all Cavalier models except the LS Sedan. The wide range of gear ratios helps allow the driver select the best gear for any driving situation. The fifth gear overdrive lowers engine rpm at cruising speed, thereby reducing wear and engine noise, and improving fuel economy.

The 5-speed manual transmission and clutch are engineered to make shifting smooth and easy:

- Clutch pedal has a short, efficient travel
- Concentric slave cylinder provides a solid pedal feel and smooth clutch operation

## Suspension

- MacPherson strut front suspension and trailing twist-beam rear suspension helps prevent road shocks from being transferred to the opposite wheel
- "Progressive-ride" system helps allow precise tuning between the chassis and suspension system to improve isolation, impact harshness, motion control, shake and structural feel
- Dual-path front struts help provide good road feel, yet maintain isolation from bumps
- Level II Sport Suspension, on Z24 Coupe models, includes shaped inner-metal bushings on front lower control arms, high rate front and rear springs, specific shocks and struts and a large front stabilizer bar, which combine for a firm ride and sporty handling

- Coil-Over-Shock rear suspension design positions the shock and spring "in-line" to distribute road inputs (potholes, etc.) throughout the body structure, helping to dissipate the energy for a less jarring ride
- Accurate wheel alignment is ensured at all four wheels by using precision equipment during the manufacturing process. Throughout the vehicle-build process, measurements are taken to help ensure that components affecting final wheel alignments are correct

## **Steering**

Power-assisted rack-and-pinion steering is standard on all Cavalier models

- 14.7:1 ratio is featured on Cavalier models
- 15.7:1 ratio on Z24 Coupe
- Steering rack mounted on the front suspension cradle helps provide a more solid feel compared to steering racks mounted directly to the car body.

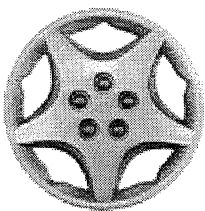
## **Brakes**

All Cavalier models include front disc/rear drum brakes with standard power assist. For 2000, all Cavaliers come equipped with a new ABS brake system.

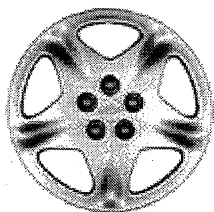
- ABS helps the driver maintain steering control during severe braking situations by minimizing wheel lockup on most slippery surfaces. The driver simply maintains pressure on the brake pedal and steers the vehicle
- ABS adjusts brake pressure by modulating the brakes several times per second, a rate even most skilled professional drivers cannot attain physically.

## Wheels and Tires

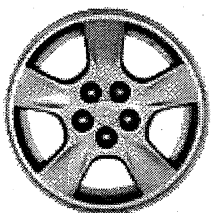
### Wheels



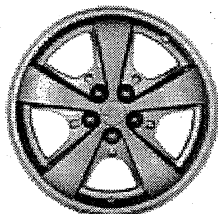
14-inch x 6-inch full wheel cover — standard on Coupe and Sedan models



• 15-inch x 6-inch full wheel cover — standard on LS Sedan



• 15-inch x 6-inch aluminum wheel – Standard on Z24 Convertible



• 16-inch x 6-inch aluminum wheels — standard on Z24 Coupe

### Tires

- P195/70R-14 all-season tires (standard on Coupe and Sedan models)
- P195/65R-15 all-season touring tires (standard on LS Sedan and optional on Cavalier Coupe with PEG 1SC only)
- P195/65R-15 all-season touring tires (standard on Z24 Convertible models and optional on Cavalier Coupe and LS Sedan)
- P205/55R-16 performance tires (standard on Z24 Coupe).

## Feature Availability

	Coupe/ Sedan	LS Sedan	Z24 Coupe	Z24 Conv.
<b>Interior</b>				
Air bags - driver and front-passenger <sup>1</sup>	S	S	S	S
Air conditioning - with CFC-free refrigerant	S	S	S	S
Cruise control	O <sup>2</sup> /NA	S	S	S
Defogger - rear-window, electric	S	S	S	S
Door locks - power	O <sup>3</sup>	O <sup>3</sup>	S	S
Easy entry passenger seat	O/NA	NA	S	S
Remote Keyless Entry with content theft alarm	O	O	S	S
Seat - front bucket and full-folding rear	S	S	S	S
Steering column - Tilt-Wheel™ adjustable	O <sup>2</sup> /NA	S	S	S
Stereo - ETR AM/FM with seek-scan and digital clock	S	NA	NA	NA
- ETR AM/FM with cassette player, seek-scan and digital clock	O	S	NA	NA
- ETR AM/FM with compact disc player, seek-scan, digital clock, TheftLock, speed-compensated volume and auto tone control	O	O	S	S
- ETR AM/FM with compact disc and remote cassette players, seek-scan, digital clock, TheftLock, speed-compensated volume, auto tone control and Radio Data System (RDS)	O	O	O	O
Sunroof - power	O/NA	NA	O	NA
Trunk release - mechanical/power	O/O <sup>3</sup>	S/O <sup>3</sup>	NA/S	NA/S
Tachometer/trip odometer	O/S;NA/S	S/S	S/S	S/S
Windows - power	O <sup>2</sup> /NA	O <sup>2</sup>	S	S
Wipers - intermittent fixed	S	NA	NA	NA
- intermittent variable	O <sup>2</sup>	S	S	S
<b>Exterior</b>				
Daytime Running Lamps	S	S	S	S
Foglamps	NA	NA	S	S
Mirrors outside - electric	O <sup>2</sup> /NA	O <sup>2</sup>	S	S
Moldings - body-side, body-color	O <sup>2</sup>	S	S	S
Mud guards-front	O <sup>2</sup>	S	NA	NA
Paint - basecoat/clearcoat	S	S	S	S
Spoiler - rear decklid	O/NA	O	S	S
Tires - P195/70R-14 all-season	S	NA	NA	NA
- P195/65R-15 all-season touring	O <sup>2</sup> /NA	S	NA	S
- P205/55R-16 all-season performance	NA	NA	S	NA
Wheel covers- 14" full	S	NA	NA	NA
- 15" full	O <sup>2</sup> /NA	S	NA	NA
vWheels- 15" aluminum	O/NA	O	NA	S
- 16" aluminum	NA	NA	S	NA
<b>Functional</b>				
Brake system - 4-wheel antilock (ABS)	S	S	S	S
Engine - 2200 L4 SFI	S	S	NA	NA
- 2.4 liter twin cam L4 SFI	NA	O	S	S
Exhaust system - stainless-steel	S	S	S	S
PASSlock® II theft-deterrent system	S	S	S	S

# 2000 Chevrolet Cavalier Restoration Kit

Steering – power rack-and-pinion	S	S	S	S
Transmission– 5-speed manual	S	NA	S	S
– 3-speed automatic	O	NA	NA	NA
– 4-speed electronically controlled automatic with Traction Control	O <sup>2</sup> /NA	S	O	O

S — Standard.

O — Optional. (Some options may be available only as part of a Preferred Equipment Group.)

NA — Not available.

1 Always use safety belts and proper child restraints, even with air bags. Children are safer when properly secured in a rear seat.

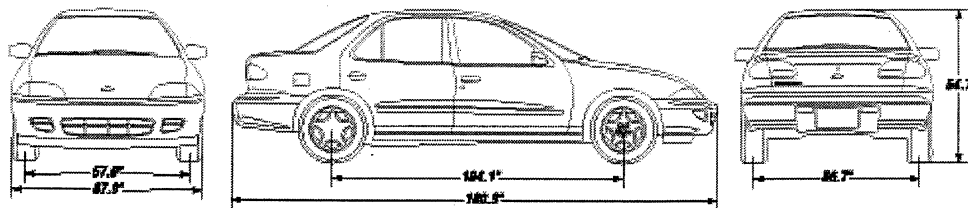
See the owner's manual for more safety information.

2 Requires optional PEG.

3 Included with the optional Remote Keyless Entry System.

## Specifications

### Dimensions



#### Model Availability

Cavalier Coupe/Sedan, Coupe, LS Sedan, Z24 Coupe/Convertible

EPA vehicle class Subcompact

Assembly Lansing, Mich. Lordstown, Ohio Ramos Arizpe, Mexico

#### Dimensions & Capacities (inches/millimeters, unless otherwise noted)

Exterior Dimensions	Coupe	Sedan	Convertible
Wheelbase	104.1/2644.1	104.1/2644.1	104.1/2644.1
Length (overall)	180.9/4595.8	180.9/4595.8	180.9/4595.8
Width (overall)	68.7/1745.0	67.9/1724.7	68.7/1745.0
Height (overall)	53.0/1346.2	54.7/1389.4	54.1/1374.1
Tread — front	57.6/1463.0	57.6/1463.0	57.6/1463.0
Tread — rear	56.4/1432.6	56.7/1440.2	56.6/1437.6
Interior Front Dimensions			
Headroom	37.6/955.0	38.9/988.1	38.1/967.7
Legroom	41.9/1064.3	41.9/1064.3	42.1/1069.3
Shoulder room	53.9/1369.1	54.6/1386.8	53.9/1369.1
Hip room	50.0/1270.0	50.8/1290.3	50.0/1270.0
Interior Rear Dimensions			
Headroom	36.6/929.6	37.2/944.9	37.6/955.0
Legroom	32.7/830.6	34.4/873.8	32.6/828.0
Shoulder room	54.9/1394.5	53.9/1369.1	47.1/1196.3
Hip room	49.5/1257.3	50.6/1285.2	47.8/1214.1
Capacities			
Passenger capacity	5	5	5
Passenger index (cu. ft./liters)	87.1/2473.3	91.5/2597.9	82.8/2350.9
Cargo index (cu. ft./liters)	13.2/374.8	13.6/386.1	10.5/298.1
Fuel tank capacity (gal./liters approx.)	14.3/54.2	15/56.8	15/56.8
EPA interior index (cu. ft./liters)	100.3/2847.8	105.1/2984.1	93.3/2369.8
Curb weight (lbs./kg, est.)	2617/1188	2676/1214	2838/1288 kg
Engine oil (quarts/liters)	4.0/3.8 (2200 L4)	4.0/3.8 (2.4 Liter Twin Cam)	
Engine coolant (quarts/liters)	9.6/9.1 (2200 L4)	9.4/8.9 (2.4 Liter Twin Cam)	

## Specifications

Steering		
Type	Power Rack-and-Pinion	
Ratio (overall)	14.7:1 (base), 15.7:1 (Z24 Coupe)	
Turns stop-to-stop	2.6 (base), 2.8 (Z24 Coupe)	
Turning diameter curb-to-curb (ft./m)	35.6/10.9	
Turning diameter curb-to-curb (ft./m)	35.6/10.9	
Brakes		
Type	Power, front vented disc/rear drum with 4-wheel ABS	
	U. S. STANDARD	METRIC
Gross lining, front/rear	31.7/50.2 sq. in.	204.5/323.9 sq. cm
Effective area, front/rear	31.7/50.2 sq. in	204.5/323.9 sq. cm
Front rotor outer working diam. x thickness	10.2 x .79 in.	259.5 x 20.0mm
Rear drum diameter x width	7.87 x 1.77 in.	200 x 45.0mm
Total swept area, front/rear	182.2/86.2 sq. in.	1175.6/556.2 sq. cm
Engines		
Model	Std. Coupe, Sedan RS, Coupe	Std. Z24 Coupe, Z24 Convertible; opt. LS Sedan
Type	2200 L4 SFI	2.4 Liter Twin Cam L4
Block	Cast iron	Cast iron
Cylinder head	Cast aluminum	Cast aluminum
Valve configuration	Overhead valves (OHV)	Dual Overhead Camshafts (DOHC)
Hydraulic lifters	Yes/roller	Yes
Bore & stroke (in.)	3.50 x 3.46	3.54 x 3.70
(mm)	89.0 x 88.0	90.0 x 94.0
Cam drive	Chain	Chain
Redline (maximum rpm)	6000	6500
Displacement (liters/cu. in.)	2.2/134	2.4/146
Compression ratio	9.0:1	9.5:1
Fuel induction	Sequential Fuel Injection (SFI)	Sequential Fuel Injection (SFI)
Horsepower/kW @ engine RPM	115 @ 5000/85 kW @ 5000	150 @ 5600 /111 kW @ 5600
Torque/N-m (lb.-ft.)	135 @ 360 /100 N-m @ 3600	155 @ 4400 /115 N-m @ 4400
Exhaust system	One-piece welded stainless steel	One-piece welded stainless steel
Tailpipe(s)	Single outlet	Single outlet (dual on Z24)
Ignition system	Electronic direct ignition	Electronic direct ignition
Delcotron alternator rating (amps)	105	105
Battery (SAE capacity rating), cca	525	600
Recommend fuel (unleaded)	87 octane	87 octane



Transmissions										
Model	Std. Coupe, Sedan, RS Coupe, Z24 Coupe and Convertible				Opt. Coupe, Sedan			Std. LS Sedan, Opt. Coupe, Sedan, RS Coupe, Z24 Coupe and Convertible		
Type	5-speed manual				3-speed automatic			4-speed electric automatic with OD and Traction Control		
Layout	FWD transverse				FWD transverse			FWD transverse		
Gear ratios:										
1st	3.91 (3.73 — Z24)				2.84			2.96		
2nd	2.18				1.60			1.63		
3rd	1.45 (1.33 — Z24)				1.00			1.00		
4th	1.03 (0.92 — Z24)				—			0.68		
5th	0.74				—			—		
Reverse	3.58				2.07			2.13		
Final drive ratios	3.58 (3.94 — Z24)				3.18			3.63 (3.91 with 2.4L engine)		
Chassis										
Chassis										
Structure/frame					Unitized body construction					
Body material					Steel					
Suspension — front										
Type					Independent MacPherson strut w/coil spring					
Stabilizer bar design/diameter (mm)					Link/19 (w/ 2.4L engine); 22 (Z24 Coupe only)					
Suspension — rear										
Type					Trailing tubular control arms with twist beam axle					
Stabilizer bar design/diameter (mm)					Solid/14 (Z24 Coupe only)					
Mileage/Performance*										
Powertrain	2200 L4 w/5-Speed Manual		2200 L4 w/3-Speed Automatic		2200 L4 w/4-Speed Automatic		2.4L w/5-Speed Manual		2.4L w/4-Speed Automatic	
Mileage:	mpg	liters/100km	mpg	liters/100km	mpg	liters/100km	mpg	liters/100km	mpg	liters/100km
City	24	9.8	23	10.2	23	10.2	23	10.2	22	10.7
Highway	34	6.9	29	8.1	31	7.6	33	7.2	30	7.8
Combined	28	8.4	25	9.4	26	9.0	26	9	25	9.4
Est. cruising range:	mi.	km	mi.	km	mi.	km	mi.	km	mi.	km
City	360	579	345	555	345	555	345	555	330	531
Highway	510	821	435	700	465	748	495	796	450	724
Combined	420	676	375	603	390	627	390	627	375	603

\* Based on projected 1999 EPA figures.

**Trailer Information\***

Model	LS Sedan, Z24 Models
Trailer classification	Light
Gross trailer weight (lbs./kg, up to)	1000/454
Max tongue load (lbs./kg)	100/46

\* Requires 2.4 Liter Twin Cam engine and 4-speed automatic transmission.

