Chevrolet

Malibu/Malibu Maxx

2004

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Product Information

2004 Malibu: Versatility, Refinement And Tailored Comfort

The all-new 2004 Chevrolet Malibu delivers the comfort and style of tailored-to-fit clothing for an off-the-rack price. But not even a $3,000 suit can match the Malibu's ability to mold itself to different individuals and lifestyles.

A tailored suit fits only one person and one purpose. Almost everybody can find a perfect fit in the 2004 Malibu's driver's seat while getting an overall package that adapts to needs that may change from day to day.

With a 60/40 split/folding rear seat and a fold-flat front passenger seat, the Malibu can be a cavernous cargo carrier by day and a refined, comfortable people-hauler by night, or the other way around.

Every Malibu sedan features standard and optional equipment allowing drivers to customize their driving experience. A power driver's seat height adjuster, tilt/telescoping steering column, power windows, door locks and mirrors are standard on all Malibus. Power adjustable brake and accelerator pedals and manual lumbar support are standard on the Malibu LS and LT and available on the base Malibu sedan. Many of these features cannot be found in other cars in the Malibu's class.

The Malibu sedan also will be the first car in its class to offer an optional factory-installed remote vehicle starter system, allowing the driver to get a head start on the car's interior heating and cooling from a range of about 200 feet.

Versatility and refinement everywhere

Everything about the Malibu speaks to its unexpected versatility and refinement, including its available engine and transmission combinations. The base model delivers 145 horsepower (108 kw) from its fuel-efficient Ecotec 2.2L, dual-overhead-cam four-cylinder engine. The Malibu LS and LT models get a 200-hp (149-kw), 3.5L overhead-valve V-6. All Malibus come with the smooth-shifting Hydra-Matic 4T45-E four-speed electronic automatic transmission.

The Malibu and its Malibu Maxx stable-mate are the first North American applications of General Motors' Epsilon global architecture, which also provides the foundation for the new Saab 9-3 and Opel Vectra.

The main characteristics of the Epsilon architecture were developed with GM's Opel subsidiary in Germany, which accounts, in part, for the European flair in Malibu's ride and handling. But each Epsilon vehicle is adapted regionally to meet local conditions and tastes.

"A lot of customers may not care that we call this the 'Epsilon architecture,' but if they have driven a previous version of the Malibu, they will immediately notice a firmer, quieter, more linear feel in the ride and handling of the '04 version," said Gene Stefanyshyn, vehicle line executive of the Malibu sedan and Malibu Maxx.

The new Malibu is spacious and quiet, with 101 cubic feet (2,871L) of space for passengers and superb acoustical characteristics. In addition to the vibration-reducing properties of the Epsilon architecture itself, the car has a host of noise-elimination features, including a cast foam-rubber barrier covering the dash panel; a modular noise-dampening plate in the dash panel; a compression-molded fiberglass-composite hood insulator; and front and rear "glove-fit" carpet floor modules.

The Epsilon body structure gives the Malibu a high degree of structural stiffness, greatly enhancing both vehicle handling and interior acoustics. A fully isolated powertrain cradle with tuned bushings further contributes to the Malibu's quiet ride. Rounding out the package is an independent front suspension with MacPherson struts and a four-link independent rear suspension.

The design features crisp, clean lines that highlight a space-efficient and aerodynamic exterior. Crystalline-like headlamp lenses and a chrome front bar and gold Chevy bowtie highlight these contemporary lines. Compared with its predecessor, the new Malibu has a slightly wider stance and a much more substantial front end. The exterior is a fresh direction that honors Chevrolet's heritage while allowing European influence in execution.

The interior features a Chevrolet-signature dual cockpit design in an upscale environment loaded with luxury features and an overall sense of quality and attention to detail. Seating in the Malibu has the look and feel of an upscale European sedan with comfortable, firm foam padding to give occupants a solid, secure ride that matches the car's nimble performance.

The look and feel of refinement is enhanced with the use of soft, durable foam-backed thermoplastic polyolefin (TPO) for the instrument panel, door trim, console and other trim areas. TPO has double the life of conventional automotive paneling materials, and it resists fading and sun damage.

The center console provides exceptional functionality, including best-in-segment storage capacity of 6.2L, four cupholders, a power outlet, a tray and small receptacles for cell phones, PDAs and other items.

Comfort for rear-seat passengers is enhanced with a heating/air conditioning system designed for their needs. In addition to airflow to the feet, two vents on the center of the dash - dubbed "turbo blasters" by the car's engineers - are designed to pour generous amounts of heated or cooled air directly into the back seat.

The headliner console in the LS and LT models has reading lights for front and rear passengers and offers the Homelink system for programming garage door openers and other electronic home-based functions.

Four levels of radio offerings are available on the Malibu, starting with the base model with AM/FM stereo and CD player up to an uplevel radio with an in-dash, six-CD changer, six speakers, automatic volume and tone controls, and XM Satellite Radio (continental U.S. only) compatibility. XM Satellite Radio provides 100 coast-to-coast, digital-quality channels of original music, news, sports and talk. Consumers can subscribe to the basic service for $9.99 a month - less than the cost of a single CD. In addition, GM customers with GMAC financing can choose to include the XM subscription in their car payments.

Safety and strength

Engineers made extensive use of high-strength steel in strategic areas of the body and developed energy-absorbing front and rear crush zones to help obtain impressive structural performance for safety.

Other safety features in the Malibu include:

- Dual-stage frontal air bags for the driver and front passenger
- Three-point safety belts for all occupants
- Standard safety belt pretensioners for front-seat passengers
- Optional head curtain side-impact air bags to help protect front and rear outboard passengers
- Standard four-wheel anti-lock brakes with traction control on LS and LT models, available on base sedan
- LATCH (Lower Anchors and Tethers for CHildren) child-seat attachment system in all rear seating positions

All Malibu models will be equipped with electric power steering (EPS) with variable assist for low- and high-speed steering maneuvers and power brakes. Other standard features include a driver information center integrated into the radio display that enables personalization of electrical features and provides more than 15 warning messages including low key-fob battery life, the possibility of ice forming on the road and an oil life monitor. Options include heated front seats and OnStar.

The all-new 2004 Malibu sedan will be manufactured at General Motors Kansas City, Kan., assembly plant. Start of production is targeted for the third quarter of 2003.

All-New 2004 Malibu Maxx: Comfort, Refinement And Versatility

Delivering the comfort of first class for the price of a coach-class ticket, the 2004 Chevy Malibu Maxx offers a spacious new alternative in the mid-size car segment.

"The Malibu Maxx is a unique package that provides the maximum passenger comfort for everyone, front and back, along with a roomy cargo area that has a great deal of flexibility," said Brent Dewar, Chevrolet marketing general manager.

The five-door Malibu Maxx rides on a wheelbase that is 6 inches (152 mm) longer than the 2004 Malibu sedan, yet its overall length is a half-inch (12.7 mm) shorter. The result is an interior that is cavernous for a car its size.

The Malibu Maxx has the ride and handling of a sedan and the interior versatility of a sport utility. Chevrolet calls it a five-door extended sedan. This new category of car is reflected in the design of the Malibu Maxx's rear profile. The angle of the rear window in the liftgate - which is made of lightweight aluminum for easy operation - is more like a sedan than a station wagon.

For Ed Schoener, Malibu Maxx marketing director, the car's unique character begins with its accommodations for rear passengers.

"When we considered what car buyers might want in the future and what this car can capture, their choices in airplane travel was one thing we looked at," Schoener said. "Virtually all mid-size car buyers would like to fly first class, but nine out of 10 go coach. So, in designing and equipping the Malibu Maxx, we tried to go beyond what a sedan or wagon can offer."

First-class comfort

The rear seat slides nearly 7 inches (178 mm) fore and aft - unlike the stationary rear seats of most conventional mid-size sedans - and is split 60/40 not just in the seat back, but also the seat cushion, to further increase comfort. The seat backs recline - distinguishing them from the seat backs in most sedans - allowing different-size rear passengers to tailor their seating position in a similar way front-seat passengers can. The Malibu Maxx has a generous 106 cubic feet (3,002L) of passenger space and a luxurious 41 inches (1041 mm) of legroom with the seats pushed all the way back.

The Malibu Maxx also features a standard fixed rear glass skylight that provides a spacious, open atmosphere over the rear seats, and reduces the feeling of occupants being cut off from the outside that some backseats create. Both driver- and passenger-side rear occupants have the option of opening or closing a standard split/retractable shade to control the amount of light coming through the skylight.

Comfort for rear-seat passengers is enhanced with a heating/air conditioning system designed for their needs. In addition to airflow to the feet, two vents on the center of the dash - dubbed "turbo blasters" by the car's engineers - are designed to pour generous amounts of heated or cooled air directly into the back seat.

Four levels of radio offerings are available on the Malibu Maxx including an uplevel radio with an in-dash, six-CD changer, six speakers (including two tweeters on the A-pillar), automatic volume and tone controls, and XM Satellite Radio (continental U.S. only) compatibility. An optional rear DVD entertainment system complements the spacious accommodations. The system is mounted into the rear of the center console and includes a 7-inch (178-mm) flip-up LCD screen, two sets of infrared headphones, video game jacks, remote control and independent audio selection.

Cargo room, flexibility to spare

The cargo area (the area behind the back seats when they are in normal position) of the Malibu Maxx is officially calculated at 22.8 cubic feet (646L) - nearly 50 percent larger than the trunks of other mid-size sedans. But the design of the Malibu Maxx's cabin and seats offer even greater flexibility.

Rear seats and the front passenger seat fold forward flat, creating a space that can accommodate longer items. The rear seats also are split 60/40, providing flexibility for passengers and cargo.

The Malibu Maxx's rear cargo area features a standard power outlet and a multi-functional cargo panel with four positions for two-tier loading. The cargo panel also can be positioned as a table for picnics or tailgate parties. Hooks on the cargo panel help secure smaller items, and cargo nets on each side of the cargo area help keep items from sliding around.

All-new body structure

Of course, the Malibu Maxx is a 2004 Malibu sedan at heart - all new from the ground up. The Malibu Maxx and the Malibu sedan are the first North American applications of General Motors' Epsilon global architecture, which also provides the foundation for the new Opel Vectra and Saab 9-3.

The main characteristics of the Epsilon architecture were developed with GM's Opel subsidiary in Germany, which accounts, in part, for the European flair in Malibu's ride and handling. However, each Epsilon vehicle is adapted regionally to meet local conditions and tastes.

"A lot of customers may not care that we call this the 'Epsilon architecture,' but if they have driven a previous version of the Malibu, they will immediately notice a firmer, quieter, more linear feel in the ride and handling of the '04 version," said Gene Stefanyshyn, vehicle line executive of the Malibu sedan and Malibu Maxx.

In addition to the vibration-reducing properties of the Epsilon architecture itself, the car has a host of noise-elimination features, including a cast foam-rubber barrier covering the dash panel; a modular noise-dampening plate in the dash panel; a compression-molded fiberglass-composite hood insulator; and front and rear "glove-fit" carpet floor modules.

The Epsilon body structure gives the Malibu Maxx a high degree of structural stiffness, greatly enhancing both vehicle handling and interior acoustics. A fully isolated powertrain cradle with tuned bushings - also found on many high-end luxury vehicles - further contributes to Malibu Maxx's quiet ride. Rounding out the package is an independent front suspension with MacPherson struts and a four-link independent rear suspension.

In terms of design, clean, crisp lines outline a car that features a space-efficient and aerodynamic exterior. Crystalline-like headlamp lenses and a chrome front bar with a gold Chevy bowtie highlight these contemporary lines.

"The buyers of mid-size cars tend to keep them for a long time, so they're looking for an appealing design that won't go out of style when the next fad comes along," said Schoener. "Timeless styling is contemporary, yet enduring. I think we've nailed that pretty well with the Malibu Maxx."

Remote start feature

The Malibu sedan and Malibu Maxx will be the first cars in their class to offer an optional factory-installed remote vehicle starter system, allowing the driver while inside the house to start the car outside on cold winter mornings or sweltering summer afternoons. The system is designed to work from approximately 200 feet (61 m).

Safety and strength

Engineers made extensive use of high-strength steel in strategic areas of the body, and developed energy-absorbing front and rear crush zones to help obtain impressive structural performance for safety.

Other safety features in the Malibu Maxx include:

- Dual-stage frontal air bags for the driver and front passenger
- Three-point safety belts for all occupants
- Standard safety belt pretensioners for front-seat passengers
- Optional head curtain side-impact air bags to help protect front and rear outboard passengers
- Standard four-wheel anti-lock disc brakes with traction control
- A LATCH (Lower Anchors and Tethers for CHildren) child-seat attachment system in all rear seating positions.

Tailored driving experience, rock solid powertrain

Operating with the idea that a comfortable driver is a better driver, engineers also equipped the Malibu Maxx to fit the driver like a tailored suit. Power adjustable brake and accelerator pedals and a tilt/telescopic steering column are standard. Also standard is a power seat height adjuster.

The standard engine in the Malibu Maxx is GM's new 200-horsepower (149-kw), 3.5L 3500 V-6, which is mated to a Hydra-Matic 4T45-E four-speed electronic-shift automatic transmission. The 3500, based off of GM's 3.4L V-6, features many performance, fuel efficiency, and noise, vibration and harshness improvements.

All Malibu models will be equipped with electric power steering (EPS) with variable assist for low and high speed steering maneuvers and power brakes. Other standard features include a driver information center

integrated into the radio display that enables personalization of electrical features, and provides more than 15 warning messages including low key-fob battery life, the possibility of ice forming on the road and an oil life monitor. Options include heated front seats, OnStar in-vehicle communications and assistance service and XM Satellite Radio.

The all-new 2004 Malibu Maxx extended sedan will be manufactured at GM's Kansas City, Kan., assembly plant. Start of production is targeted for the fourth quarter of 2003.

2004 Malibu Maxx: It's A Malibu And Much More

Chevrolet's all-new Malibu Maxx is a new alternative for customers who like the ride, handling and economy of a midsize sedan, but want the enhanced functionality found in a compact sport utility vehicle or wagon.

"The Malibu Maxx is a unique package that provides the maximum passenger comfort for everyone, front and back, along with a roomy cargo area with a surprising degree of flexibility," said Brent Dewar, Chevrolet marketing general manager.

From the B-pillar forward, the Malibu Maxx and the Malibu sedan are virtually the same. The Malibu Maxx has a standard power height adjuster for the driver's seat, a manual lumbar adjuster, tilt/telescoping steering column, power adjustable brake and accelerator pedals, dual cockpit design, fold-flat passenger seat and other features. From the B-pillar back, the Malibu Maxx is unique.

The five-door Malibu Maxx rides on a wheelbase that is 6 inches longer than the 2004 Malibu sedan, while its overall length is a half-inch shorter. The result is an interior that is cavernous for a car its size.

Chevrolet calls the Malibu Maxx a five-door extended sedan - a new category of car that is reflected in the design of its rear profile. The angle of the rear window in the liftgate - which is made of lightweight aluminum for easy operation - is more like a sedan than a station wagon.

For Ed Schoener, Malibu Maxx marketing director, the car's unique character begins with its accommodations for rear passengers.

"When we considered what car buyers might want in the future and what this car can capture, their choices in airplane travel was one thing we looked at," Schoener said. "Virtually all midsize car buyers would like to fly first class, but nine out of 10 go coach. So, in designing and equipping the Malibu Maxx, we tried to go beyond what a sedan or wagon can offer."

First-class comfort

The rear seat slides nearly 7 inches fore and aft and is split 60/40 not just in the seat back, but also the seat cushion, to further increase comfort. The seat backs recline allowing different sized rear passengers to tailor their seating position in a similar way a front-seat passenger can. The Malibu Maxx has a generous 106 cubic feet of passenger space and a luxurious 41 inches of legroom with the seats pushed all the way back - legroom comparable to a full-size domestic luxury sedan.

The Malibu Maxx also features a standard fixed-rear glass skylight that provides a spacious, open atmosphere over the rear seats and reduces the feeling of occupants being cut off from the outside that some back seats create. Both driver- and passenger-side rear occupants have the option of opening or closing a standard split/retractable shade to control the amount of light coming through the skylight.

Comfort for rear-seat passengers is enhanced with a heating/air conditioning system designed for their needs. In addition to airflow to the feet, two vents on the center of the dash - dubbed "turbo blasters" by the car's engineers - are designed to pour generous amounts of heated or cooled air directly into the back seat.

Four levels of radio offerings will be available on the Malibu Maxx, including an uplevel radio with an in-dash, six-CD changer, six speakers (including two tweeters on the A pillar), automatic volume and tone controls, and XM Satellite Radio compatibility.