**Wheels & Tires**

	Coupe/Sedan	Coupe, LS Sedan	Z24 Coupe	Z24 Convertible
Wheel type/size	Steel/14" x 6"	Steel/15" x 6"	Cast-aluminum/16" x 6"	Cast-aluminum/15" x 6"
Wheel trim	14" full covers	15" full covers	NA	NA
Tire type	All-season Steel-belted radial	All-Season Steel-belted radial Touring	Steel-belted radial Performance	All-season Steel-belted radial Touring
Tire size	P195/70R-14	P195/65R-15	P205/55R-16	P195/65R-15
Spare size	T115/70D-14	T115/70D-14	T115/70D-14	T115/70D-14

All specifications are preliminary and subject to change. Chevrolet Motor Division, June 1999.

## Cavalier History

Introduced in spring 1981 as a 1982 model.

1983 – Cyclonic induction, fuel-injected 2.0 Liter engine; convertible debuts

1984 – Cavalier is the best-selling car in the U.S.

1985 – 2.8 Liter V6 introduced; major suspension tuning

1987 – Gen II 4- and 6-cylinder engines; Getrag 5-speed; Z24 Convertible for California only

1988 – Aerodynamic facelift for coupes and convertible; Z24 Convertible goes national

1991 – All-new interior and minor exterior changes; RS Convertible debuts

1992 – ABS VI brake system is standard; Z24 Convertible returns; Port Fuel Injection on L4

1994 – 2.2 Liter LN2 improvements; 3.1 Liter V6 option available on all Cavalier RS models

1995 – All-new interior and exterior design, new 2.3 Liter Quad 4 engine, 4T40-E transmission and standard dual air bags

1996 – New Daytime Running Lamps, 2.4 Liter Twin Cam engine; OBD II; extended-life coolant

1997 – Rally Sport Coupe model added, new easy-open gas cap, enhanced Evaporative Emissions Control system and federal dynamic side-impact standards met

1998 – Z24 Convertible replaces LS Convertible; Bi-Fuel Cavalier added to the model lineup

1999 – Refined 2.4 Liter Twin Cam engine

2000 – Exterior enhancements including body-color fascias on all models; air conditioning standard on all models; redesigned instrument panel cluster and rear-window defogger

## **Miscellaneous Information**

### **Technical Product Information**

#### **Vehicle Classification**

- Compact

#### **Assembly Plant Locations**

- Lordstown, Ohio

#### **Frame**

- Unitized

#### **Chassis Layout**

- Front engine, front-wheel drive

#### **Body Material**

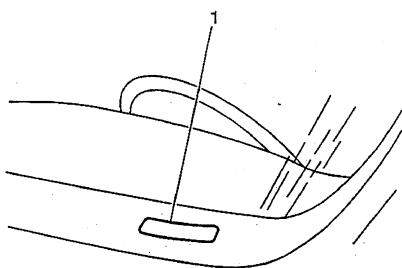
- Steel

#### **Affinity Relationships**

- United States Figure Skating Association and U.S. Figure Skating Team
- U.S. Soccer
- GM Concept:Cure

## Vehicle Identification

### Vehicle Identification Number (VIN)



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

Position	Definition	Character	Description
1	Country of Origin	1	U.S.A.
		3	Mexico
2	Manufacturer	G	General Motors
3	Make	1	Chevrolet
		2	Pontiac
4-5	Carline/Series	J/C	Cavalier
		J/F	Cavalier Z24 or LS
		J/B	Sunfire SE
		J/D	Sunfire GT
6	Body Style	1	2 Door Coupe (37)
		3	2 Door Convertible (67)
		5	4 Door Sedan (69)
7	Restraint System	2	Active (Manual) Belts w/Driver and Passenger Inflatable Restraint System
8	Engine Type	4	RPO LN2, 2.2L, L4, MFI
		T	RPO LD9, 2.4L, L4, MFI
9	Check Digit	--	Check Digit
10	Model Year	Y	2000
11	Plant Location	M	Lansing, MI
		7	Lordstown, OH
		8	Lansing, MI
		S	Ramos Arizpe, MEX
12-17	Plant Sequence Number	--	Plant Sequence Number

## VIN Derivative

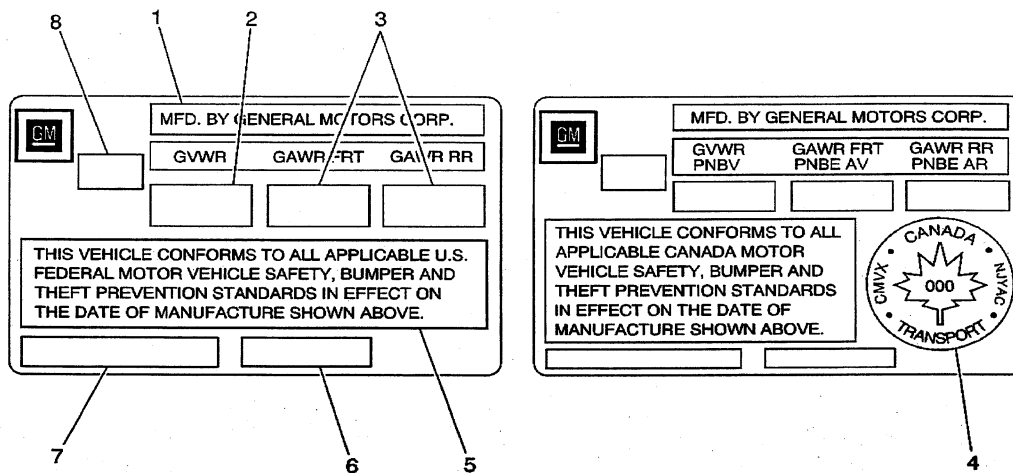
All engines and transmissions are stamped or laser etched with a partial vehicle identification number (VIN), which was derived from the complete VIN. A VIN derivative contains the following nine positions:

Position	Definition	Character	Description
1	GM Division Identifier	1	Chevrolet
		2	Pontiac
2	Model Year	Y	20001
3	Assembly Plant	M	Lansing, MI
		7	Lordstown, OH
		8	Lansing, MI
		S	Ramos Arizpe, MEX
4-9	Plant Sequence Number	--	--

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

VIN Derivative Position	Equivalent VIN Position
1	3
2	10
3	11
4-5	12-17

## Label Certification



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

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

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

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

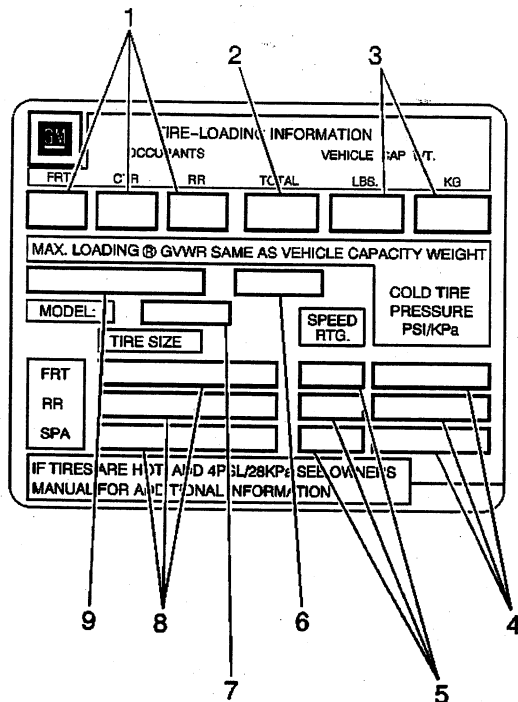
The GVW is the weight of the vehicle and everything the vehicle carries. Include the following items when figuring the GVW:

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

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

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

## Tire Placard

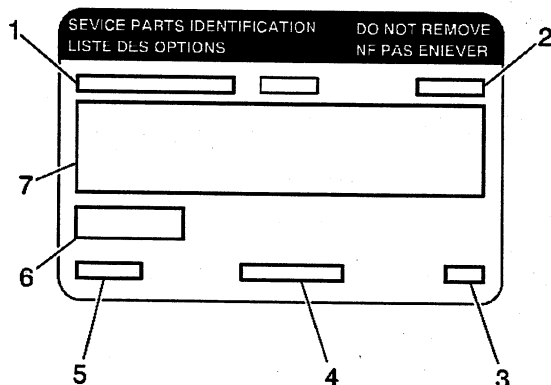


1. Specified Occupant Seating Positions
2. Total Occupant Seating
3. Maximum Vehicle Capacity Weight
4. Tire Pressures, Front, Rear, and Spare
5. Tire Speed Rating, Front, Rear, and Spare
6. Tire Label Code
7. Engineering Model Minus First Character
8. Tire Sizes, Front, Rear, and Spare
9. Vehicle Identification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

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

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

## Service Parts Identification Label (SPID)



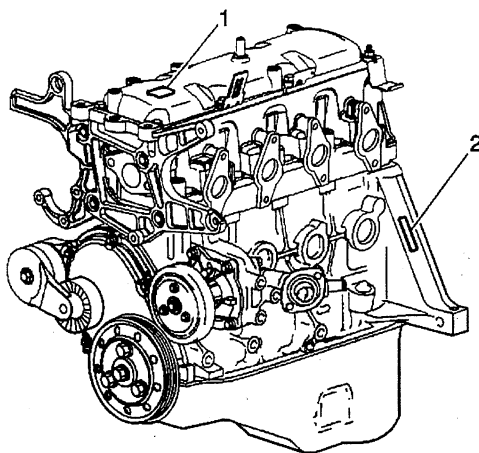
1. Vehicle Identification Number
2. Wheel Base
3. Part Number Location
4. Model Designation
5. Order Number
6. Exterior Color
7. Paint Technology

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



## Engine ID and VIN Derivative Location

### 2.2 L VIN 4 Engine ID Location

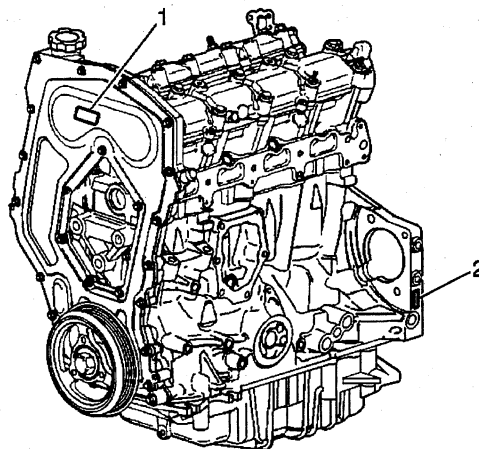


The engine code letter is the eight digit of the VIN, which identifies the engine.

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

The engine ID number will be located on valve rocker arm cover (1), and the VIN derivative is located on the left side of the engine block above the starter (2), as shown.

### 2.4 VIN T Engine ID Location



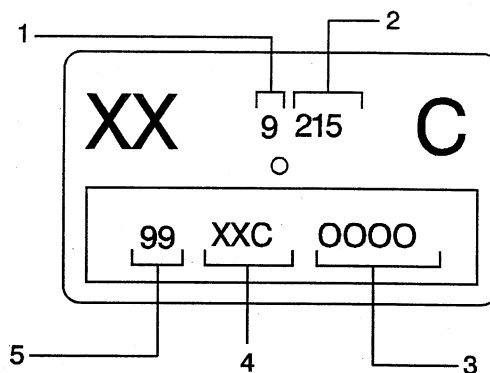
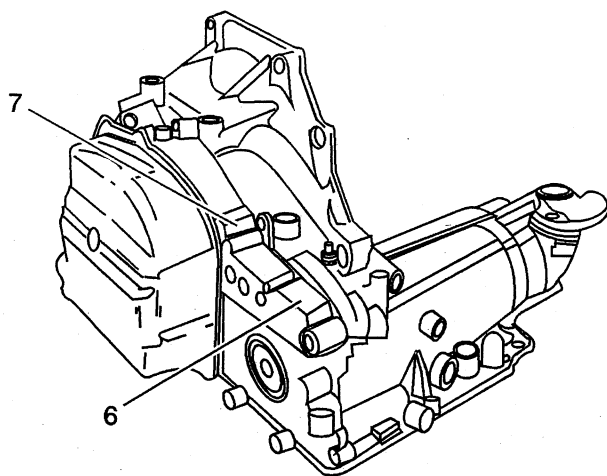
The engine code letter is the eight digit of the VIN, which identifies the engine.

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

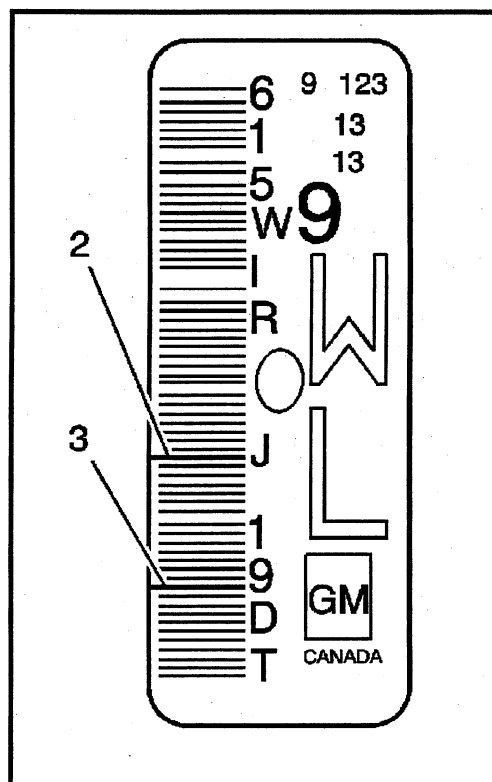
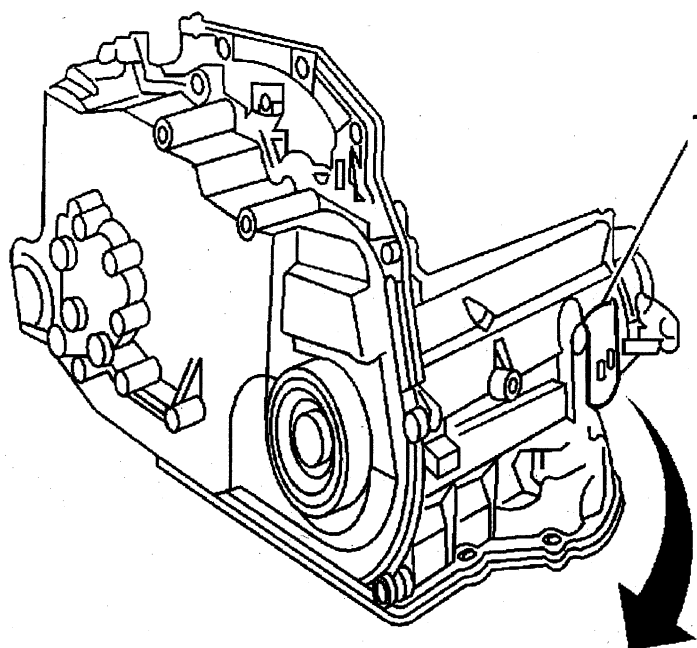
The engine ID number will be located on top of the timing chain cover (1), and the VIN derivative is located on the left side of the engine block next to the starter (2), as shown.