An optional rear DVD entertainment system completes the accommodations. The system is mounted into the rear of the center console and includes a 7-inch flip-up LCD screen, two sets of infrared headphones, video game jacks, remote control and independent audio selection.

The Malibu Maxx also features an optional factory-installed remote vehicle starter system, allowing the driver to get a head start on heating or cooling the car's interior from a range of about 200 feet.

Also available is the OnStar safety and security package with Advanced Automatic Collision Notification, a new technology debuting on the Malibu that will help save lives by getting the right emergency staff to crashes faster.

Cargo room, flexibility to spare

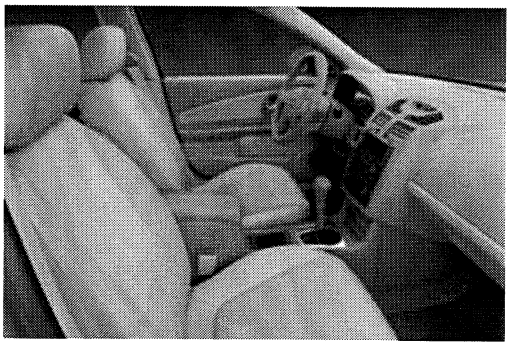
The cargo area of the Malibu Maxx is officially calculated at 22.8 cubic feet - nearly 50 percent larger than the trunks of other midsize sedans. But the design of the Malibu Maxx's cabin and seats offer even greater flexibility.

Rear seats and the front passenger seat fold forward flat, creating a space that can accommodate longer items. The rear seats also are split 60/40, providing flexibility for passengers and cargo.

The Malibu Maxx's rear cargo area features a standard power outlet and a multi-functional cargo panel with four positions for two-tier loading. The cargo panel also can be positioned as a table for picnics or tailgate parties. Hooks on the cargo panel help secure smaller items, and cargo nets on each side of the cargo area, also unique to the Malibu Maxx, help keep items from sliding around.

New Malibu Interiors: The Best Of Chevy With European Flair

The interiors of the 2004 Malibu and Malibu Maxx are designed to create a sense of timeless styling with a European flavor, while remaining true to Chevrolet's strong heritage and tradition.



"We've set a new standard for Chevy car interiors with the 2004 Malibu and Malibu Maxx," said Brent Dewar, general marketing manager. "We've achieved the refined look of a European sedan by paying close attention to detail and careful selection of materials and colors, while staying true to Chevrolet values."

More than 101 cubic feet of interior space contributes to the roomy appearance. The ergonomic layout of the gauges and controls in the instrument panel, center stack and console carry the strong character feel from the exterior to the interior.

There is plenty of space in the two Malibu models to create a sense of roominess and comfort that invites occupants to interact and communicate. The interiors are designed with clean, crisp lines and forms, but with softened edges and fabrics that are soft to the touch in warm, relaxing colors.

The front seats of the 2004 Malibus have a dual cockpit design, a defining Chevrolet characteristic and an essential element of the brand's heritage. This is achieved by designing the instrument panel (IP), console and front seats to create distinct driver and passenger zones.

The center console flows into the IP center stack creating the dual cockpit look, which is reinforced by the concave curvature of the dash in front of both driver and passenger.

The driver's cockpit is designed for comfort and to provide a sense of control, confidence and safety. There is slightly more space for added comfort while operating the vehicle and instruments and controls are ergonomically designed and placed for visibility and ease of access. Windshield and windows provide clear, panoramic views of the road ahead and to the sides.

Control levers and buttons were designed to comfortably accommodate hands and fingers of all sizes.

Driver control adjustability, one of the Malibus' most defining features, helps the vehicles comfortably accommodate virtually any size adult from a 5th percentile female to 95th percentile male. With the new

Malibus, a tilt/telescoping steering column and power driver's seat height adjuster are standard. Power adjustable brake and accelerator pedals and manual lumbar support also are available on the Malibu sedan and standard on all LS and LT models.

Seating

The benchmark for seating comfort in the Malibus is an upscale European sedan with comfortable, firm padding to give occupants a secure feel that matches the nimble, responsive performance of Malibu and Malibu Maxx.

The seat fabrics also reflect a European heritage. The seats of the Malibu sedan are finished in an attractive durable material with an upscale look, while the LS versions of the Malibu and Malibu Maxx have a more luxurious cloth. The seats in the LT models feature long-lasting Ultra-Lux synthetic suede with leather appointments. All seats are finished with French seams, another subtle touch of refinement.

Heated seats are available in the LT models.

The rear seats in both the Malibu sedans and the Malibu Maxx have 60/40 seat backs that fold forward to give the Malibus another dimension of functionality by providing a pass-through from the cargo area.

The Malibu Maxx extended sedan is unique, not only to the midsize segment but to most sedans regardless of size, with its adjustable rear seats, which recline and can be moved fore and aft with independent 60/40 seat cushions.

Rich materials, coordinating colors

Colors and material for the Malibu interiors were selected for their refinement and integration with exterior color and trim selections. There are two basic interior colors: light beige with wood grain trim plates and gray with metallic silver trim plates.

The look and feel of refinement is enhanced with the use of soft, durable foam-backed thermoplastic olefin (TPO) for the IP, door trim, paneling, moldings, console and other trim areas. TPO is a material that has double the life of conventional automotive paneling materials, resists fading and sun damage, and minimizes interior fogging from plasticizers migrating out of various synthetic materials.

The front passenger frontal air-bag door is hidden behind the TPO so the entire surface is seamless. In the event of deployment, the air bag breaks through the finish material in a controlled pattern.

The carpet is a form-fitting foam-in-place module, which matches the interior colors. It is molded to precisely fit all the curves and crevices of the floor pan to give the car a smooth, custom-fit appearance.

Consoles that work

The center console provides exceptional functionality, including best-in-segment storage capacity of 6.2 liters, four cupholders, a power outlet, a tray and small receptacles for cell phones, PDAs and other items.

The center stack is positioned with forward controls to accent the interior's open, airy feeling, and the driver information center is located high on the center stack for quick reference to minimize the time the driver's eyes are off the road. It also has an integrated clipboard for posting photographs, memos or other items.

The heating and air conditioning outlet vanes in the IP and center stack are flush when closed, another mark of quality and attention to detail.

The headliner console in LS and LT models has reading lights for front passengers and offers the Homelink system for programming garage door openers and other electronic home-based functions. LT headliners also have reading lights for rear passengers.

Unique to the Malibu Maxx

The unique interior features of the Malibu Maxx start with the rear seat, designed to provide first class comfort. Besides the independently adjustable, split/folding, sliding and reclining 60/40 rear seat, back seat passengers in the Malibu Maxx also ride a little higher than front seat occupants - theater style - for a feeling of greater openness and a more all-inclusive cabin.

The Malibu Maxx has a generous 106 cubic feet of passenger space, with 42 inches of front legroom and a luxurious 41 inches of rear legroom with the seats pushed all the way back.

The feeling of openness in the rear seat of the Malibu Maxx is enhanced with a standard fixed glass skylight over the back seat. Both driver- and passenger-side rear occupants have the option of opening or closing a standard split/retractable shade to control of the amount of light coming through the skylight.

An optional rear-seat DVD entertainment system - mounted in the back of the center console - comes with infrared headphones, video game jacks, remote control and independent audio selection.

The Malibu Maxx fills the need for customers who want the functionality and flexibility of a compact sport utility vehicle, but would rather buy a sedan because of its styling and smoother ride. The Malibu Maxx fills that gap with a cavernous and highly flexible cargo area.

The cargo area of the Malibu Maxx is officially calculated at 22.8 cubic feet - nearly 50 percent larger than the trunks of other midsize sedans. But the design of the Malibu Maxx's cabin and seats offer even greater flexibility.

Fold-flat seats in the front passenger and rear passenger positions offer the ability of carrying a load up to 9 feet long. And, because the rear seats are so independently adjustable, it's possible to carry a passenger or two at the same time, depending on the load.

The Malibu Maxx's rear cargo area features a standard power outlet and a multi-functional cargo panel with four positions for two-tier loading. The cargo panel also can be positioned as a table for picnics or tailgate parties. Hooks on the cargo panel help secure smaller items, and cargo nets on each side of the cargo area help keep items from sliding around.

Always In Style: 2004 Malibu Sedan And Malibu Maxx

Always in good taste, never out of style. That's what men want from a gray business suit and women want from a black cocktail dress. That timeless style and impeccable execution is what midsize-car buyers get with the all-new 2004 Malibu sedan.

The Malibu Maxx five-door extended sedan is a little more daring: think a blue pinstripe suit or a bright red cocktail dress.

Any way you look at them, the Malibu and Malibu Maxx are designed to always look their best during a daily commute, a family vacation or an evening out at a great restaurant.

"The 2004 Malibu sedan and Malibu Maxx extended sedan both have clean, uncluttered exterior designs with an unmistakable European influence and strong Chevrolet heritage," said Brent Dewar, Chevrolet general marketing manager. "They're refined and stylish, with elegant touches like the jewelry-like headlights and taillights and the exposed edge-of-glass mounting of the windshield and backlight."

Special attention was paid to the lighting design to add to the upscale look of the vehicles. The headlamps have crystalline-like lenses so the sculpted reflectors and chrome bulb shields are exposed to view. The jewel-like effect is further enhanced by chrome bezels.

The rear lights and optional halogen fog lights are designed to achieve similar jewelry-like effects with see-through lenses set off with chrome accents.

Another distinctive styling feature of the new Malibus is the exposed edge-of-glass mounting of the windshield and back window for a higher quality and more finished, seamless appearance.

The molding is only on the underside of the windows and the glass is inset so it fits snugly against the body panels, providing a flatter, more finished appearance. Typically, the molding is exposed and encases all sides of the windows.

The windshield angle of the new Malibu is slightly more upright for better visibility, and the entire greenhouse is proportionally larger than the previous model for better visibility and an added sense of spaciousness.

Aerodynamically, the Malibu sedan is designed to reach a coefficient of drag (cd) of 0.301, which ranks among the leaders in midsize cars. The low cd helps deliver higher fuel economy and reduces wind noise as the car moves through the air.

Malibu Maxx

Chevrolet creates a new segment in the midsize car market with the introduction of the Malibu Maxx five-door extended sedan.

The Malibu Maxx rides on a wheelbase that is 6 inches longer than the 2004 Malibu sedan, yet its overall length is a half-inch shorter. The result is an interior that is cavernous for a car its size.

Perhaps the most distinguishing exterior feature of the Malibu Maxx is its standard, fixed glass skylight positioned over the rear passenger compartment. The length of the Malibu Maxx's greenhouse also is expanded due to its raised rear-quarters.

Malibu Maxx is designed to deliver much of the space and functionality of a compact sport utility vehicle or station wagon with the exterior design of a sedan. In fact, from the B-pillar forward, the Malibu Maxx looks the same as its Malibu sedan stable mate. From the B-pillar back, the differences become clear.

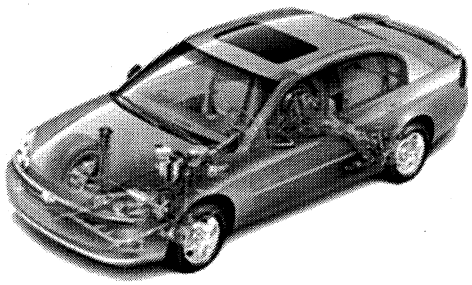
The angle of the rear window in the Malibu Maxx's liftgate - which is made of lightweight aluminum for easy operation - is angled slightly less than the Malibu sedan, but still looks more like a sedan than a station wagon. And with its shorter rear overhang and rear deck, the Malibu Maxx has a more compact appearance than its sibling. The extra wheelbase of the Malibu Maxx also allows bigger rear door openings that are more than 4 inches wider than the Malibu sedan's, making it easier for passengers to enter and exit and for easier loading of cargo.

"The Malibu Maxx is a slightly more upscale vehicle for those interested in making a bolder statement, yet it retains the strong Chevrolet character of the Malibu sedan," said Ed Schoener, Malibu Maxx marketing director.

The upper front grille of both cars is set off with a horizontal chrome bar with the Chevrolet insignia in the center, a tribute to the Malibu's heritage. The horizontal chrome bar theme is repeated on the rear deck of the sedan and tailgate of the Maxx, another link to the Malibus' Chevrolet tradition.

"We think Malibu and Malibu Maxx bring great design and a strong Chevrolet presence to a midsize segment where me-too designs are often the standard," said Schoener. "Combined with the Malibu's performance, versatility and comfort, we think it is a winning formula."

Malibu Graduates From Driving School, With Honors



An impressive combination of European road manners and American performance awaits the buyers of the all-new Malibu sedan and Malibu Maxx extended sedan.

The unexpected ride, handling and performance springs from the General Motors Epsilon global architecture, which makes its North American debut on the 2004 Malibu and Malibu Maxx.

"The Malibu and Malibu Maxx disprove the theory of some car enthusiasts that midsize cars are too bland," said Brent Dewar, Chevrolet general marketing manager. "Bland is not what you'll think of when you drive these cars."

The basic characteristics of the Epsilon architecture were developed with GM's Opel subsidiary in Germany, which helps account for the European flair in the ride and handling of the Malibu and Malibu Maxx. Each Epsilon vehicle is then tailored to meet local conditions and preferences.

The new Malibus take the best of European responsiveness while stepping up to the rigors of American roads and driving habits by delivering a comfortable, smooth, quiet ride. The new Malibus deliver a precise, linear steering feel, confident road manners, predicable handling and controlled ride motion - features that every driver appreciates.

Suspension

A sophisticated suspension system common on many high-end sport sedans is used on all Malibu sedans and Malibu Maxx extended sedans. The system features an independent, gas-pressurized MacPherson strut front suspension and four-link independent rear suspension, front and rear stabilizer bars, and a four-point isolated front cradle with tuned bushings.

The front suspension is compact and has a long wheel travel, which enhances ride and handling. The suspension is carried by a perimeter-type front chassis cradle assembly, which consists of a large, U-shaped hydroformed steel tube welded integrally with a rear cross member. L-shaped control arms are forged, high-strength aluminum.

The four-link independent rear suspension incorporates twin-tube gas shocks, dual-rate mini-block coil springs, direct-acting solid stabilizer bar and adjustable toe and camber.

Tuned chassis

Europeans traditionally fine-tune their suspensions for driving on their typically narrow, twisting roads in hilly terrain. Americans have been more focused on ride quality because of the wider, straighter highways and a higher percentage of punishing, rough road surfaces here.

The Malibu has the same suspension geometry, characteristics and settings typical of European sedans, so the excellent handling agility is retained. But there are subtle refinements that make the Malibu and Malibu Maxx more accommodating to the demands of many American streets and highways.

For example, the forward control arm bushing, which transmits most of the cornering force, has been moved slightly rearward to help negate the effect of high-speed steering shake on rough roads or wheels knocked out of balance by potholes. The rear bushing is larger and configured to allow controlled rearward movement of the front wheel to minimize harshness during impacts or other road surface disturbances.

Also, the upper strut mounts have softer fore-aft stiffness rates, compared with their lateral stiffness, which softens harsh impacts while adding cornering capability.

A number of unsprung chassis and wheel assembly components are aluminum rather than steel to reduce weight, which makes it easier to tune the cars and reduces the load reaction from harsh road impacts back into the body structure.

The front and rear suspension systems are delivered to the Kansas City Assembly Center as modules that have been precision assembled in a controlled environment, assuring more accurate alignment and tuning of the final assembly.

Electric power steering

The new Malibus are the first midsize sedans in North America equipped with electric power steering (EPS). Among the many benefits of EPS are improved fuel efficiency, elimination of hydraulic pump noise (there is no hydraulic pump) and improved cold-weather performance.

With EPS, an electronic control unit determines the amount of steering assist needed for current driving conditions. This electrical assist is especially helpful in low-speed parking maneuvers. On the road, as speed increases, the assistance tapers off.

The steering effort also is variable, designed for a faster response and light feel at slow speeds for easier parking lot maneuvers and a firmer feel at straight-line highway speeds to increase long-distance comfort.

The steering column in all models will telescope and adjust up or down.

Engine mounts

The engine mounting system is designed to give the Malibu a solid ride and a confident, secure feeling for driver and passengers. It also allows the suspension system to operate at maximum efficiency and minimizes engine noise and vibration.

The 3500 3.5-liter V-6, which is standard on the LS and LT versions of both cars, has two load-bearing hydraulic mounts that provide smooth idling while offering the damping needed to control powertrain motion during rough road conditions.

The Ecotec 2.2L I-4, standard on the Malibu sedan, benefits from a hydraulic torque-axis mounting system.

Brakes

The Malibu LT sedan and both versions of the Malibu Maxx extended sedan will have four-wheel disc brakes. The Malibu and Malibu LS sedan are equipped with single-piston vented discs in front with drum brakes in the rear.