## Transmission ID and VIN Derivative Location

### 3T40 Transmission ID Location



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



#### 4T40E Transmission ID Location

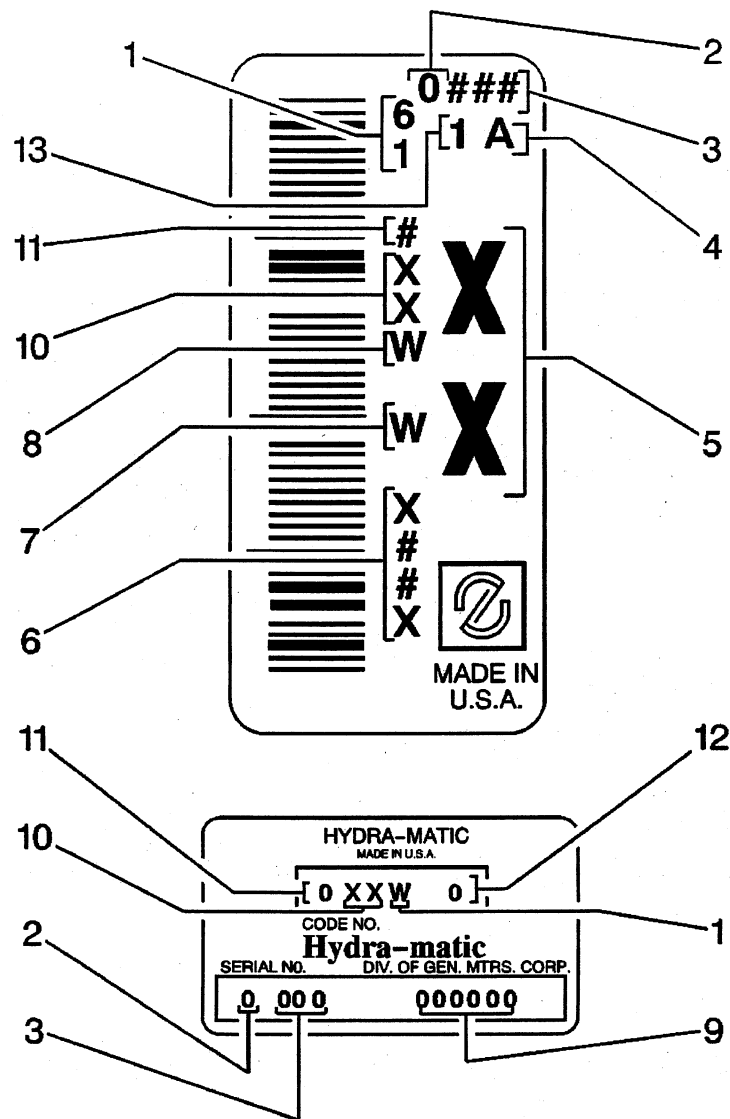
1. Goodwrench Tag Location

## 2000 Chevrolet Cavalier Restoration Kit

2. Remanufacturing Site Code
3. Serial Number

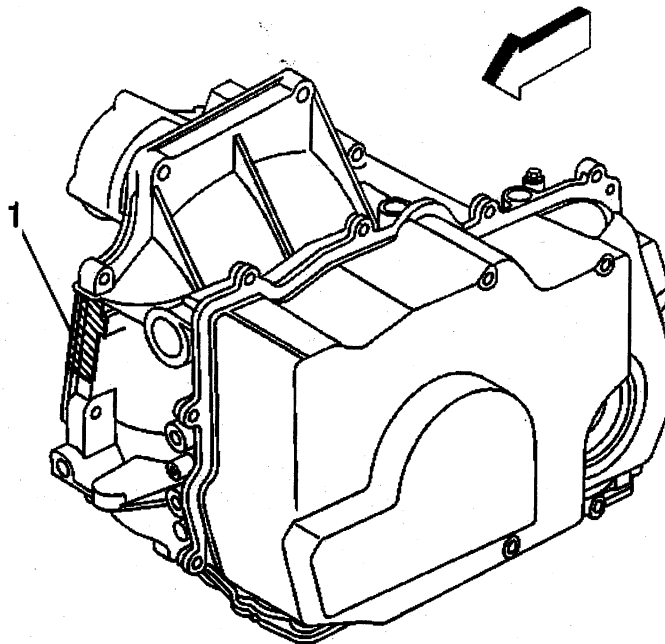
## Automatic Transmission ID Nameplate

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



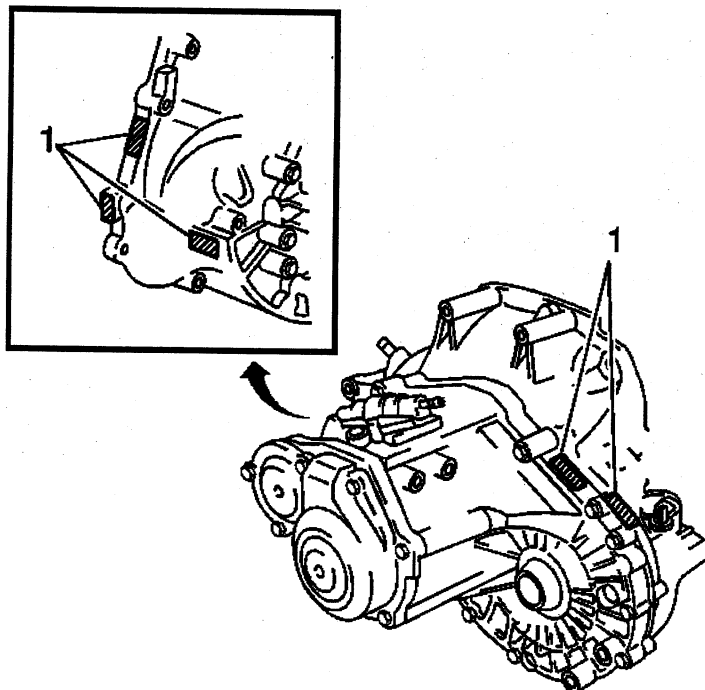
1. Transaxle
2. Calendar Year
3. Julian Date or Day of the Year
4. Shift (A=First Shift, B=Second Shift, C=Third Shift)
5. Model
6. Serial Number in Base Code 31
7. Plant
8. Hydramatic 4T40 E
9. Serial Number
10. Model
11. Model Year
12. Control Number
13. Line Built (1=Line 1, 2=Line 2, 3=Line 3, 4=Line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

## VIN Derivative Location 4T40/4T45-E



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

## Getrag 5T45-E Transmission VIN Location, M86



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

## RPO Code List

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

RPO	Description
AF5	Easy Entry Seat Adjuster; Passenger Side
AK5	Restraint System Front Seat, Inflatable, Driver and Passenger
AR9	Seats; Bucket, Reclining
AS5	Seats; Deluxe Bucket, Reclining, with Driver Lumbar Adjust, Seat Back Pocket, Firmer Side Bolsters
AU0	Remote Keyless Entry
AU3	Power Door Locks
C41	HVAC, Heater System Outside Air, With Fan
C49	Defogger, Rear Window Electric
C60	HVAC, Air Conditioner Front Manual Controls
C95	Lamp Interior, Roof, Courtesy and Dual Reading
DC1	Mirror, Outside Left Hand and Right Hand Remote Control, Electric, Defog, Tinted Glass, Power, Foldaway, Painted
DC3	Mirror, Outside Left Hand and Right Hand Remote Control, Electric, Defog, Tinted Glass, Manual Foldaway, Painted
DC4	Mirror, Inside Rearview, Tilt, Dual Reading Lamps
DD2	Sunvisor Vanity Mirrors
DG7	Mirror, Outside, Remote Control, Electric, Color
DL5	Decal Roadside Service Information
DT3	Box Rear Storage Compartment
DT4	Ashtray Cigarette Lighter
D35	Mirror, Outside Remote Control, Color
FEO	Suspension System Front and Rear Active
FE1	Suspension System, Soft Ride
FE2	Suspension System, Ride Handling
FP2	Ratio Transaxle Final Drive, 3.58
FX1	Ratio Transaxle Final Drive, 3.94
FX2	Ratio Transaxle Final Drive, 3.91
FY1	Ratio Transaxle Final Drive, 3.63
IJC	Trim Interior Design (JC) (95)
IJN	Trim Interior Design (JN)
IPB	Trim Interior Design (PB)
IPD	Trim Interior Design (PD)
IPE	Trim Interior Design (PE)
IPG	Trim Interior Design (PG)
IPH	Trim Interior Design (PH)
IPJ	Trim Interior Design (PJ)
JA7	Park Brake Lever Handle, Leather Wrapped
JM4	Brake System Power, Front Disc, Rear Drum, Cast Iron, Antilock, Front and Rear Wheel
KL6	Provisions Natural Gas
KO5	Engine Block Heater
K29	Module Powertrain Control
K34	Cruise Control Automatic, Electronic
K62	Generator, CS 130-D, 105 Amp, Dual Internal Fan
LD9	Engine; 2.4L L4 DOHC
LN2	Engine Gas, 4 Cylinder, 2.2L, MFI

MD9	Transmission, Automatic 3 Speed, 3T40
MJ1	Transmission, Manual 5 Speed
MK7	Transmission, Manual 5 Speed, 3.58 Final
MN4	Transmission, Automatic 4 Speed, 4T40E
NK5	Steering Wheel Standard
NP5	Steering Wheel Leather Wrapped
NW7	Traction Control; Powertrain Mgmt Only
N33	Stg Clm, Tilt
N46	Steering Wheel; Deluxe Urethane, w/SIR
N78	Wheel, 14 x 6, Aluminum, Hub Cap, Wheel Nuts
N81	Fullsize Spare Tire
PB1	Wheel Cover, 15 Inch
PC1	Wheel, 14 x 6, Aluminum
PF7	Wheel, 15 x 6, Aluminum Cast, Styled
PG0	Wheel 16 x 6, Aluminum, Styled
PG1	Wheel 14 x 6, Steel
OFB	P195/70 R14 All Season, Black Wall Tires
QLG	P205/55 R16 Performance; Black Wall Tire
QPD	P195/65 R15 Touring; Black Wall Tires
T43	Spoiler Rear
T79	Fog Lamp, Rear
T84	Headlamps Right Hand Rule of the Road, E Mark
UD4	Alarm Vehicle Speed, 120 K/H
UH7	Cluster Instrument, Cool Temp
UH8	Cluster Instrument, Cool Temp, Trip Odom, Tach
UJ5	Cluster Instrument, Cool Temp, Trip Odom, Tach, Fuel, Speedo, Analog, Metric Only
UK3	Radio Control; Redundant on Steering Wheel
UL0	Radio, AM/FM Stereo, Seek/Scan, Auto Reverse Music Search Cassette, Auto Tone, Clock
UM6	Radio; AM/FM Stereo Seek/Scan, Auto Reverse, Cassette, Clock
UM7	Radio, AM/FM Stereo, Seek/Scan, Clock
UN0	Radio, AM/FM, Stereo, Seek/Scan, Compact Disc, Auto Tone, Clock
UN6	Radio, AM/FM, Stereo, Seek/Scan, Auto Reverse Music Search Cassette, Clock
UP3	Radio, AM/FM, Stereo, Seek/Scan, Compact Disc, Equalizer, Clock
UQ9	Speaker Delete
US6	Antenna Fixed, Painted, Radio
UT6	Radio; AM/FM Stereo, Seek/Scan Auto Reverse Music Search, Cassette, Equalizer, Clock
UW6	6 Speaker System, Dual F/D Tweet and Woof, Dual Extended Range Shelf
UX7	Speaker System 4, Dual Front Door Mounted, Dual Extended Range Package Shelf
U19	Metric Scale Instrument Cluster
U77	Antenna Rear Window, Radio
U79	Speakers (4), 2 Rear Shelf, 1 Coaxial per Door
VD9	Fascia Front and Rear, Body Color
VG9	Protector Wax, Exterior Body
VH4	Front Mud Guards
VH9	Envelope Owner Information Manual
VK3	Front License Plate Mounting Provisions
VP6	Noise Control
VR6	Hook Tie Down
VY7	Leather Shift Knob
V05	Radiator Heavy Duty
01L	Secondary Color Exterior, Special (91)
10I	Interior Trim Arctic White (93)



10N	Trim Combination Vinyl, Arctic White (N) (93)
12B	Trim Combination Cloth, Graphite (B) (95)
12C	Trim Combination Cloth Graphite (C) (94)
12D	Trim Combination Cloth, Graphite (D) (95)
12E	Trim Combination Cloth, Graphite (E) (92)
12G	Trim Combination Cloth, Graphite (G) (96)
12H	Trim Combination Cloth, Graphite (H) (96)
12I	Interior Trim Graphite (95)
12J	Trim Combination Cloth, Graphite (J) (98)
16T	Top Color Bright White (94)
16U	Primary Color Exterior, Brite White (91)
22U	Primary Color Exterior, Dahlia Blue Met (97)
24U	Primary Color Exterior, Opal Blue (97)
36U	Primary Color Exterior, Fern Green Mint (99)
37U	Primary Color Exterior, Manta Green Met (96)
41T	Top Color Black (91)
41U	Primary Color Exterior, Black (94)
49U	Primary Color Exterior, Light Sandrift Met (96)
52B	Trim Combination Cloth, Light Neutral (B) (92)
52C	Trim Combination Cloth, Light Neutral (C) (95)
52D	Trim Combination Cloth, Light Neutral (D) (96)
52E	Trim Combination Cloth, Light Neutral (E) (96)
52G	Trim Combination Cloth, Light Neutral (G) (96)
52H	Trim Combination Cloth, Medium Neutral II (H) (96)
52I	Interior Trim, Light Neutral (I) (92)
52N	Trim Combination Vinyl, Light Neutral (N) (96)
52T	Top Color Neutral
60U	Primary Color Exterior, Gold Firemist (98)
8X1	Label Fastener Seat Belts
81U	Primary Color Exterior, Bright Red (91)
92B	Trim Combination Cloth, Pewter (B) (97)
92E	Trim Combination Cloth, Medium Dark Pewter (97) (E)
92G	Trim Combination Cloth, Medium Dark Pewter (97) (G)
92H	Trim Combination Cloth, Medium Dark Pewter (97) (H)
92I	Interior Trim Pewter (97)
96U	Primary Color Exterior, Cayenne Red Metallic (96)

## Technical Information

### Maintenance and Lubrication

#### Capacities - Approximate Fluid

Application	Specification	
	Metric	English
<b>Cooling System</b>		
Engine Cooling, 2.2L	9.7 L	10.3 qt
Engine Cooling, 2.4L	10.1 L	10.7 qt
<b>Engine Crankcase</b>		
With Filter	3.8 L	4.0 qt
<b>Fuel System</b>		
Fuel Tank	56.8 L	15 gal
<b>Power Steering System</b>	0.70 L	1.5 pt
<b>Transaxle</b>		
3T40 Transaxle Bottom Pan Removal	3.8 L	4.0 qt
3T40 Transaxle Complete Overhaul	6.6 L	7.0 qt
3T40 Transaxle Dry	8.5 L	9.0 qt
4T40E/4T45E Transaxle Bottom Pan Removal	6.5 L	6.9 qt
4T40E/4T45E Transaxle Complete Overhaul	9.0 L	9.5 qt
4T40E/4T45E Transaxle Dry	12.2 L	12.9 qt
Manual Transaxle Complete Drain and Refill	1.9 L	2.0 qt

#### Tire Inflation Pressure Specifications

Application	Specification	
	Metric	English
Tire Inflation; Front Tires	207 kPa	30 psi
Tire Inflation; Rear Tires	207 kPa	30 psi
Tire Inflation; Convertible Front Tires	207 kPa	30 psi
Tire Inflation; Convertible Rear Tires	193 kPa	28 psi
Tire Inflation; Compact Spare	420 kPa	60 psi

#### Maintenance Items

Application	Specification
Air Cleaner Filter, 2.2L	AC Type A-1172C
Air Cleaner Filter, 2.4L	AC Type A-1172C
Engine Oil Filter, 2.2L	AC Type PF47
Engine Oil Filter, 2.4L	AC Type PF44
Spark Plug and Gap, 2.2L	AC Type 41-928, 1.27 mm (0.050 in) Gap
Spark Plug and Gap, 2.4L	AC Type 41-942, 1.27 mm (0.050 in) Gap

**Fluid and Lubricant Recommendations**

<b>Application</b>	<b>Fluid/Lubricant</b>
Automatic Transmission	DEXRON®-III Automatic Transmission Fluid.
Engine Coolant	50/50 mixture of clean, drinkable water and use only GM Goodwrench® DEX-COOL® or Havoline® DEX-COOL® coolant.
Engine Oil	Engine oil with the American Petroleum Institute Certified for Gasoline Engines "Starburst" symbol of the proper viscosity. To determine the preferred viscosity for your vehicle's engine, refer to Engine Oil Viscosity in Explanation of Scheduled Services.
Hydraulic Brake System	Delco Supreme 11® Brake Fluid (GM P/N 12377967 or equivalent DOT-3 brake fluid).
Parking Brake Cable Guides	Chassis lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Power Steering System	GM Power Steering Fluid (GM P/N 1052884 - 1 pint or 1050017 - 1 quart, or equivalent).
Chassis Lubricant	Chassis lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Front Wheel Bearings	Wheel Bearing Lubricant (GM P/N 1051344 or equivalent) or lubricant meeting requirements of NLGI #2, Category GC or GC-LB.
Propshaft Splines and Universal Joints	Chassis lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Windshield Washer Solvent	GM Optikleen® Washer Solvent (GM P/N 1051515) or equivalent.