The Delphi 7.2 series anti-lock braking system (ABS) with traction control is standard on LS and LT versions and available on the Malibu sedan. Front-to-rear proportioning is handled electronically as an integral ABS function called dynamic rear proportioning.

Adjustable pedals

Power adjustable brake and accelerator pedals are standard on the LS and LT versions and available on the Malibu sedan. The system allows adjustment of the pedals from a switch on the instrument panel while the vehicle is in Park. The brake and accelerator pedals provide total fore/aft travel of about 3 inches which, combined with seat adjustment, accommodate a wide range of driver position preferences.

Brake and accelerator pedal movement are always synchronized through active monitoring to maintain a comfortable pedal spacing and orientation and to prevent any inadvertent adjustment. After adjusting to the driver's preferred driving position, the brake and accelerator pedals will operate and feel exactly like traditional fixed pedals.

Wheels and tires

The wheels and tires for the Malibu were selected for appearance, all-weather performance and ride quality. A team of 70 engineers and technicians help develop the specifications and tire performance criteria for each GM vehicle. Major tire manufacturers produce tires for GM vehicles under the automaker's supervision.

The standard wheels for the Malibu sedan are 15-inch by 6.5-inch steel with Bridgestone P205/65R15 tires. The standard wheels for the Malibu Maxx extended sedan are 16-inch by 6.5-inch cast aluminum wheels with Bridgestone P215/60R16 tires.

Safety Goes To The Heart Of Malibu, Malibu Maxx

Safety is built into the heart of the all-new 2004 Chevrolet Malibu sedan and Malibu Maxx extended sedan, starting with the Epsilon architecture that is the foundation for the cars.

"The Malibu and Malibu Maxx were designed from their initial concept with safety as a primary goal," said Robert C. Lange, General Motors' executive director of structure and safety integration. "We think they will be among the safest midsize passenger cars on the market."

The Epsilon architecture's extensive use of high-strength steel and tailor-welded steel reinforcements provides exceptional structural integrity for the passenger compartment and outstanding impact protection for the front, rear and sides. The fundamentally strong construction is augmented with advanced occupant protection features including dual-stage frontal air bags, three-point safety belts for all seating positions, standard safety belt pretensioners for front-seat passengers and optional head curtain side-impact air bags to help protect front and rear outboard passengers.

"The Epsilon architecture helps provide everyday safety with a refined ride and confident handling, while the structure and the safety features we built in will be there when they're needed," said Brent Dewar, Chevrolet marketing general manager.

Operating with the idea that a comfortable driver is a better driver, engineers also equipped the Malibu and Malibu Maxx to fit the driver like a hand-tailored suit. Every Malibu features standard and optional equipment allowing drivers to customize their driving experience. A power driver's seat height adjuster, tilt/telescoping steering column, and power windows, door locks and mirrors are standard on all Malibus. Power adjustable brake and accelerator pedals and manual lumbar support are standard on the LS and LT models and are available on the Malibu sedan.

Crash avoidance

The keys to a safe design are features that help drivers avoid crashes in the first place. Crash-avoidance features on the Malibu and Malibu Maxx include:

- Nimble, responsive handling
- Daytime running lamps
- Automatic headlamp control
- Electric speed-variable steering
- Power-assisted front disc/rear drum brakes (the Malibu LT and both versions of the Malibu Maxx have four-wheel disc brakes)
- Power outside mirrors
- Excellent driver visibility
- Anti-lock brakes and traction control, standard on Malibu and Malibu Maxx LS and LT models, available on the Malibu sedan

Occupant protection

Safety belts remain the primary and most effective form of occupant protection. All seating positions in the 2004 Malibus have three-point safety belts. The inboard belts are mounted to the seats so the buckle moves with the seat during adjustments. The safety belts are equipped with frictionless D-rings and low-effort, energy-absorbing retractors for comfort and performance.

Both the Malibu and Malibu Maxx also have dual-stage frontal air bags for supplemental protection for front seat passengers. When the air-bag system's central control unit detects an impact, it determines whether the crash is severe enough to trigger a deployment, and whether the primary amount of inflation is sufficient. The primary stage alone will deploy in most frontal impacts requiring the supplemental protection of an air bag, while a secondary stage is designed to deploy in more severe frontal collisions.

The Malibu and Malibu Maxx also have pretensioners that deploy at the same time as the air bags to take up slack in the safety belt webbing. The optional roof-rail air bags act like a protective curtain when deployed, unfolding from the roof rail between the A-pillar and side window header. When the bag deploys, it is angled somewhat toward the window to help provide protection for front- and rear-seat outboard passengers.

All seats have a steel ramp base plate to reduce the chance that passengers would submarine (slide) under the safety belt in a frontal impact. The ramp pushes occupants upward as they move forward. The safety belt pretensioners also help minimize the risk of submarining.

Rear seats in the Malibu and Malibu Maxx are equipped with the LATCH (Lower Anchors and Tethers for CHildren) system of child seat anchors, for both top tethers and lower latches, to simplify installation of child seats with these features.

Crashworthiness

The all-new Malibus are designed to achieve high ratings in the federal government's New Car Assessment Program (NCAP) and Lateral Impact New Car Assessment Program (LINCAP). NCAP and LINCAP are programs of the National Highway Traffic Safety Administration. NCAP assesses occupant injury performance in a 35-mph front rigid barrier impact, and LINCAP assesses occupant injury for the driver and left rear passenger when the car is impacted from the side at a 27-degree angle at 38 mph.

The Malibu and Malibu Maxx also are designed to perform very well in frontal crash tests by the Insurance Institute for Highway Safety (IIHS). These tests are conducted using an offset deformable barrier crash test at 40 mph.

One enabler for a top performance on these tests is the extensive use of high-strength steel on the Malibu and Malibu Maxx. Nearly two-thirds of the underbody components are high-strength, dual-phase steel, which has very high yield strength.

Both the sedan and extended sedan have a rigid steel passenger compartment that helps protect occupants in the event of a crash.

Exceptionally strong high-strength front bumper beams are welded to the body structure, which adds strength and reduces noise, vibration and harshness. The rear bumper beam is bolted to the body structure.

The Malibu and Malibu Maxx are equipped with a full-perimeter, hydroformed steel engine cradle for both four-cylinder and six-cylinder engine installations. The cradle is designed to crush in the front so the engine assembly doesn't intrude on the passenger compartment in a crash. For added strength, the cradle is bolted to the frame and isolated with rubber mounts.

Reinforced rockers, A-pillars, B-pillars and roof rails combine to provide passengers with additional side-impact protection.

The instrument panel structure in the new Malibus is a one-piece magnesium casting, which helps provide more strength and also works to improve side and frontal crash protection.

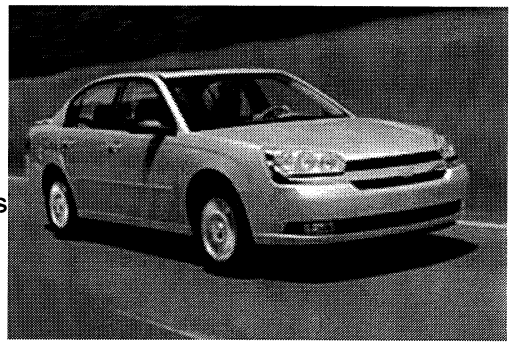
All the doors are reinforced with very high-strength boron-steel intrusion beams. The rear doors also have a door-to-body interlock near the bottom for added resistance to intrusion into the passenger compartment during side-impact crashes.

Safety and security

For added safety and security, the Malibu and Malibu Maxx will be equipped with:

- Content theft security
- Driver information center
- Emergency trunk release handle
- Optional OnStar safety and security package

Advanced Automatic Crash Notification Debuts On New Malibu And Malibu Maxx



The General Motors Advanced Automatic Crash Notification (AACN) system makes it debut on the all-new Chevrolet Malibu and Malibu Maxx, enhancing an already impressive list of standard and optional safety features.

AACN is a standard feature of the OnStar Safe and Sound subscriber package that is available with the Malibu and Malibu Maxx. The system will make crash data available to 911 centers so that they may dispatch the appropriate life-saving personnel and equipment to crash scenes faster.

"We are pleased that we'll be able to provide AACN with our Malibu OnStar package and proud to be the first automaker to offer such a system," said Brent Dewar, Chevrolet general manager. The Malibu will be available in showrooms in August; the Malibu Maxx in January.