**Tire and Wheel Runout Specifications**

Application	Specification	
	Metric	English
<b>Tire and Wheel Assembly - Lateral and Radial</b>		
• Off-Vehicle	1.27 mm	0.050 in
• On-Vehicle	1.52 mm	0.060 in
<b>Wheel, Aluminum</b>		
• Lateral	0.762 mm	0.030 in
• Radial	0.762 mm	0.030 in
<b>Wheel, Steel</b>		
• Lateral	1.143 mm	0.045 in
• Radial	1.015 mm	0.040 in
<b>Wheel Hub/Axle Flange - Guideline</b>	0.130 mm	0.005 in
<b>Wheel Stud - Guideline</b>	0.25 mm	0.010 in

## Descriptions and Operations

### Power Steering System Description and Operation w/o Electro-Hydraulic Steering

#### Fluid Specifications

Application	Type of Material	GM Part Number
Lubricant	GM Power Steering Fluid	1050017
Lubricant	GM Cold Climate Power Steering Fluid	12345866

#### Capacities - Approximate Fluid

Application	Specification	
	Metric	English
Complete System	0.70L	1.5 pts
Pump Only	0.50L	1 pt

#### Power Steering Pump Description

The power steering pump system consists of the following major components:

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

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

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

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

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

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

The power steering pump is driven by the accessory drive belt. No adjustment of the belt is required.

## **Power Steering Gear Description**

The movement of the steering wheel has the following results:

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

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

The integral pick piston attaches to the rack.

The integral rack piston has the following effects:

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

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

## **Steering Wheel and Column - Standard Description and Operation**

The steering wheel and column has 4 primary functions:

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

### **Vehicle Steering**

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

### **Vehicle Security**

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

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

### **Driver Convenience**

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

- The turn signal switch
- The hazard switch
- The headlamp dimmer switch
- The wiper/washer switch
- The horn pad/cruise control switch

- The redundant radio/entertainment system controls
- The tilt or tilt/telescoping functions
- The HVAC controls

## **Driver Safety**

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

## **Suspension Description and Operation**

### **Front Suspension**

The front suspension has 2 primary purposes:

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

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

The front suspension is a combination of the strut and the spring design. The control arms pivot from the crossmember. Conventional rubber bushings are used for the lower control arm pivots. The upper end of the strut is isolated by a rubber mount. This contains a bearing in order to allow the wheel to turn.

The lower end of the steering knuckle pivots on a ball joint riveted to the control arm. The ball joint is fastened to the steering knuckle with a castellated nut and cotter pin.

### **Rear Suspension**

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

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

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

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

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

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

## Wheels and Tires

### Fastener Tightening Specifications

Application	Specification	
	Metric	English
All Wheel Nuts	140 N·m	100 lb ft

### General Description

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

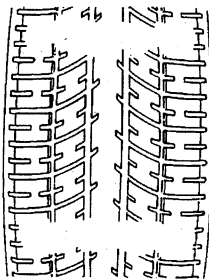
The following factors have an important influence on tire life:

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

The following factors increase tire wear:

- Heavy cornering
- Excessively rapid acceleration
- Heavy braking

### Tread Wear Indicators Description



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

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

### Metric Wheel Nuts and Bolts Description

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

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

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

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



## Tire Inflation Description

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

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

Inspect the tire pressure when the following conditions apply:

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

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

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

### Inflation Pressure Conversion (Kilopascals to PSI)

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

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

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

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

- A tire squeal on turns
- Hard steering
- Rapid wear and uneven wear on the edge of the tread
- Tire rim bruises and tire rim rupture
- Tire cord breakage
- High tire temperatures

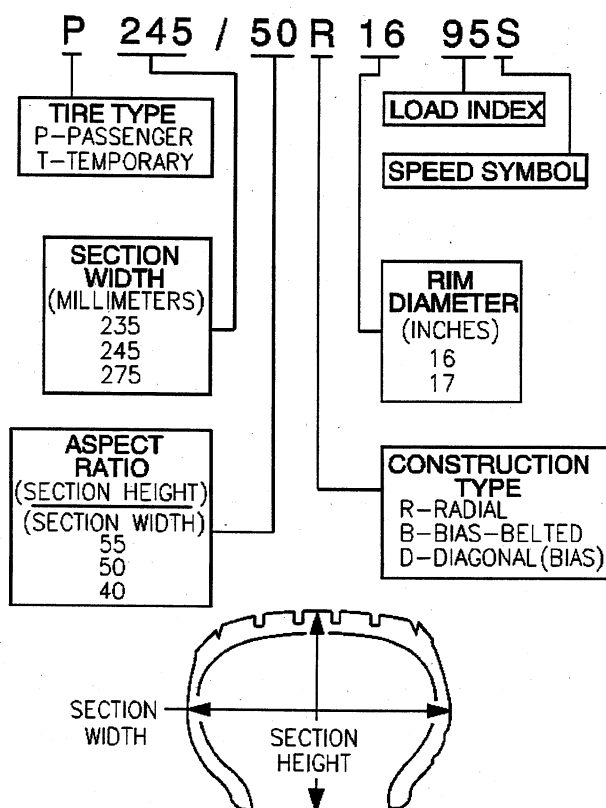
- Reduced vehicle handling
- High fuel consumption
- Soft riding

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

- Uneven braking
- Steering lead
- Reduced vehicle handling

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

### P-Metric Sized Tires Description



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

## **Braking System Description and Operation**

### **Hydraulic Brake System Description and Operation**

#### **System Component Description**

The hydraulic brake system consists of the following:

##### **Hydraulic Brake Master Cylinder Fluid Reservoir**

Contains supply of brake fluid for the hydraulic brake system.

##### **Hydraulic Brake Master Cylinder**

Converts mechanical input force into hydraulic output pressure.

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

##### **Hydraulic Brake Pressure Balance Control System**

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

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

##### **Hydraulic Brake Pipes and Flexible Brake Hoses**

Carries brake fluid to and from hydraulic brake system components.

##### **Hydraulic Brake Wheel Apply Components**

Converts hydraulic input pressure into mechanical output force.

#### **System Operation**

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

## **Brake Assist System Description and Operation**

#### **System Component Description**

The brake assist system consists of the following:

##### **Brake Pedal**

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

##### **Brake Pedal Pushrod**

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

##### **Vacuum Brake Booster**

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

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

### **Vacuum Source**

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

### **Vacuum Source Delivery System**

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

### **System Operation**

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

## **Disc Brake System Description and Operation**

### **System Component Description**

The disc brake system consists of the following components:

#### **Disc Brake Pads**

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

#### **Disc Brake Rotors**

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

#### **Disc Brake Pad Hardware**

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

#### **Disc Brake Caliper Hardware**

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

### **System Operation**

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

## **Drum Brake System Description and Operation**

### **System Component Description**

The drum brake system consists of the following:

#### **Drum Brake Shoes**

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

#### **Brake Drums**

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

#### **Drum Brake Hardware**

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

#### **Drum Brake Adjusting Hardware**

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

### **System Operation**

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

## **Park Brake System Description and Operation**

### **System Component Description**

The park brake system consists of the following:

#### **Park Brake Lever Assembly**

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

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

#### **Park Brake Cables**

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

#### **Park Brake Cable Equalizer**

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

### **Park Brake Apply Lever**

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

### **Park Brake Actuator/Adjuster**

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

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

### **Drum Brake Shoes**

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

## **System Operation**

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

## **ABS Description and Operation**

### **Antilock Brake System**

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

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

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

## Engine Description and Operation

### Engine Mechanical – 2.2L

#### Engine Mechanical Specifications

Application	Specifications	
	Metric	English
General Data		
• Engine Type	L-4	
• Regular Production Option (RPO) Code LN2 VIN Code 4		
• Displacement	2.2 L	134 CID
• Bore	89 mm	3.5 in
• Stroke	88 mm	3.46 in
• Compression Ratio	9:1	
• Firing Order	1-3-4-2	
Lubricating System		
• Oil Pressure @ 65°C (150°F)	348 kPa	56 psi @ 3000 RPM

#### Fastener Tightening Specifications

Application	Specifications	
	Metric	English
Accelerator Cable Mounting Bracket	10 N·m	89 lb in
Accessory Bracket Bolts	50 N·m	37 lb ft
Accessory Drive Belt Idler Pulley	50 N·m	37 lb ft
Camshaft Position Sensor to Block Bolt	10 N·m	89 lb in
Camshaft Rear Cover Bolts	12 N·m	106 lb in
Camshaft Sprocket	130 N·m	96 lb ft
Camshaft Thrust Plate Bolts	12 N·m	106 lb in
Clutch Cover and Pressure Plate Assembly Bolts		
• First Pass	20 N·m	15 lb ft
• Final Pass	45 degrees	
Connecting Rod Cap Nuts	52 N·m	38 lb ft
Crankcase Front Cover Bolts	11 N·m	97 lb in
Crankshaft Main Bearing Cap Bolts	95 N·m	70 lb ft
Crankshaft Pulley Hub to Crankshaft Bolts	105 N·m	77 lb ft
Crankshaft Pulley to Hub Bolt	50 N·m	37 lb ft
Crankshaft Sensor Bolt	8 N·m	72 lb in
Cylinder Head Bolts -- Long		
• First Pass	63 N·m	46 lb ft
• Final Pass	90 degrees	
Cylinder Head Bolts -- Short		
• First Pass	58 N·m	43 lb ft
• Final Pass	90 degrees	
Direct Ignition System Coil Assembly	25 N·m	18 lb ft
Engine Lift Bracket Nut	50 N·m	37 lb ft
Engine Mount Assembly Cage Nuts	45 N·m	33 lb ft
Engine Mount Assembly to Accessory Bracket Bolts		
• First Pass	60 N·m	44 lb ft
• Final Pass	90 degrees	

Engine Mount Assembly to Body Nuts	66 N·m	49 lb ft
Engine Mount Strut Bolt		
• First Pass	100 N·m	74 lb ft
• Final Pass	90 degrees	
Engine Mount Strut Bracket Bolts (Front)	66 N·m	49 lb ft
Engine Mount Strut Bracket Bolts (Rear)	75 N·m	55 lb ft
Exhaust Manifold Nuts	13 N·m	118 lb in
Flywheel Bolts	75 N·m	55 lb ft
Intake Manifold Bolts	24 N·m	17 lb ft
Intake Manifold Nuts	24 N·m	17 lb ft
Intake Manifold Studs	12 N·m	105 lb in
Knock Sensor	19 N·m	26 lb ft
Lifter Guide	11 N·m	97 lb in
Oil Fill Tube	50 N·m	37 lb ft
Oil Filter	17 N·m	13 lb ft
Oil Filter Adapter	35 N·m	26 lb ft
Oil Gallery Plug (Large) - at Rear of Engine Block	33 N·m	24 lb ft
Oil Gallery Plug (Small) - at Rear of Engine Block	15 N·m	11 lb ft
Oil Gallery Plugs - at Side of Block above Oil Filter	21 N·m	15 lb ft
Oil Pan	10 N·m	89 lb in
Oil Pressure Sensor/Switch	12 N·m	106 lb in
Oil Pump Cover Bolts	10 N·m	89 lb in
Oil Pump Drive Assembly	25 N·m	18 lb ft
Oil Pump Mounting Bolt	44 N·m	32 lb ft
Oxygen Sensor	42 N·m	31 lb ft
Rocker Arm Bolts	25 N·m	19 lb ft
Rocker Arm Cover Bolts	10 N·m	89 lb in
Serpentine Drive Belt Tensioner Bolt	50 N·m	37 lb ft
Spark Plugs	17 N·m	13 lb ft
Throttle Body to Intake Manifold Bolts	10 N·m	89 lb in
Timing Chain Tensioner Bolts	24 N·m	18 lb ft
Water Jacket Drain Plug	15 N·m	11 lb ft
Water Outlet Pipe	26 N·m	19 lb ft
Water Pump	25 N·m	18 lb ft
Water Pump Inlet	25 N·m	18 lb ft
Water Pump Pulley Bolts	30 N·m	22 lb ft

### 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



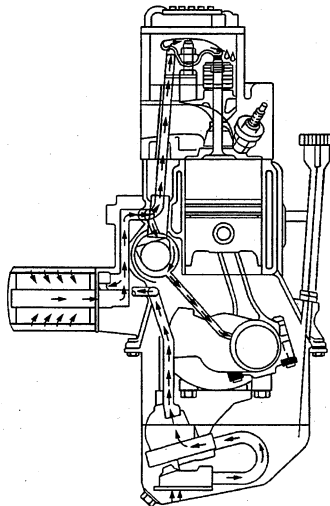
The drive belt system may use one belt or two belts. The drive belt is thin so that it can bend backwards and has several ribs to match the grooves in the pulleys. There also may be a V-belt style belt used to drive certain accessory drive components. The drive belts are made of different types of rubbers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

## Lubrication System



Full pressure lubrication, through a full-flow oil filter is supplied by a gear-type oil pump. Oil is drawn up through the oil pump screen and passes through the pump to the oil filter. The oil filter is a full-flow paper element unit with an anti-drain back valve. An oil filter bypass valve is used to ensure adequate oil supply, in the event the filter becomes plugged or develops excessive pressure drop. Filtered oil flows into the main gallery and then to the camshaft, the balance shaft, the rear bearing, and the crankshaft bearings. The valve lifter oil gallery supplies oil to the valve lifters. Oil flows from the valve lifters through the hollow valve pushrods to the valve rocker arms. Oil drains back to the crankcase through the oil drain holes in the cylinder head. The camshaft timing chain is drip fed from the front camshaft bearing. The pistons and piston pins are lubricated by oil splash.

## Engine Component Description

### Engine Block

The engine block is cast iron. The engine block has four cylinders arranged in-line. The engine block is a one piece casting. The cylinders are encircled by coolant jackets.

### **Cylinder Head**

The cylinder head is cast aluminum made in a lost-foam casting process. This results in a casting requiring very little final machining. The cylinder head has sintered powdered metal valve guides and valve seats.

### **Crankshaft**

The crankshaft is cast nodular iron. Five crankshaft bearings support the crankshaft. The bearings are retained by bearing caps. Number four crankshaft bearing also serves as the crankshaft thrust bearing. The bearing caps are machined with the block for proper alignment and clearances. The bearing caps are retained by two bolts each. Four connecting rod journals are spaced 90 degrees apart. There is one connecting rod on each journal.

### **Piston and Connecting Rod Assemblies**

The pistons are cast aluminum. The pistons use two compression rings and one oil control ring assembly. The piston is a low friction, lightweight design with a flat top and barrel shaped skirt. The piston pins are chromium steel. They have a floating fit in the piston and are retained by a press fit in the connecting rod. The connecting rods are forged steel. The connecting rods are machined with the rod cap installed for proper clearances and alignments.

### **Camshaft**

The camshaft is steel. The camshaft is supported by five bearings pressed into the engine block. The camshaft is of an assembled design with each lobe, journal, and the oil pump drive gear assembled onto a hollow tube which is then expanded to hold the components in place. The camshaft timing chain sprocket mounted to the front of the camshaft is driven by the crankshaft sprocket thorough a camshaft timing chain.

### **Valve Train**

The LN2 valve train utilizes cast steel rocker arms with a roller bearing fulcrum. Motion is transmitted from the camshaft through the hydraulic roller valve lifters and the tubular pushrods to the valve rocker arms. The valve rocker arm pivots on a roller bearing in order to open the valve. The valve train is of the net-lash type without provision for manual adjustment. All valve train lash is taken up by hydraulic roller valve lifters.

The valve springs are of a conical type which reduce valve train harmonics and noise.

The valve seals are integral with the valve spring seats.

### **Intake Manifold and Fuel Rail**

The intake manifold is constructed of a composite material incorporating metallic compression limiters at the mounting points for the throttle body, fuel rail, and the manifold to cylinder head flange. The fuel rail is of an assembled tubular design.

### **Exhaust Manifold**

The exhaust manifold is cast iron.

**Engine Mechanical – 2.4L**

Application	Specification	
	Metric	English
General Data		
Engine Type	Inline 4 Cylinder	
Displacement	2.4 L	146 CID
Regular Production Option (RPO) Code LD9 VIN Code T		
Bore	90 mm	3.54 in
Stroke	94 mm	3.70 in
Compression Ratio	9.5 to 1	
Firing Order	1-3-4-2	
Lubricating System		
Oil Pressure @ 3,000 RPM	207 kPa	30 psi min
Oil Pressure @ 900 RPM	69 kPa	10 psi min

**Fastener Tightening Specifications**

Application	Specifications	
	Metric	English
Balance Shaft Cover Nut and Bolt	13 N·m	115 lb in
Balance Shaft Driven Sprocket Bolt (left hand thread)		
• First Pass	40 N·m	30 lb ft
• Final Pass	45 degrees	
Balance Shaft to Housing Bolts 8 mm hex		
• First Pass	10 N·m	89 lb in
• Final Pass	40 degrees	
Balance Shaft Housing Bolts 10 mm hex		
• First Pass	15 N·m	11 lb ft
• Final Pass	40 degrees	
Balance Shaft to block Bolts 13 mm hex		
• First Pass	25 N·m	18 lb ft
• Final Pass	70 degrees	
Balance Shaft to block Bolts 15 mm hex	53 N·m	39 lb ft
Balance Shaft to Block Bolts 18 mm hex		
• First Pass	40 N·m	30 lb ft
• Final Pass	60 degrees	
Camshaft (exhaust) Rear Cover	14 N·m	124 lb in
Camshaft Position Sensor Bolt	10 N·m	89 lb in
Camshaft Sprocket to the Camshaft Bolt	70 N·m	52 lb ft
Connecting Rod Nuts		
• First Pass	25 N·m	18 lb ft
• Final Pass	80 degrees	
Coolant Bleeder Valve	Fully Driven, Seated , Not Stripped	
Coolant Outlet to Cylinder Head	26 N·m	19 lb ft
Coolant Pump to the Timing Chain Housing	26 N·m	19 lb ft
Coolant Pump to the Coolant Pump Cover	14 N·m	124 lb in
Coolant Pump Cover to the Block	26 N·m	19 lb ft

Crankshaft Balancer to the Crankshaft		
• First Pass	175 N·m	129 lb ft
• Final Pass	90 degrees	
Crankshaft Bearing Cap Bolts		
• First Pass	20 N·m	15 lb ft
• Final Pass	90 degrees	
Crankshaft Position Sensor to Block	9 N·m	80 lb in
Cylinder Head Bolts	Refer to Procedure	
Engine Coolant Air Bleed Pipe	14 N·m	124 lb in
Engine Coolant Air Bleed Pipe Nut	42 N·m	31 lb ft
Engine Coolant Temperature Sensor to the Coolant Outlet	11 N·m	97 lb in
Engine Coolant Temperature Gauge Sensor to the Water Outlet	Fully Driven, Seated, Not Stripped	
Engine Lift Bracket	96 N·m	68 lb ft
Engine Mount Bracket Adapter to Block Bolt Manual Trans		
• First Pass	60 N·m	44 lb ft
• Final Pass	60 degrees	
Engine Mount Bracket Adapter to Block Bolt Auto Trans		
• First Pass	60 N·m	44 lb ft
• Final Pass	60 degrees	
Engine Mount (right hand side) to the Engine Mount Bracket Bolts	62 N·m	46 lb ft
Engine Mount (right hand side) to the Body Support Nut	44 N·m	32 lb ft
Engine Mount (right hand side) to the body support bolt	66 N·m	49 lb ft
Engine Mount Strut	100 N·m	74 lb ft
Engine Mount Strut Bracket Front Bolts	66 N·m	49 lb ft
Engine Mount Strut Bracket Bottom Bolts	130 N·m	96 lb ft
EVAP Canister Purge Valve Solenoid Bracket Bolt	8 N·m	72 lb in
Exhaust Manifold Upper Heat Shield to the Manifold Bolts	26 N·m	19 lb ft
Exhaust Manifold to the Cylinder Head Nuts	42 N·m	31 lb ft
Exhaust Manifold to the Cylinder Head Studs	11 N·m	97 lb in
Exhaust Manifold Brace to the Exhaust Manifold Bolt	56 N·m	41 lb ft
Exhaust Manifold Brace to the Oil Pan Nuts	26 N·m	19 lb ft
Flywheel to Clutch Cover		
• First Pass	20 N·m	15 lb ft
• Final Pass	45 degrees	
Flywheel to the Converter	66 N·m	49 lb ft
Flywheel to the Crankshaft		
• First Pass	30 N·m	22 lb ft
• Final Pass	45 degrees	
Front Cover to the Timing Chain Housing	12 N·m	106 lb in
Fuel Pipe Bracket to the Camshaft Housing		
• First Pass	15 N·m	11 lb ft
• Final Pass	30 degrees	
Fuel Pipe to the Fuel Rail Nut	30 N·m	22 lb ft
Fuel Rail to the Camshaft Housing	26 N·m	19 lb ft
Ignition Coil and Module Assembly to the Camshaft Housings	22 N·m	16 lb ft
Intake Manifold to the Cylinder Head Bolts/Nuts	24 N·m	18 lb ft
Intake Manifold to the Cylinder Head Studs	11 N·m	97 lb in
Knock Sensor	20 N·m	15 lb ft
Oil Filter Connector to the Block	29 N·m	21 lb ft
Oil/Air Separator To Block Bolts	24 N·m	18 lb ft
Oil Dipstick Tube Bolt/Screw	8 N·m	71 lb in
Oil Filter to the Block	3/4 to one complete turn after gasket	

	contact	
Oil Pan Bolts	24 N·m	18 lb ft
Oil Pan Bolts, Second Set	12 N·m	106 lb in
Oil Pan Drain Plug	26 N·m	19 lb ft
Oil Pan Studs	26 N·m	19 lb ft
Oil Passage Plugs, Block 1/8x27	10 N·m	89 lb in
Oil Passage Plugs, 3/8x18	30 N·m	22 lb ft
Oil Passage Plugs, 1/4x18	20 N·m	15 lb ft
Oil Passage Plug Bolt	30 N·m	22 lb ft
Oil Pressure Switch	14 N·m	124 lb in
Oil Pump to the Balance Shaft Housing	12 N·m	106 lb in
Oil Pump to the Balance Shaft Housing	10 N·m	89 lb in
Oxygen Sensor To Exhaust Manifold	42 N·m	31 lb ft
Powersteering Pipe to the Pump Nut	27 N·m	20 lb ft
Powersteering Pump to the Cam Carrier Bolts	26 N·m	19 lb ft
Rear Crankshaft Seal Housing to Block	12 N·m	106 lb in
Spark Plugs to the Cylinder Head	18 N·m	13 lb ft
Starter to the Block Bolt	90 N·m	66 lb ft
Tensioner to Tensioner Bracket Nut	54 N·m	40 lb ft
Timing Chain Housing to the Camshaft Housings	26 N·m	19 lb ft
Timing Chain Housing to the Block Bolts/Studs	29 N·m	21 lb ft
Timing Chain Tensioner to Housing and Block	10 N·m	89 lb in
Throttle Body to the Intake Manifold	10 N·m	89 lb in
Thrust Plate to the Balance Shaft Housing	13 N·m	115 lb in
Transaxle To Block Bolt	58 N·m	43 lb ft
Transaxle To Block Nut	66 N·m	49 lb ft
Transaxle To Block Stud	13 N·m	115 lb in

### 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

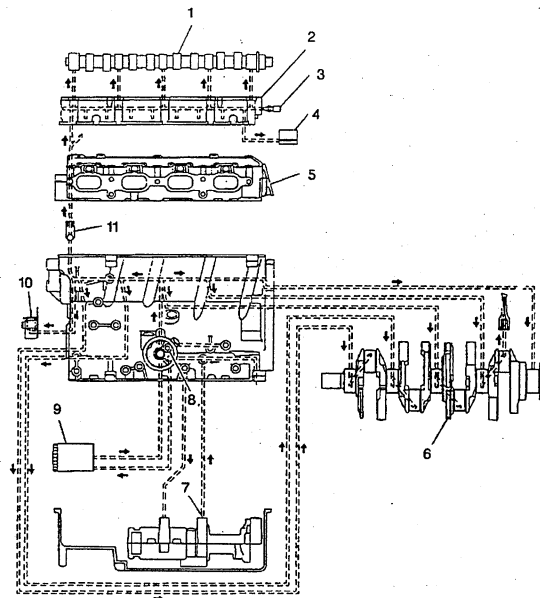
The drive belt system may use one belt or two belts. The drive belt is thin so that it can bend backwards and has several ribs to match the grooves in the pulleys. There also may be a V-belt style belt used to drive certain accessory drive components. The drive belts are made of different types of rubbers (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.

## Lubrication System



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 (7) thorough a fixed inlet screen. The oil pump is driven by one of the balance shafts. The oil pump body and the cover are cast aluminum, and the gerotor gears are steel. The pressurized oil from the pump passes through the oil filter (9). The oil filter is located on the left (front) side of the engine block. A by-pass valve (8) in the engine block 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, the crankshaft (6), the timing chain hydraulic tensioner (10), the lifters (4) and the camshafts (1). 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 main bearing furnishes oil to the drilled crankshaft passages. An oil cooling hole, which indexes once each revolution with the connecting rod oil feed hole, is drilled in the connecting bearing surface. The pressurized oil passages through the oil flow check valve (11) into the cylinder head (5) and then into each camshaft housing (2). Cast passages feed each valve lifter (4) and drilled passages feed each camshaft bearing surface. An engine oil pressure switch or sensor (3) is installed at the end of the intake camshaft housing oil gallery. Oil returns to the oil pan through passages cast into the camshaft housings and the cylinder head. The timing chain housing drains directly into the oil pan.

## **Engine Component Description**

### **Cylinder Block**

The cylinder block is cast gray iron and has four cylinders arranged "In-Line". The casting is a semi-open deck type with deep skirt design.

### **Crankshaft**

The crankshaft is cast nodular iron with eight counterweights. The number five counterweight is also the ignition system reluctor wheel. The main bearing journals are cross-drilled, except #5, and the upper bearings are grooved. The crankshaft has a pressed-on balance shaft driven sprocket. Number three main bearing is the thrust bearing. A harmonic balancer is used to control torsional vibration.

### **Connecting Rod and Piston**

The connecting rods are powdered metal, heat treated and shot peened. The connecting rod incorporates the floating piston pin. An oil cooling hole, which indexes once per revolution with the connecting rod oil feed hole, is drilled in the large end of the rod for piston cooling. The pistons are cast aluminum. The piston rings are of a low tension type to reduce friction. The top compression ring is steel 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. The balance shaft assembly acts like an oil baffle.

### **Balance Shaft Assembly**

There are two shafts supported on bearing insets in a cast split housing. The balance shaft assembly is mounted to the bottom of the engine block. The longer shaft is chain driven by a sprocket on the crankshaft. The shorter shaft is driven by the longer shaft. The shafts rotate at twice the engine speed. The shorter shaft drives the oil pump which is attached to the balance shaft housing. The housing assembly contains the oil pump pick-up and screen on the bottom of the assembly.

### **Cylinder Head**

The cylinder head is a semi-permanent mold aluminum casting. Pressed-in powdered metal valve guides and valve seat insets are used. The fuel injection nozzle is located in the intake port.

### **Valves**

There are two intake and two exhaust valves per cylinder. The valve springs are conical-shaped to fit inside the valve lifter body. 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 has a pressed-in hex insert. The hex insert is used to drive the direct drive power steering pump. The intake camshaft also has the camshaft position sensor lobe cast onto it.

### **Valve Lifters**

Direct acting hydraulic valve lifter are used. The valve lifter body includes a hardened iron contact foot bonded to a steel shell. These lifters are not repairable.

## Camshaft Housings and Covers

The camshaft housings and covers are cast aluminum. The camshafts run directly on the housings and covers without bearing inserts.

## Camshaft Drive

An inverted tooth chain is used. A hydraulic tensioner and three guides control chain motion. The crankshaft and camshaft sprockets are powdered metal. The coolant pump sprocket, which acts as the timing chain idler sprocket, is steel.

## Timing Chain Housing and Cover

The timing chain housing is die cast aluminum. The housing assembly includes the oil fill location. The timing chain cover is laminated stamped steel and retains the crankshaft front seal.

## Intake and Exhaust Manifold

The intake manifold is made of composite plastic. The exhaust manifold is cast iron.