Using a series of strategically located sensors, the AACN system will automatically call OnStar if the vehicle is involved in a moderate to severe frontal, rear or side-impact crash, regardless of air-bag deployment. Also, the new system provides crash severity information to OnStar call center advisors, who relay it to 911 dispatchers, helping them to quickly determine the appropriate combination of emergency personnel, equipment and medical facilities needed.

OnStar, the industry's leading in-vehicle safety and security communications system, is automatically notified within seconds when a subscriber's air bag deploys. The next-generation GM automatic crash notification system takes this potentially life-saving service beyond air-bag deployments to moderate and severe crashes.

When a vehicle crash occurs, a quick medical response often can mean the difference between life and death when a crash occurs.

"With the new technology of this enhanced GM crash notification system, we have a tremendous opportunity to save more lives," said Robert C. Lange, GM executive director of vehicle safety. "AACN will assist emergency personnel in determining crash severity in those precious minutes following a crash, and help get the right people to the scene faster."

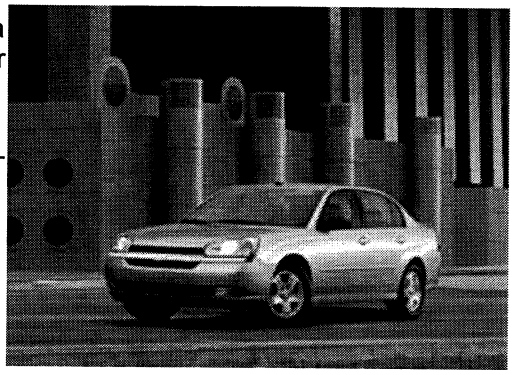
The AACN system works by using new and existing sensors in conjunction with advanced intelligence to transmit key crash data including the direction of impact and the impact force. Impact force is one of the most important pieces of data used to determine the severity of a crash.

When the AACN system is triggered by a crash of sufficient severity, an emergency voice/data connection will be established with an OnStar call center. The advisor will use the voice channel in the vehicle to communicate with the crash victims and, at the same time, conference-in the nearest public service answering point (911 dispatcher) and provide specific data about the severity of the crash. The 911 dispatcher can then inform emergency responders of the data.

In the future, AACN data may be transmitted electronically to the 911 centers, emergency responders, emergency departments and trauma centers using secured Internet connections.

Also in the future, AACN systems may be capable of determining how many occupants are in the vehicle, whether they are using safety belts and other information that helps emergency responders further anticipate the types and severity of injuries that may have occurred in a crash.

Factory-Installed Remote Vehicle Starter System Debuts On Malibu And Malibu Maxx



The new Malibu and Malibu Maxx will be the first cars to offer a factory-installed remote vehicle starter system, giving the driver a head start on heating or cooling the car's interior from a range of about 200 feet.

The remote vehicle starter system is standard on the Malibu LT sedan and Malibu Maxx LT extended sedan and optional on the rest of the lineup.

Until now, remote vehicle starter systems were only available as an aftermarket add-on. This will be the first factory-installed remote starter system that is integrated with the vehicle safety and security systems and fully warranted by Chevrolet.

The remote vehicle starter system is activated from the remote key fob by first pressing the "lock" button, then pressing and holding the remote start button for one and one-half seconds. This two-step process helps prevent inadvertent activation, locks the car and engages the anti-theft system.

When a Malibu equipped with the system receives the rolling code radio frequency remote start signal, the car's signal lamps flash once and the park lamps turn on when the engine begins running. The car doors must be locked each time the remote start is initiated, but they may be unlocked with the fob at any time.

The car will shut itself off if left unattended for 10 minutes after being remotely started. The system will not work unless the doors are locked and the hood is closed. The system can be temporarily disabled through the car's driver information center personalization options menu.

The key benefit of the factory-installed remote vehicle starter system is its integration with the Malibu's safety, security, electrical and engine management systems. The remote vehicle starter system checks whether the hood is closed and monitors anti-theft systems, engine oil pressure, engine temperature, engine rpm, throttle position, brake transmission shift interlock, vehicle speed, emission system diagnostics, battery voltage, data communications links and the ignition switch. All systems must be within operating requirements for the GM remote vehicle starter system to operate.

To drive away after a remote start, the ignition key must be placed in the switch and rotated to the "run" position. With the proper key in the "run" position, the vehicle anti-theft password is sent to the theft deterrent system, and an electrical message is sent to the operating modules that the vehicle is in a normal running condition. With these systems satisfied, the brake transmission shift interlock will allow shifting out of "park."

A remote start can be stopped several ways:

- Pressing the remote start button on the key fob.
- Pressing the "hazard" button.
- Inserting the key and rotating the ignition switch out of the "off" position and then returning to "off."

Model Lineup – Malibu

	Engines		Transmission
	Ecotec 2.2L I-4	3500 3.5L V-6	4-spd electronic auto (Hydra-Matic 4T45-E)
Malibu	s	o	s
Malibu LS	-	s	s
Malibu LT	-	s	s

Vehicle Highlights – Malibu

- All-new mid-size sedan
- Standard: tilt/telescoping steering column; power windows, mirrors and locks; power driver's seat height adjuster
- Standard LS & LT: power adjustable pedals (available on base model)
- Factory-installed remote starter available
- Versatile seating, cargo combinations
- Rigid body structure provides exceptional handling and interior quietness
- Clean, contemporary design inside and out
- Powerful, fuel efficient, smooth powertrain choices

Model Lineup – Malibu Maxx

	Engine	Transmission
	3500 3.5LV-6	4-spd electronic auto(Hydra-Matic 4T45-E)
Malibu Maxx LS	s	s
Malibu Maxx LT	s	s

Key:
Standard s
Optional o
Not available -

Vehicle Highlights – Malibu Maxx

- Five-door extended sedan
- Wheelbase is 6 inches (152 mm) longer than 2004 Malibu sedan, overall length .5-inch (12.7 mm) shorter
- 106 cubic feet of passenger space
- Rear seat slides 7 inches (178 mm) fore and aft
- 22.8 cubic feet (646L) of cargo space, expandable, reconfigurable
- Standard rear fixed skylight with retractable shade
- Standard tilt, telescoping steering wheel
- Standard 3.5L V-6 and automatic transmission
- Factory-installed remote starter available

Specifications – Malibu

Overview		
Models:	Malibu, Malibu LS, Malibu LT	
Body style / driveline:	5-passenger sedan, unit body frame, front engine, front-wheel drive	
Construction:	2-sided galvanized steel on exterior panels (except roof)	
EPA vehicle class:	mid-size car	
Manufacturing location:	Kansas City, Kan.	
Key competitors:	Toyota Camry, Honda Accord, Dodge Stratus, Hyundai Sonata, Mazda 6	
Engines	**Ecotec 2.2L I-4 (L61)**	**3500 3.5L V-6 (LX9)**
Application:	std on Malibu	opt on Malibu; std on Malibu LS, LT
Type:	2.2L DOHC I-4	3.5L V-6
Displacement (cu in / cc):	134 / 2189	213 / 3500
Bore & stroke (in / mm):	3.39 x 3.72 / 86 x 94.6	3.70 x 3.31 / 94 x 84
Block material:	cast aluminum	cast iron
Cylinder head material:	cast aluminum	cast aluminum
Valvetrain:	DOHC, 4-valves per cylinder	OHV, 2 valves per cylinder
Ignition system:	electronic direct	electronic direct
Fuel delivery:	sequential multi-port fuel injection	sequential multi-port fuel injection
Compression ratio:	10.0:1	9.80:1
Horsepower (hp / kw @ rpm):	145 / 108 @ 5600	200 / 149 @ 5400
Torque (lb-ft / Nm @ rpm):	155 / 210 @ 4000	220 / 298 @ 3200
Recommended fuel:	87 octane	87 octane
Maximum engine speed (rpm):	6500	6200
Exhaust system:	stainless steel with aluminized coating on the muffler and tailpipe	stainless steel with aluminized coating on the muffler and tailpipe
Emissions controls:	close-coupled catalytic converters; Quick-Sync 24x ignition system; returnless fuel rail; fast-response O2 sensor	close-coupled catalytic converters; Quick-Sync 24x ignition system; returnless fuel rail; fast-response O2 sensor
Estimated fuel economy (mpg city / hwy / combined):	24 / 34 / 29	23 / 32 / 25

Transmission	
Type:	Hydra-Matic 4T45-E4-speed automatic w/overdrive, front-wheel drive
Gear ratios (:1):	
First:	2.96
Second:	1.62
Third:	1.00
Fourth:	0.68
Reverse:	2.14
Final drive ratio:	3.29:1