## Engine Cooling

### Engine Cooling System Approximate Capacities

Application	Specifications	
	Metric	English
2.2 L Engine (RPO LN2)	9.1 L	9.6 qt
2.4 L Engine (RPO LD9)	9.4 L	9.9 qt

### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Coolant Outlet Bolts 2.2L (LN2)	14 N·m	124 lb in
Coolant Pump Cover to Engine Block Bolts 2.4L (LD9)	26 N·m	19 lb ft
Coolant Pump Pulley to Pump Bolts 2.2L (LN2)	30 N·m	22 lb ft
Coolant Pump to Block Bolts 2.2L (LN2)	25 N·m	18 lb ft
Coolant Pump to Coolant Pump Cover Bolts 2.4L (LD9)	14 N·m	124 lb in
Coolant Pump to Timing Chain Housing Nuts 2.4L (LD9)	26 N·m	19 lb ft
Engine Cooling Fan Bolt	6 N·m	53 lb in
Radiator Outlet Pipe Bolts 2.2L (LN2)	14 N·m	124 lb in
Radiator Outlet Pipe to Coolant Pump Cover Bolts 2.4L (LD9)	14 N·m	124 lb in
Radiator Outlet Pipe to Engine Oil Pan Bolt 2.4L (LD9)	25 N·m	18 lb ft
Radiator Surge Tank Cap	4 N·m	35 lb in
Radiator Upper Mount Bolt	10 N·m	89 lb in
Surge Tank Inlet Hose Clip	10 N·m	89 lb in
Transaxle Oil Cooler Line Fittings at Radiator	36 N·m	27 lb ft
Transaxle Oil Cooler Line Bracket	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. Its purpose is to help regulate the operating temperature of the engine. It utilizes a temperature sensitive wax-pellet element. The element connects to a valve through a small piston. When the element is heated, it expands and exerts pressure against the small piston. This pressure forces the valve to open. As the element is cooled, it contracts. This contraction allows a spring to push the valve closed.

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

### **Engine Oil Cooler**

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

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

### **Transmission Oil Cooler**

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

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

## Engine Electrical

### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Battery Retainer Bolt	18 N·m	13 lb ft
Front Generator Bracket to Block Attaching Bolt (2.2L)	50 N·m	37 lb ft
Generator (Upper) Front Mounting Bolt (2.2L)	30 N·m	22 lb ft
Generator (Lower) Front Mounting Bolt (2.2L)	50 N·m	37 lb ft
Generator Mounting Bolt (2.4L)	50 N·m	37 lb ft
Negative Battery Cable Terminal Nut	15 N·m	11 lb ft
Negative Battery to Transaxle Stud Nut	25 N·m	18 lb ft
Negative Battery Cable to Tray Bolt	35 N·m	26 lb ft
Positive Battery Cable Terminal Nut	15 N·m	11 lb ft
Positive Battery Cable to Starter Solenoid Nut	11 N·m	8 lb ft
Rear Generator Bracket to Block Attaching Bolt (2.2L)	85 N·m	63 lb ft
Rear Generator Bracket to Block Attaching Nut (2.2L)	43 N·m	32 lb ft
Rear of Generator to Bracket Bolt (2.2L)	30 N·m	22 lb ft
Starter Motor Mounting Bolt (2.4L)	43 N·m	32 lb ft
Starter Motor to Engine Bolt (2.2L)	50 N·m	37 lb ft
Starter Motor to Engine Bolt (2.4L)	90 N·m	66 lb ft
Starter Motor Solenoid to the S Terminal Nut	3 N·m	27 lb in

### Battery Usage

Application	Specification
<b>2.2L 4cyl (LN2, L61)</b>	
GM Part Number	19000670
Cold Cranking Amperage (CCA)	525
Reserve Capacity	90 min.
Replacement Model Number	75-60
<b>2.4L 4cyl (LD9)</b>	
GM Part Number	19000672
Cold Cranking Amperage (CCA)	600
Reserve Capacity	90 min.
Replacement Model Number	75A-72

### Generator Usage

Engine	Generator Model	Option Code	Rated Output AMPS	Load Test Output AMPS
<b>LN2 Engine</b>	CS130D	K60	100 A	70 A
<b>LD9 Engine</b>	CS130D	K68	105 A	73 A

### Starter Motor Usage

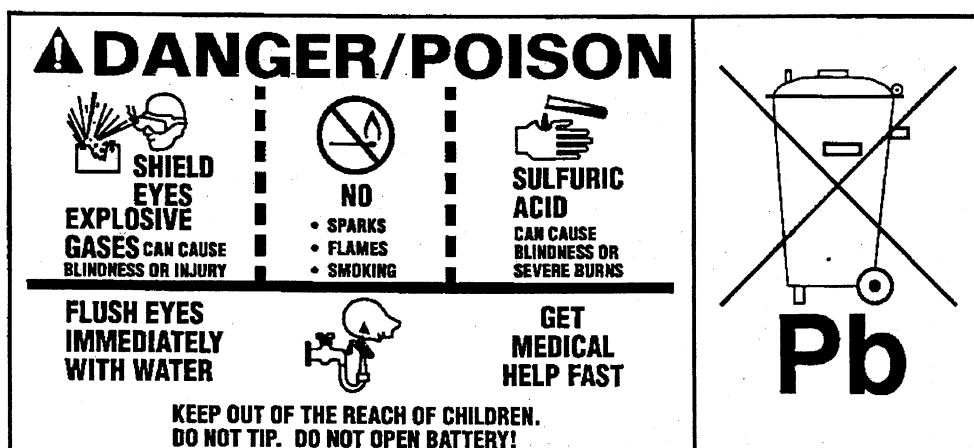
Engine Type	Starter Type
Gasoline Engine	PG-260

## Battery Description and Operation

### Caution

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

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



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

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

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

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

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

CATALOG NO.

1819

CCA 770	LOAD TEST 380
REPLACEMENT MODEL 100-6YR	

A battery has 2 ratings:

- Reserve capacity
- Cold cranking amperage

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

### Reserve Capacity

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

### Cold Cranking Amperage

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

### Circuit Description

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

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

### Starting System Description and Operation

The PG-260 is a non-repairable starter motor. It has pole pieces that are arranged around the armature within the starter housing. When the solenoid windings are energized, the pull-in winding circuit is completed to ground through the starter motor. The hold-in winding circuit is completed to ground through the solenoid. The windings work together magnetically to pull in and hold in the plunger. The plunger moves the shift lever. This action causes the starter drive assembly to rotate on the armature shaft spline

as it engages with the flywheel ring gear on the engine. At the same time, the plunger closes the solenoid switch contacts in the starter solenoid. Full battery voltage is then applied directly to the starter motor and it cranks the engine.

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

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

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

### **Circuit Description**

Moving the ignition switch to the CRANK position sends a 12 V signal to the park neutral switch on the transmission (or clutch switch). When the park neutral switch is in the PARK or NEUTRAL position (or the clutch switch is closed), it completes the B+ voltage circuit to the starter solenoid S terminal.

### **Charging System Description and Operation**

#### **Generator**

The CS130D generator is non-repairable. They are electrically similar to earlier models. The generator features the following major components:

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

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

The AD stands for Air-cooled Dual internal fan; the 2 is an electrical design designator; the 30 denotes the outside diameter of the stator laminations in millimeters, over 100 millimeters. The generator (K60) is rated at 100 amperes, the (K68) is rated at 105 amperes.

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

## Regulator

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

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

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

## Circuit Description

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

When the engine is running, the generator turn-on signal is sent to the generator from the PCM, turning on the regulator. The generator's voltage regulator controls the current flow to the rotor, thereby controlling the generator output voltage. The rotor current is proportional to an electrical pulse width modulated voltage supplied by the regulator. When the engine is started, the regulator senses generator rotation by detecting AC voltage at the stator through an internal wire. Once the engine is running, the regulator varies the field current by controlling the pulse width. This regulates the generator's output voltage for proper battery charging and electrical system operation. The generator F terminal is connected internally to the voltage regulator and externally to the PCM. When the voltage regulator detects a charging system problem, it grounds this circuit to signal the PCM that a problem exists.

When the ignition switch is turned to RUN, the charge indicator turns ON for a few seconds (bulb check), then turns OFF. The powertrain control module (PCM) commands the charge indicator ON or OFF by sending a Class 2 serial data message to the instrument panel cluster.

## Ignition System Description

The ignition system components covered in this section include:

- Spark Plugs
- Secondary Ignition wiring.
- All engines have electronic Ignition Systems.



## Engine Controls

### Engine Controls - 2.2L (LN2)

#### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accel. Cable Bracket Bolts	12 N·m	106 lb in
Accel. Cable Bracket Nut	26 N·m	19 lb in
Air Cleaner Outlet Resonator Clamp	5 N·m	44 lb in
Air Cleaner Outlet Resonator Mounting Screws	6 N·m	53 lb in
Accel. Pedal Nuts	30 N·m	25 lb in
CKP Sensor Bolts	10 N·m	88 lb in
CMP Sensor Bolts	15 N·m	11 lb ft
Engine Oil Pressure Sensor	12 N·m	106 lb in
EVAP Canister Retainer Attaching Bolt	10 N·m	88 lb in
Flex Duct Clamps	5 N·m	44 lb in
Fuel Filter Fitting	27 N·m	20 lb ft
Fuel Pipe Clamp Bolt	12 N·m	106 lb in
Fuel Pipe Fittings	27 N·m	20 lb in
Fuel Inlet Pipe Nut	30 N·m	22 lb in
Fuel Line Clamp Screws	10 N·m	89 lb in
Fuel line Fitting to Fuel Rail	27 N·m	20 lb in
Fuel Pressure Regulator Retainer Screw	6 N·m	53 lb in
Fuel Rail Attaching Bolts	24 N·m	18 lb in
HO2S 2	41 N·m	30 lb in
ICM Cover Bolts	22 N·m	16 lb in
ICM Screws	4 N·m	35 lb in
Idle Air Control Valve	3 N·m	27 lb in
Ignition Coil Housing Screws	4 N·m	35 lb in
Idle Air Control Valve	3 N·m	27 lb in
Knock Sensor	25 N·m	18 lb ft
Lower Air Cleaner Mounting Bolt	6 N·m	53 lb in
MAP Sensor Attaching Screw	6.5 N·m	53 lb in
Muffler Hanger Bolt	15 N·m	11 lb in
O2S 1	41 N·m	30 lb in
Outlet Pipe Bracket	6 N·m	53 lb in
PCM Retainer Attaching Bolts	10 N·m	88 lb in
PCM Electrical Connector Screws	8 N·m	71 lb in
Purge Valve Mounting Bracket Attaching Bolt	8 N·m	71 lb in
Regulator Retainer	11.5 N·m	102 lb in
Resonator Attaching Bolt	6 N·m	53 lb in
Separator and Solenoid Attaching Bolts	8 N·m	71 lb in
Spark Plugs	18 N·m	13 lb in
Tank Retaining Straps Bolt	35 N·m	26 lb in
Throttle Body Attaching Bolts	6.5 N·m	58 lb in
Throttle Position Sensor	2 N·m	18 lb in
TP Sensor Mounting Screws	3 N·m	27 lb in
Upper Air Cleaner Cover Screws	3 N·m	27 lb in

## Fuel System Specifications

Use regular unleaded gasoline rated at 87 octane or higher. It is recommended that the gasoline meet specifications which have been developed by the American Automobile Manufacturers Association (AAMA) and endorsed by the Canadian Motor Vehicle Manufacturers Association for better vehicle performance and engine protection. Gasoline meeting the AAMA specification could provide improved driveability and emission control system performance compared to other 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.

## Electronic Ignition (EI) System Description

### System Operation

The electronic ignition (EI) system consists of the following:

- Two ignition coils
- The ignition control (IC) module
- The crankshaft position (CKP) sensor
- The camshaft position (CMP) sensor
- The powertrain control (PCM) module

In this system the secondary windings of each coil feed two spark plugs, and neither end of the windings are grounded. The engine cylinders are paired in opposites, i.e. cylinders 1 and 4, and 2 and 3. Each pair is on top dead center at the same time. When a coil discharges both plugs fire at the same time to complete a series circuit. The cylinder on the compression stroke is said to be the event cylinder, the cylinder on the exhaust stroke the waste cylinder. The waste cylinder requires very little of the available energy to fire the spark plug, the event cylinder will use most of the energy. This same process will be repeated when the respective pair of cylinders are on the opposite stroke. This method of ignition is known as waste spark ignition.

It is possible in a waste spark ignition system for a spark plug to fire even if the spark plug's companion plug is disconnected. The disconnected plug wire acts as one plate of a capacitor, with the engine being the other plate. These two capacitor plates are charged as the spark jumps across the gap of the connected spark plug. The plates are then discharged as the secondary energy is dissipated in an oscillating current across the gap of the spark plug that is still connected. Secondary voltage requirements are very high with part of the circuit open, but the ignition coil has enough reserve energy to fire the connected plug at idle. Under high load it is possible neither plug will fire resulting in a severe misfire. In order to properly control the ignition timing, the PCM relies on the following information:

- The engine load (manifold pressure or vacuum)
- The engine coolant temperature
- The intake air temperature
- The crankshaft position
- The engine speed (RPM)
- The knock sensor
- The TP sensor

### **System Components**

#### **The Crankshaft Position (CKP) Sensor**

This system uses a magnetic CKP sensor, mounted remotely from the ICM, which protrudes into the block within approximately 0.050 inches from the crankshaft reluctor. The graphic illustrates a typical sensor in relationship to the crankshaft reluctor. The reluctor is a special wheel which is cast into the crankshaft with 7 slots machined into the wheel, 6 of which are equally spaced (60 degrees apart). A seventh slot is spaced 10 degrees from one of the other slots and serves to generate sync-pulses. As the reluctor rotates as part of the crankshaft, the slots change the magnetic field of the sensor, creating an induced voltage pulse. This signal is known as the 7x or low resolution signal because it occurs 7 times per crankshaft resolution. The PCM uses this signal to determine the speed and position of the crankshaft. The 7x reference signal is also used for fuel injector activation and ignition coil sequencing.

#### **Ignition Coils**

Two separate coils are mounted to the ignition coil assembly. Each coil provides the spark for two plugs simultaneously (waste spark distribution). Each coil can also be replaced separately.

#### **Ignition Control Module (ICM)**

The ICM receives the ignition control (IC) signals from the powertrain control module (PCM) which in turn triggers the corresponding ignition coils. Since the PCM controls spark timing and ignition control during crank and run, there is no bypass mode. The ICM is not repairable. When an ICM is replaced, transfer the remaining components to the new module.

#### **Air Intake System Description**

The air induction system draws outside air through a forward mounted air cleaner. The air cleaner is remotely mounted. The air enters the engine by flowing in through the intake duct into the lower air cleaner, through the air filter, out of the upper air cleaner, through the flex duct, into the air cleaner outlet resonator, and into the throttle body and the intake manifold. The air is then directed into the intake runners, the cylinder head and into the cylinders. A remotely mounted resonator as well as a resonator mounted on the throttle body help to dampen the noise caused by drawing air into the engine.

**Engine Controls - 2.4L (LN9)****Fastener Tightening Specifications**

Application	Specification	
	Metric	English
Accel. Cable Bracket Bolts	12 N·m	106 lb in
Accel. Cable Bracket Nut	26 N·m	19 lb in
Air Cleaner Outlet Resonator Clamp	5 N·m	44 lb in
Air Cleaner Outlet Resonator Mounting Screws	6 N·m	53 lb in
Accel. Pedal Nuts	30 N·m	25 lb in
CKP Sensor Bolts	10 N·m	88 lb in
CMP Sensor Bolts	15 N·m	11 lb ft
Engine Oil Pressure Sensor	12 N·m	106 lb in
EVAP Canister Retainer Attaching Bolt	10 N·m	88 lb in
Flex Duct Clamps	5 N·m	44 lb in
Fuel Filter Fitting	27 N·m	20 lb ft
Fuel Pipe Clamp Bolt	12 N·m	106 lb in
Fuel Pipe Fittings	27 N·m	20 lb in
Fuel Inlet Pipe Nut	30 N·m	22 lb in
Fuel Line Clamp Screws	10 N·m	89 lb in
Fuel line Fitting to Fuel Rail	27 N·m	20 lb in
Fuel Pressure Regulator Retainer Screw	6 N·m	53 lb in
Fuel Rail Attaching Bolts	24 N·m	18 lb in
HO2S 2	41 N·m	30 lb in
ICM Cover Bolts	22 N·m	16 lb in
ICM Screws	4 N·m	35 lb in
Idle Air Control Valve	3 N·m	27 lb in
Ignition Coil Housing Screws	4 N·m	35 lb in
Idle Air Control Valve	3 N·m	27 lb in
Knock Sensor	25 N·m	18 lb ft
Lower Air Cleaner Mounting Bolt	6 N·m	53 lb in
MAP Sensor Attaching Screw	6.5 N·m	53 lb in
Muffler Hanger Bolt	15 N·m	11 lb in
O2S 1	41 N·m	30 lb in
Outlet Pipe Bracket	6 N·m	53 lb in
PCM Retainer Attaching Bolts	10 N·m	88 lb in
PCM Electrical Connector Screws	8 N·m	71 lb in
Purge Valve Mounting Bracket Attaching Bolt	8 N·m	71 lb in
Regulator Retainer	11.5 N·m	102 lb in
Resonator Attaching Bolt	6 N·m	53 lb in
Separator and Solenoid Attaching Bolts	8 N·m	71 lb in
Spark Plugs	18 N·m	13 lb in
Tank Retaining Straps Bolt	35 N·m	26 lb in
Throttle Body Attaching Bolts	6.5 N·m	58 lb in
Throttle Position Sensor	2 N·m	18 lb in
TP Sensor Mounting Screws	3 N·m	27 lb in
Upper Air Cleaner Cover Screws	3 N·m	27 lb in

**Fuel System Specifications**

See Fuel System Specifications for 2.2L Engine above.

## Electronic Ignition (EI) System Description

See Electronic Ignition (EI) System Description for 2.2L Engine above.

## Air Intake System Description

See Air Intake System Description for 2.2L Engine above.

## Exhaust System

### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Exhaust Manifold Heat Shield Bolt (2.4 L)	14 N·m	10 lb ft
Exhaust Manifold Nut	13 N·m	115 lb in
Exhaust Manifold Pipe Bolt	45 N·m	33 lb ft
Flex Decoupler to Exhaust Manifold Bolt (2.4 L)	35 N·m	26 lb ft
Heater Outlet Hose Nut (2.2 L)	25 N·m	18 lb ft
Intermediate Pipe Bolt	30 N·m	22 lb ft
Muffler Hanger Bolt	16 N·m	12 lb ft

### Exhaust System Clearances

Application	Specification	
	Metric	English
All of the Exhaust System Components to all of the Underbody Components (Minimum)	25 mm	1 in
All of the Heat Shields to the Underbody (Maximum)	15 mm	0.60 in
All of the Heat Shields to the Underbody (Minimum)	10 mm	0.40 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.

A flex coupling is used to connect to the exhaust pipe to the exhaust manifold connections. The flex coupling allows angular movement between the engine and the exhaust system.

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:

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

The catalyst in the converter is not serviceable.

### **Muffler**

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

## Transmission/Transaxle Description and Operation

### Manual Transmission - M86/M94 Getrag

#### Fastener Tightening Specifications

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

#### Lubrication Specifications

Application	Specification	
	Metric	English
DEXRON®III	1.7 liters	1.8 quarts

#### Shim Size Specifications

Shim Thickness	
Metric	English
0.5 mm	0.0197 in
0.55 mm	0.0217 in
0.6 mm	0.0236 in
0.65 mm	0.0256 in
0.7 mm	0.0276 in
0.75 mm	0.0295 in
0.8 mm	0.0315 in
0.85 mm	0.0335 in
0.9 mm	0.0354 in
0.95 mm	0.0374 in
1.00 mm	0.0394 in
1.05 mm	0.0413 in
1.1 mm	0.0433 in
1.15 mm	0.0453 in
1.2 mm	0.0473 in
1.25 mm	0.0493 in
1.3 mm	0.0512 in
1.35 mm	0.0531 in

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

## Automatic Transaxle - 3T40

### Fastener Tightening Specifications

Description of Usage	Ref No.*	Qty	Size	Specification	
				Metric	English
Case Cover to Case	62	4	M8x1.25x45	24 N·m	18 lb ft
Case Cover to Case	63	4	M8x1.25x55	24 N·m	18 lb ft
Case Cover to Case	61	1	M8x1.25x40	24 N·m	18 lb ft
Case Cover to Case	60	7	M8x1.25x25	24 N·m	18 lb ft
Case Cover to Case	64	2	M8x1.25x25	24 N·m	18 lb ft
Case Side Cover	--	--	--	20 N·m	15 lb ft
Case to Drive Sprocket Support	114	4	M8x1.25x24	24 N·m	18 lb ft
Control Valve Body Cover to Case	36	11	M8x1.25x16	11 N·m	8 lb ft
Converter Shield	--	--	--	10 N·m	18 lb ft
Cooler Connector to Case	17	2	1/4-18NPSF	38 N·m	28 lb ft
Cooler Pipes at Case	--	--	--	22 N·m	16 lb ft
Cooler Pipes at Radiator	--	--	--	27 N·m	20 lb ft
Flywheel to Torque Converter	--	--	--	62 N·m	46 lb ft
Intermediate Servo Cover to Case	141	4	M6x1.0x20	11 N·m	8 lb ft
Line Pressure Plug	405	1	1/8-27NPTF	11 N·m	8 lb ft
Manual Detent Spring Assembly to Case	418	1	M6x1.0x10	11 N·m	8 lb ft
Oil Feed Tube Bolts	--	--	--	14 N·m	124 lb in
Oil Pan to Case	36	16	M8x1.25x16	10 N·m	89 lb in
Oil Pressure Switch to Valve Body	338	1	1/8-27NPTF	11 N·m	8 lb ft
Park/Neutral Position Switch to Case	--	--	--	24 N·m	18 lb ft
Parking Lock Bracket to Case	712	2	M8x1.25x25	24 N·m	18 lb ft



Pipe Retainer to Case	142	2	M6x1.0x15	24 N·m	18 lb ft
Pressure Switch Assembly Bolts	--	--	--	12 N·m	106 lb in
Pump Cover to Case Cover	44	1	M8x1.25x130	24 N·m	18 lb ft
Pump Cover to Valve Cover	8	4	M6x1.0x25	11 N·m	8 lb ft
Pump Cover to Valve Body	41	3	M6x1.0x90	11 N·m	8 lb ft
Shift Lever to Transmission Nut	--	--	--	20 N·m	15 lb ft
Speed Sensor/Governor Cover to Case	8	2	M6x1.0x25	11 N·m	97 lb in
TCC Solenoid Valve to Valve Body	334	1	M6x1.0x16	11 N·m	97 lb in
Thrid Clutch Pressure Switch to Valve Body	335	1	1/8-27NPTF	11 N·m	97 lb in
Transmission to Engine Mount Bolts	--	--	--	96 N·m	71 lb ft
TV Cable to Case	N/A	1	M6x1.0x16	9 N·m	80 lb in
Valve Body to Case	43	1	M8x1.25x85	24 N·m	18 lb ft
Valve Body to Case Cover	24	9	M6x1.0x45	11 N·m	8 lb ft
Valve Body to Case Cover	40	2	M6x1.0x65.0	11 N·m	8 lb ft
Valve Body to Driven Sprocket Support	42	1	M8x1.25x65	24 N·m	18 lb ft

### Transmission General Specifications

Name	Hydra-matic 3T40
RPO Codes	MD9
Production Location	Ypsilanti, Michigan
Vehicle Platform (Engine/Transmission)	J
Usage	
Transmission Drive	Transverse Mounted Front Wheel Drive
Maximum Engine Torque	270 N·m (200 lb ft)
1st Gear Ratio	2.840:1
2nd Gear Ratio	1.600:1
3rd Gear Ratio	1.000:1
Reverse	2.067:1
Torque Converter Size (Diameter of Torque Converter Turbine)	245 mm
Pressure Taps	Line Pressure Governor Pressure
Transmission Fluid Type	DEXRON® III
Transmission Type: 3	Three Forward Gears
Transmission Type: T	Transverse Mount
Transmission Type: 40	Product Series
Position Quadrant	P, R, N, D, 2, 1
Case Material	Die Cast Aluminum
Transmission Weight Dry	65.7 kg (144 lbs)
Transmission Weight Wet	73.1 kg (161 lbs)
Maximum Trailer Towing Capacity	487 kg (1,000 lbs)
Maximum Gross Vehicle Weight (GVW)	2,318 kg (5,100 lbs)

Ratios		
Chain	Final Drive	Effective (Overall)
33/37	2.84	3.18
33/37	3.06	3.43
33/37	3.33	3.73
35/35	2.84	2.84
35/35	3.06	3.06
35/35	3.33	3.33
37/33	2.84	2.53
37/33	3.06	2.73
37/33	3.33	2.97

**Fluid Capacity Specifications**

Application	Specification	
	Metric	English
Bottom Pan Removal	3.8 liters	4 quarts
Complete Overhaul	6.6 liters	7 quarts
Dry	8.5 liters	9 quarts
(measurements are approximate)		

**Range Reference**

Range	Park/ Neutral	Reverse	D			2		1
Gear	P-N	R	1st	2nd	3rd	1st	2nd	1st
Direct Clutch	--	Applied	--	--	Applied	--	--	--
Interm. Band	--	--	--	Applied	--	--	Applied	--
Forward Clutch	--	--	Applied	Applied	Applied	Applied	Applied	Applied
Lo-Reverse Clutch	--	Applied	--	--	--	--	--	Applied
Roller Clutch	--	--	Holding	--	--	*Holding	--	Holding
*May not be holding in Intermediate (D2), may stay in 2nd gear when vehicle is stopped.								

**Shift Speed**

Transmission Model	OAKC
Vehicle Series	J
Engine Displacement	2.2L
Engine RPO Code	LN2
Engine VIN Code	4
Overall Axle Ratio	3.18
Final Drive Ratio	2.84
Drive/Driven Sprocket Teeth	33/37

Minimum Throttle 1-2 Upshift	11 mph (18 km/h)
Wide Open Throttle 1-2 Upshift	41 mph (66 km/h)
Minimum Throttle 2-3 Upshift	21 mph (34 km/h)
Wide Open Throttle 2-3 Upshift	76 mph (122 km/h)
Minimum TCC Apply	35
N/V Ratio	40
Torque Converter K-Factor	203
Governor Pressure Switch	N/A
Second Gear Pressure Switch	N/A
Third Gear Pressure Switch	N.O.
Direct Clutch Type	5 plate
Transmission Vent Type	Elbow
Manual Valve Thermal Element	No
<ul style="list-style-type: none"> <li>• N/A = Not Available</li> <li>• N.O. = Normally Open</li> <li>• N/V Ratio = Engine RPM to Vehicle Speed ratio in the third gear with TCC applied</li> <li>• K-Factor = Torque converter numeric rating (combines stall speed and torque multiplication ratings)</li> </ul>	

### Transmission General Description

The Hydra-Matic 3T40 transmission is a fully automatic unit for front wheel drive vehicles. The 3T40 provides three forward gear ranges and a reverse. Throttle opening controls the oil pressure and shift points.

You can operate the transmission in any one of the following six 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 -- Drive position is used for normal driving conditions. Drive position provides three gear ratios plus a converter clutch operation. Downshifts are available for safe passing by depressing the accelerator.
- 2 -- Manual second provides acceleration and engine braking. You may select this range at any vehicle speed.
- 1 -- Manual Low provides maximum engine braking. You may select this range at any vehicle speed.

## Transmission Component and System Description

The 3T40 transmission consists primarily of the following components:

- A four-element hydraulic torque converter
- A compound planetary gear set
- A dual sprocket and drive link assembly
- Three multiple disc clutches
- One roller clutch
- An intermediate band assembly
- A valve body assembly
- A vane type oil pump

The electronic components of this unit are as follows:

- A third clutch pressure switch
- Torque converter clutch solenoid
- Park/neutral position switch
- Vehicle speed sensor assembly

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

### Fastener Tightening Specifications Unit Repair

Application	Specification	
	Metric	English
Bottom Pan to Case -- M6 x 1.0 x 19.0 (Qty 12)	12 N·m	106 lb in
Case Cover	24 N·m	18 lb ft
Case Side Cover	20 N·m	15 lb ft
Channel Plate to Case -- M6 x 1.0 x 28.0 (Qty 6)	12 N·m	106 lb in
Channel Plate to Case -- M6 x 1.0 x 63.0 (Qty 2)	12 N·m	106 lb in
Channel Plate to Driven Sprocket Support -- M6 x 1.0 x 28.0 (Qty 2)	14 N·m	124 lb in
Clip, Wiring Harness -- M6 x 1.0 x 15.0 (Qty 1)	12 N·m	106 lb in
Converter Shield	10 N·m	18 lb ft
Cooler Pipes at Case	8 N·m	71 lb in
Cooler Pipes at Radiator	20-40 N·m	15-30 lb ft
Cover Assembly, Intermediate 4th Servo to Case -- M6 x 1.0 x 28.0 (Qty 3)	12 N·m	106 lb in
Cover, Lo/Reverse Servo to Case -- M6 x 1.0 x 28.0 (Qty 3)	12 N·m	106 lb in
Cover, Side to Case -- M8 x 1.25 x 28.0 (Qty 10)	20 N·m	15 lb ft
Cover, Side to Case (Stud) -- M8 x 1.25 x 28.0 (Qty 1)	20 N·m	15 lb ft
Flywheel to Torque Converter	62 N·m	46 lb ft
Oil Check Plug	14 N·m	124 lb in
Oil Feed Tube Bolts	14 N·m	124 lb in
Oil Pan to Case	10 N·m	89 lb in
Park/Neutral Position Switch to Case	24 N·m	18 lb ft
Plug, Pipe -- 1/8-27 NPTF (Qty 2)	12 N·m	106 lb in
Pressure Switch Assembly Bolts	12 N·m	106 lb in
Pump, Valve Body, Channel Plate to Case -- M6 x 1.0 x 103.0 (Qty 1)	12 N·m	106 lb in