Chassis/Suspension	
Front:	independent MacPherson coil-over-strut strut (gas pressurized), coil springs, 19.5-mm stabilizer bar, full frame isolated front chassis cradle
Rear:	independent 4-link design, twin-tube gas shock, dual rate (non-linear) mini block coil spring, 20-mm stabilizer bar, adjustable toe and camber
Steering type:	electric, power-assisted variable-speed rack-and-pinion
Steering ratio:	15.9:1
Steering wheel turns, lock-to-lock:	3.1 turns

Turning circle, curb-to-curb (ft / m):	38 / 11.6
Brakes	
Type:	power-assisted front disc, rear drum (anti-lock braking system and traction control with Dynamic Rear Proportioning and active wheel-speed sensors std on LS/LT, opt. on base)
Front rotor (diameter x thickness, in / mm):	10.87 x 1.02 / 276 x 26; vented discs
Rear disc (diameter x thickness in / mm):	9.05 x 1.57 / 230 x 40; drums
Total swept area (sq in / sq cm):	front: 224 / 1444; rear: 88.6 / 572
Wheels/Tires	
Wheel size and type:	• Base: 15-inch x 6.5-inch steel • LS: 15-inch x 6.5-inch aluminum, machine-faced • LT: 16-inch x 6.5-inch aluminum, machine-faced
Tires:	• Base: P205/65R15, compact spare tire • opt: P205/60R15 or P215/60R16 blackwall touring tires, compact spare tire

Dimensions – Malibu

Exterior		
Wheelbase (in / mm):	106.3 / 2700	
Overall length (in / mm):	188.3 / 4783	
Overall width (in / mm):	69.9 / 1775	
Overall height (in / mm):	57.5 / 1460	
Track (in / mm):	front: 60 / 1524; rear: 59.3 / 1506	
Minimum ground clearance (in / mm):	6.1 / 154	
Curb weight (lb / kg):	Base: 3174 / 1440; LS: 3297 / 1495; LT: 3315 / 1504	
Weight distribution (% front / rear):	63 / 37	
Interior	**Front**	**Rear**
Seating capacity:	2	3
Head room (in / mm):	39.6 / 1006	37.6 / 955
Leg room (in / mm):	41.9 / 1064	38.5 / 978
Shoulder room (in / mm):	56.7 / 1440	56.1 / 1425
Hip room (in / mm):	53.2 / 1351	52.4 / 1331
Capacities		
EPA passenger volume (cu ft / L):	101.4 / 2871	
EPA interior volume (cu ft / L):	116.8 / 3307	
Cargo volume (cu ft / L):	15.4 / 436	
Trailer towing maximum (lb / kg):	1000 / 454	
Fuel tank (gal / L):	16.3 / 61.7	
Engine oil (qt / L):	4.5 / 4.3	
Cooling system (qt / L):	13.6 / 12.9	

Specifications – Malibu Maxx

Overview	
Models:	Malibu Maxx LS and LT
Body style / driveline:	5-passenger extended sedan, unit body frame, front engine, front-wheel drive
Construction:	2-sided galvanized steel on exterior panels (except roof); aluminum liftgate
EPA vehicle class:	midsize
Manufacturing location:	Kansas City, Kan.
Key competitors:	Toyota Camry, Honda Accord, Dodge Stratus, Hyundai Sonata, Mazda 6

Engine	
Type:	3500 3.5L V-6 (LX9)
Displacement (cu in / cc):	213 / 3500
Bore & stroke (in / mm):	3.7 x 3.31 / 94 x 84
Block material:	cast iron
Cylinder head material:	cast aluminum
Crank material:	steel
Valvetrain:	OHV, 2 valves per cylinder
Ignition system:	electronic direct
Fuel delivery:	sequential multi-port fuel injection
Compression ratio:	9.80:1
Horsepower (hp / kw @ rpm):	200 / 149 @ 5400
Torque (lb-ft / Nm @ rpm):	220 / 298 @ 3200
Recommended fuel:	87 octane
Maximum engine speed (rpm):	6200
Exhaust system:	stainless steel with aluminized coating on the muffler and tailpipe
Emissions controls:	close-coupled catalytic converters; Quick-Sync 24x ignition system; returnless fuel rail; fast-response O2 sensor
Estimated fuel economy (mpg city / hwy / combined):	23 / 32 / 27

Transmission	
Type:	Hydra-Matic 4T45-E 4-speed automatic w/overdrive, front-wheel drive
Gear ratios (:1):	
First:	2.96
Second:	1.62
Third:	1.00
Fourth:	0.68
Reverse:	2.14
Final drive ratio:	3.29:1

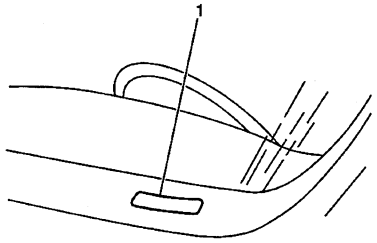
Chassis/Suspension	
Front:	independent MacPherson coil-over-strut (gas pressurized), coil springs, 19.5-mm stabilizer bar, full frame isolated front chassis cradle
Rear:	independent 4-link design, twin-tube gas shock, dual rate (non-linear) mini block coil spring, 20-mm stabilizer bar, adjustable toe and camber
Steering type:	electric, power-assisted variable-speed rack-and-pinion
Steering ratio:	15.9:1
Steering wheel turns, lock-to-lock:	3.1
Turning circle, curb-to-curb (ft / m):	38 / 11.6
Brakes	
Type:	power-assisted 4-wheel disc with anti-lock braking system and traction control with dynamic rear proportioning and active wheel-speed sensors
Front rotor (diameter x thickness, in / mm):	11.65 x 1.02 / 296 x 26; vented discs
Rear rotor (diameter x thickness, in / mm):	10.63 x 0.55 / 270 x 14; solid discs
Total swept area (sq in / sq cm):	front: 208.3 / 1344; rear: 97.9 / 631.7
Wheels/Tires	
Wheel size and type:	LS: 16-inch x 6.5-inch aluminum, painted LT: 16-inch x 6.5-inch aluminum, machined-faced
Tires:	P215/60R16 blackwall touring tires, compact spare tire

Dimensions – Malibu Maxx

Exterior		
Wheelbase (in / mm):	112.3 / 2852	
Overall length (in / mm):	187.8 / 4770	
Overall width (in / mm):	69.8 / 1773	
Overall height (in / mm):	58.1 / 1476	
Track (in / mm):	front: 60 / 1524; rear: 60.2 / 1529	
Minimum ground clearance (in / mm):	6.1 / 154	
Curb weight (lb / kg):	LS: 3458 / 1569; LT: 3476 / 1577	
Weight distribution (% front / rear):	60 / 40	
Interior	**Front**	**Rear**
Seating capacity:	2	3
Head room (in / mm):	39.4 / 1001	39.4 / 1001
Leg room (in / mm):	41.9 / 1064	41.0 / 1042
Shoulder room (in / mm):	56.7 / 1440	55.5 / 1410
Hip room (in / mm):	53.5 / 1359	52.4 / 1331
Capacities		
EPA passenger volume (cu ft / liters):	106.0 / 3002	
EPA interior volume (cu ft / liters):	128.8 / 3647	
Cargo volume (cu ft / liters):	22.8 / 646	
Trailer towing maximum (lb / kg):	1000 / 454	
Fuel tank (gal / liters):	16.3 / 62	
Engine oil (qt / liters):	4.5 / 4.3	
Cooling system (qt / liters):	13.6 / 12.9	

Vehicle Identification

Vehicle Identification Number (VIN)



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

Position	Definition	Character	Description
1	Country of Origin	1	U.S.A.
2	Manufacturer	G	General Motors
3	Make	1	Chevrolet
4-5	Carline/Series	Z/S Z/T Z/U	Malibu Malibu LS Malibu LT
6	Body Style	5 6	Sedan-4 Door 4 Window Notchback, 69 Sedan- 4 Door 6 Window Plain Back-Hatchback, 68
7	Restraint System	2	Active Manual Belts W/Driver and Passenger Inflatable Restraint System Frontal
8	Engine Type	8 F	RPO LX9 Engine Gas, 6 CYL, 3.5L, SFI, V6 RPO L61 Engine Gas, 4 CYL, 2.2L, SFI, ALUM
9	Check Digit	--	Check Digit
10	Model Year	4	2004
11	Plant Location	F	Fairfax II, KS
12-17	Plant Sequence Number	--	Plant Sequence Number