Pump, Valve Body to Channel Plate -- M6 x 1.0 x 63.0 (Qty 1)	12 N·m	106 lb in
Pump, Valve Body to Channel Plate -- M6 x 1.0 x 90.0 (Qty 6)	12 N·m	106 lb in
Sensor, Input Speed -- M6 x 1.0 x 15.0 (Qty 1)	12 N·m	106 lb in
Sensor, Output Speed (Stud) -- M6 x 1.0 x 15.0 (Qty 1)	12 N·m	106 lb in
Shift Lever to Transmission Nut	20 N·m	15 lb ft
Spacer, Channel Plate to Driven Sprocket Support -- M6 x 1.0 x 70.0 (Qty 2)	14 N·m	124 lb in
Speed Sensor Housing to Case	11 N·m	97 lb in
Spring and Roller Assembly, Detent to Channel Plate -- M6 x 1.0 x 19.0 (Qty 1)	12 N·m	106 lb in
Support Assembly, Drive Sprocket to Case -- M6 x 1.0 x 17.2 (Qty 6)	12 N·m	106 lb in
TFP Switch, Valve Body, Channel Plate -- M6 x 1.0 x 51.0 (Qty 3)	12 N·m	106 lb in
TFP Switch, Valve Body, Channel Plate -- M6 x 1.0 x 63.0 (Qty 1)	12 N·m	106 lb in
TFP Switch, Valve Body, Channel Plate to Case -- M6 x 1.0 x 90.0 (Qty 2)	12 N·m	106 lb in
Transmission to Engine Mount Bolts	90 N·m	66 lb ft
Tube Assembly, Transmission Oil to Case -- M6 x 1.0 x 19.0 (Qty 2)	12 N·m	106 lb in
Tube Assembly, Transmission Oil to Forward Clutch Support -- M6 x 1.0 x 19.0 (Qty 1)	12 N·m	106 lb in
Tube Assembly, Transmission Oil to Lo/Reverse Servo Cover -- M6 x 1.0 x 19.0 (Qty 1)	12 N·m	106 lb in
TV Cable to Case	9 N·m	80 lb in
Valve Body, Channel Plate to Case -- M6 x 1.0 x 90.0 (Qty 5)	12 N·m	106 lb in
Valve Body, Channel Plate to Case -- M6 x 1.0 x 103.0 (Qty 2)	12 N·m	106 lb in
Valve Body to Channel Plate -- M6 x 1.0 x 51.0 (Qty 5)	12 N·m	106 lb in

### Transmission General Specifications

Name	Hydra-Matic® 4T40-E/4T45-E
RPO Codes	MN4 - 4T40-E MN5 - 4T45-E
Production Location	Windsor, Ontario, Canada
Vehicle Platform Engine/Transmission Usage	J, N
Transmission Drive	Transverse Mounted Front Wheel Drive
Maximum Engine Torque	4T40-E 270 N·m (200 lb ft) 4T45-E 290 N·m (215 lb ft)
Maximum Shift Speed	1-2 6,500 RPM 2-3 6,500 RPM 3-4 6,500 RPM
1st Gear Ratio	2.960:1
2nd Gear Ratio	1.626:1
3rd Gear Ratio	1.000:1
4th Gear Ratio	0.681:1
Reverse	2.143:1
Torque Converter Size - Diameter of Torque Converter Turbine	245 mm

Pressure Taps	Line Pressure	
Transmission Fluid Type	DEXRON® III	
Transmission Fluid Capacity - Approximate	Bottom Pan Removal: 6.5 L (6.9 qts) Complete Overhaul: 9.0 L (9.5 qts) Dry: 12.2 L (12.9 qts)	
Transmission Type: 4	Four Forward Gears	
Transmission Type: T	Transverse Mount	
Transmission Type: 40	Product Series	
Transmission Type: E	Electronic Controls	
Position Quadrant	P, R, N, Overdrive, 3, 2, 1	
Case Material	Die Cast Aluminum	
Transmission Weight Dry	4T40-E 74.7 kg (164 lbs) 4T45-E 75.1 kg (165.6 lbs)	
Transmission Weight Wet	4T40-E 85.0 kg (187 lbs) 4T45-E 85.5 kg (188.5 lbs)	
Maximum Trailer Towing Capacity	487 kg (1,000 lbs)	
Maximum Gross Vehicle Weight (GVW)	1,826 kg (4,100 lbs)	
Ratios		
Chain	Final Drive	Effective - Overall
32/38	3.29	3.91
32/38	3.05	3.63
35/35	3.29	3.29
35/35	3.05	3.42
33/37	3.29	3.69
33/37	3.05	3.42

**Fluid Capacity Specifications**

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

## Range Reference

Range	Park/ Neutral	Reverse	D				3			2			1	
Gear	N	R	1st	2nd	3rd	4th	1st	2nd	3rd	1st	2nd	3rd**	1st	2nd***
1-2 Shift Solenoid	ON	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	OFF	ON	OFF
2-3 Shift Solenoid	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF
2nd Clutch	--	--	--	A	A*	A*	--	A	A*	--	A	A*	--	A
2nd Roller Clutch	--	--	--	H	O	--	--	H	O	--	H	O	--	H
Int./4th Band	--	--	--	--	--	A	--	--	--	--	A	--	--	A
Reverse Clutch	--	A	--	--	--	--	--	--	--	--	--	--	--	--
Coast Clutch	--	--	--	--	--	--	A	A	A	A	A	A	A	A
Input Sprag	--	--	H	H	H	O	H	H	H	H	H	H	H	H
Direct Clutch	--	--	--	--	A	A	--	--	A	--	--	A	--	--
Forward Clutch	--	--	A	A	A	A*	A	A	A	A	A	A	A	A
Lo/Rev Band	A	A	--	--	--	--	--	--	--	--	--	--	A	--
Lo Roller Clutch	--	--	H	O	O	O	H	O	O	H	O	O	H	O

- A = Applied
- H = Holding
- O = Overrunning
- ON = The solenoid is energized
- OFF = The solenoid is de-energized
- \* = Applied with no load
- \*\* = Manual SECOND-THIRD gear is only available above approximately 100 km/h (62 mph)
- \*\*\* = Manual FIRST-SECOND gear is only available above approximately 60 km/h (37 mph)
- Manual FIRST-THIRD gear is also possible at high vehicle speed as a safety feature

## Shift Speed

		1-2 Shift @ +/- 3 mph			2-3 Shift @ +/- 4 mph			3-4 Shift @ +/- 5 mph			Downshifts @ +/- 4 mph			TCC Apply 3rd Gear
% of TPS		10	25	50	10	25	50	10	25	50	4-3 Coast	3-2 Coast	2-1 Coast	10%
Model	Engine RPO													
WKR	LN2	9	14.5	21	18	25	39.5	39	45	67	30	11.5	6	26
WBR	LD9	9	15	28	17	29	51	34	51	79	30	11	8	22

## Transmission General Description

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

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

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

## Transmission Component and System Description

The mechanical components of this unit are as follows:

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

The electrical components of this unit are as follows:

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



## Adapt Function

### Transmission Adapt Function

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

- The clutch fiber plates
- The seals
- The springs

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

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

## Clutch

### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Clutch Actuator Bleed Screw	2 N·m	18 lb in
Clutch Cover to Flywheel Bolt 2.2L (Vin 4)	20 N·m plus rotate 30 degrees	15 lb ft plus rotate 30 degrees
Clutch Cover to Flywheel Bolts 2.4L (Vin T)	20 N·m plus rotate 45 degrees	15 lb ft plus rotate 45 degrees
Clutch Master Cylinder and Clutch Pedal Bracket Nut	21 N·m	15 lb ft

### Sealers and Lubricants

Clutch System Fluid	Fluid Levels
Use a brake fluid that meets DOT 3 specifications when adding fluid to the clutch system reservoir.	Fill the reservoir to the specified level shown on the reservoir. Do not overfill the system.

## 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:

- The rear face of the engine flywheel
- 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.

## Abbreviations and Meanings

Abbreviation	Meaning
<b>A</b>	
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</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
<b>C</b>	
°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 <sup>3</sup>	Cubic Centimeters
CCM	Convenience Charge Module, Chassis Control Module
CCOT	Cycling Clutch Orifice Tube
CCP	Climate Control Panel
CD	Compact Disc
CE	Commutator End
CEAB	Cold Engine Air Bleed
CEMF	Counter Electromotive Force
CEX	Cabin Exchanger
cfm	Cubic Feet per Minute
cg	Center of Gravity
CID	Cubic Inch Displacement
CKP	Crankshaft Position
CKT	Circuit
C/Ltr	Cigar Lighter
CL	Closed Loop
CLS	Coolant Level Switch
CMC	Compressor Motor Controller
CMP	Camshaft Position
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO <sub>2</sub>	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)
<b>D</b>	
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
H <sub>2</sub> O	Water
Harn	Harness
HC	Hydrocarbons
H/CMPR	High Compression

HD	Heavy Duty
HDC	Heavy Duty Cooling
hex	Hexagon, Hexadecimal
Hg	Mercury
Hi Alt	High Altitude
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
<b>N</b>	
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
<b>O</b>	
O <sub>2</sub>	Oxygen
O <sub>2</sub> S	Oxygen Sensor
OBD	On-Board Diagnostics
OBD II	On-Board Diagnostics Second Generation
OC	Oxidation Converter Catalytic
OCS	Opportunity Charge Station
OD	Outside Diameter
ODM	Output Drive Module
ODO	Odometer
OE	Original Equipment
OEM	Original Equipment Manufacturer
OHC	Overhead Camshaft

ohms	Ohm
OL	Open Loop, Out of Limits
ORC	Oxidation Reduction Converter Catalytic
ORN	Orange
ORVR	On-Board Refueling Vapor Recovery
OSS	Output Shaft Speed
oz	Ounce(s)
<b>P</b>	
PAG	Polyalkylene Glycol
PAIR	Pulsed Secondary Air Injection
PASS, PSGR	Passenger
PASS-Key®	Personalized Automotive Security System
P/B	Power Brakes
PC	Pressure Control
PCB	Printed Circuit Board
PCM	Powertrain Control Module
PCS	Pressure Control Solenoid
PCV	Positive Crankcase Ventilation
PEB	Power Electronics Bay
PID	Parameter Identification
PIM	Power Inverter Module
PM	Permanent Magnet Generator
P/N	Part Number
PNK	Pink
PNP	Park/Neutral Position
PRNDL	Park, Reverse, Neutral, Drive, Low
POA	Pilot Operated Absolute Valve
POS	Positive, Position
POT	Potentiometer Variable Resistor
PPL	Purple
ppm	Parts per Million
PROM	Programmable Read Only Memory
P/S, PS	Power Steering
PSCM	Power Steering Control Module, Passenger Seat Control Module
PSD	Power Sliding Door
PSP	Power Steering Pressure
psi	Pounds per Square Inch
psia	Pounds per Square Inch Absolute
psig	Pounds per Square Inch Gauge
pt	Pint
PTC	Positive Temperature Coefficient
PWM	Pulse Width Modulated

Q	
QDM	Quad Driver Module
qt	Quart(s)
R	
R-12	Refrigerant-12
R-134a	Refrigerant-134a
RAM	Random Access Memory, Non-permanent memory device, memory contents are lost when power is removed.
RAP	Retained Accessory Power
RAV	Remote Activation Verification
RCDLR	Remote Control Door Lock Receiver
RDCM	Right Door Control Module
Ref	Reference
Rev	Reverse
REX	Rear Exchanger
RIM	Rear Integration Module
RF	Right Front, Radio Frequency
RFA	Remote Function Actuation
RFI	Radio Frequency Interference
RH	Right Hand
RKE	Remote Keyless Entry
Rly	Relay
ROM	Read Only Memory, Permanent memory device, memory contents are retained when power is removed.
RPM	Revolutions per Minute Engine Speed
RPO	Regular Production Option
RR	Right Rear
RSS	Road Sensing Suspension
RTD	Real Time Damping
RT	Right
RTV	Room Temperature Vulcanizing Sealer
RWAL	Rear Wheel Antilock
RWD	Rear Wheel Drive
S	
s	Second(s)
SAE	Society of Automotive Engineers
SC	Supercharger
SCB	Supercharger Bypass
SCM	Seat Control Module
SDM	Sensing and Diagnostic Module
SEO	Special Equipment Option
SFI	Sequential Multiport Fuel Injection

SI	System International Modern Version of Metric System
SIAB	Side Impact Air Bag
SIR	Supplemental Inflatable Restraint
SLA	Short/Long Arm Suspension
sol	Solenoid
SO <sub>2</sub>	Sulfur Dioxide
SP	Splice Pack
S/P	Series/Parallel
SPO	Service Parts Operations
SPS	Service Programming System, Speed Signal
sq ft, ft <sup>2</sup>	Square Foot/Feet
sq in, in <sup>2</sup>	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
<b>T</b>	
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
<b>U</b>	
UART	Universal Asynchronous Receiver Transmitter
U/H	Underhood
U/HEC	Underhood Electrical Center
U-joint	Universal Joint
UTD	Universal Theft Deterrent
UV	Ultraviolet
<b>V</b>	
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

## 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
ln/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**

<b>Fraction (in)</b>	<b>Decimal (in)</b>	<b>Metric (mm)</b>
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

Fraction (in)	Decimal (in)	Metric (mm)
5/8	0.625	15.875
41/64	0.640625	16.27187
21/32	0.65625	16.66875
43/64	0.671875	17.06562
11/16	0.6875	17.4625
45/64	0.703125	17.85937
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

## Fasteners

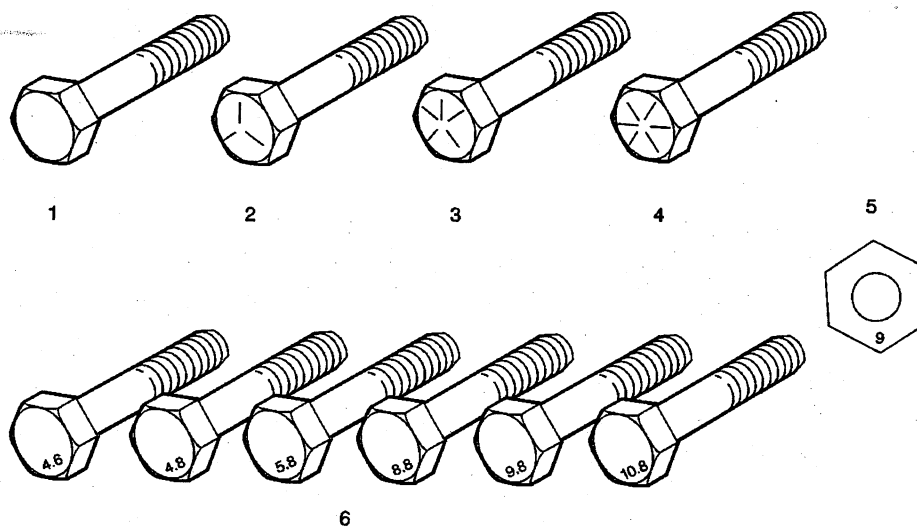
### Metric Fasteners

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

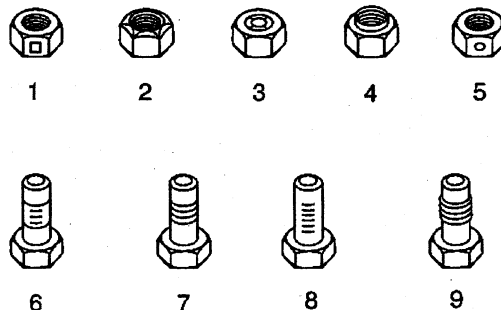
These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

#### 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
<b>All Metal Prevailing Torque Fasteners</b>		
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
<b>Nylon Interface Prevailing Torque Fasteners</b>		
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
<b>All Metal Prevailing Torque Fasteners</b>		
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
<b>Nylon Interface Prevailing Torque Fasteners</b>		
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