VIN Derivative

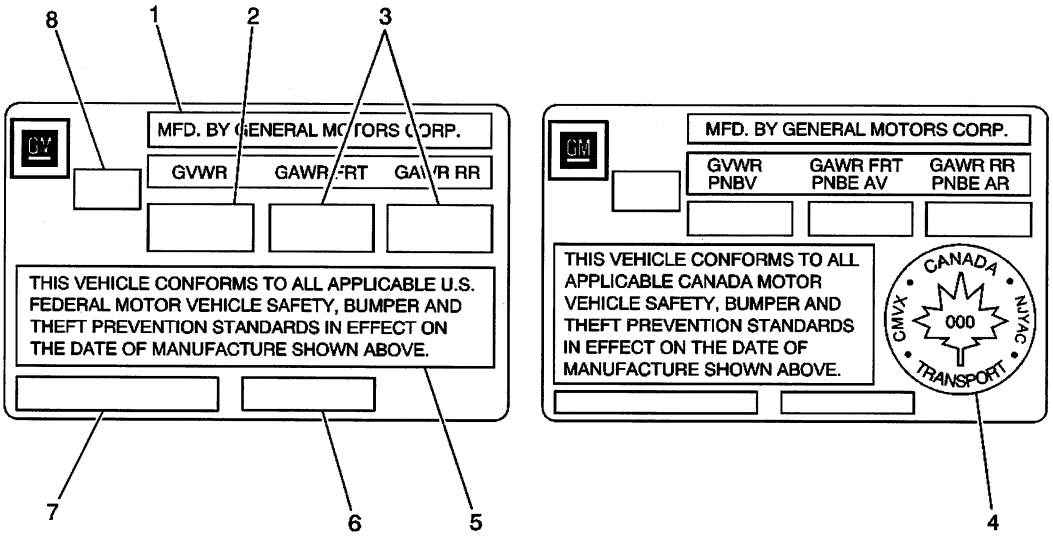
All engines and transmissions are stamped or laser etched with a partial vehicle identification number (VIN), which was derived from the complete VIN. A VIN derivative contains the following nine positions:

Position	Definition	Character	Description
1	GM Division Identifier	1	Chevrolet
2	Model Year	4	2004
3	Assembly Plant	F	Fairfax II, KS
4-9	Plant Sequence Number	--	--

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

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

Vehicle Certification Label



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

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

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

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

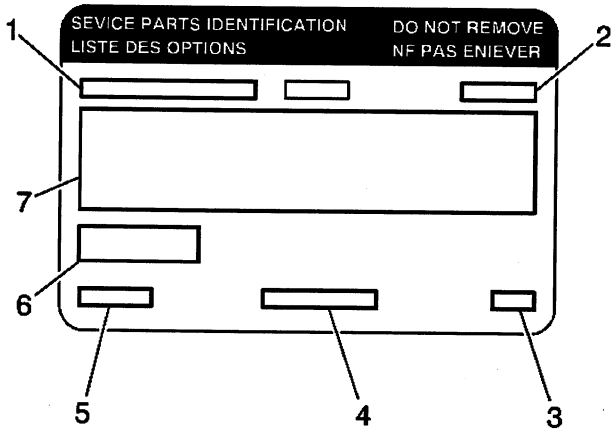
The GVW is the weight of the vehicle and everything the vehicle carries. Include the following items when figuring the GVW:

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

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

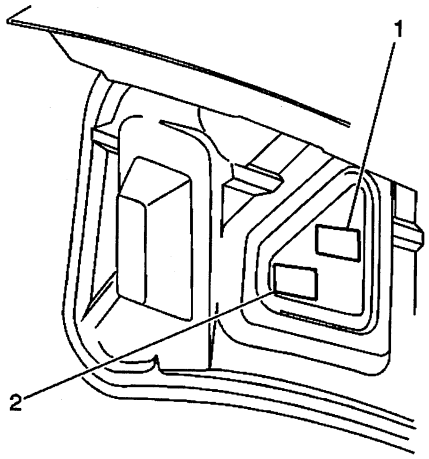
The GAW is the weight exerted on one of the axles (front or rear).

Service Parts Identification Label (SPID)



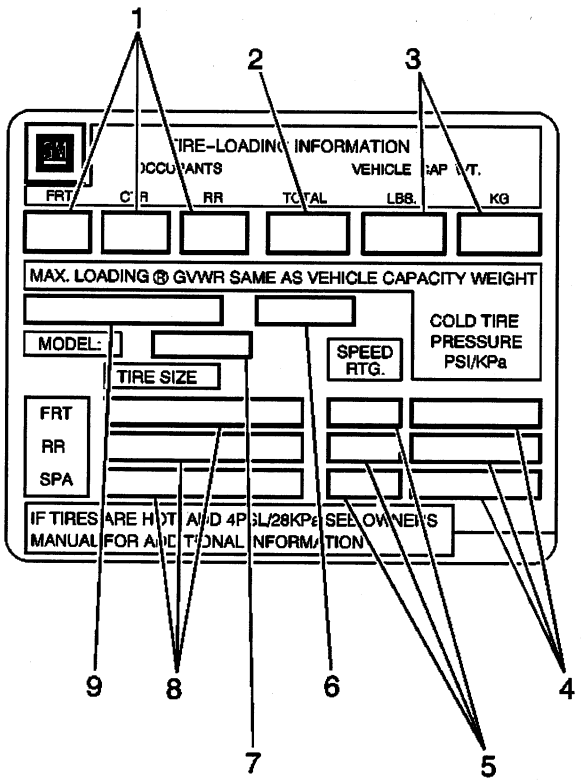
(1) Vehicle Identification Number
(2) Engineering Model Number (Vehicle Division, Vehicle Line and Body Style)
(3) Interior Trim and Decor Level
(4) Exterior (Paint Color) WA Number
(5) Paint Technology
(6) Special Order Paint Colors and Numbers
(7) Vehicle Option Content

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



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

Tire Placard



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

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

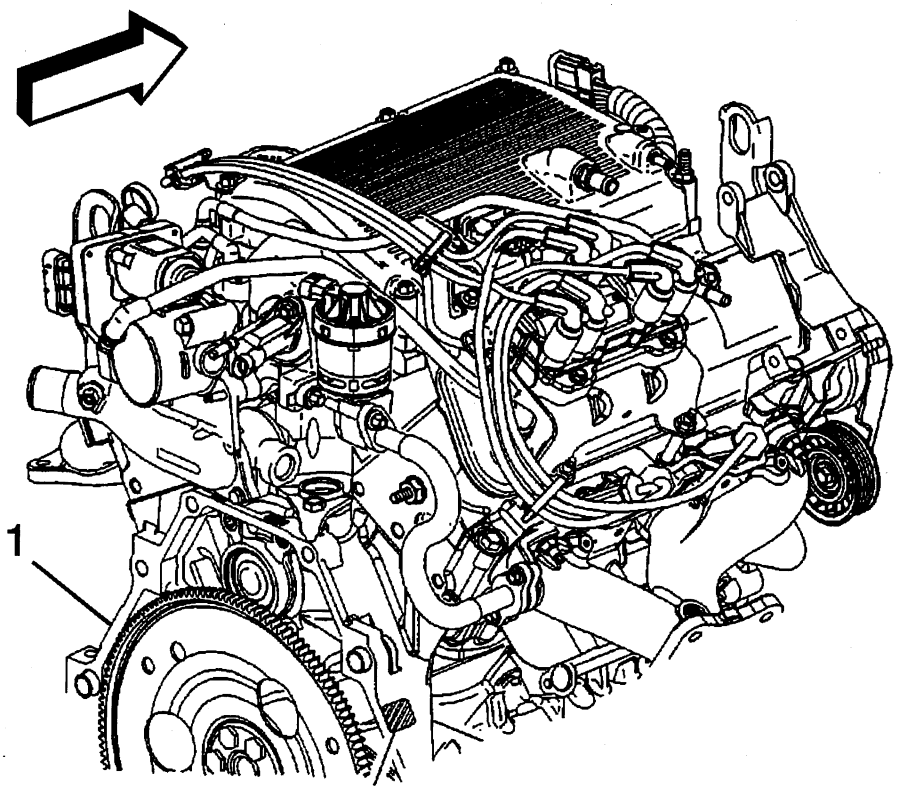
- The maximum vehicle capacity weight
- The cold tire inflation pressures
- The tire sizes (original equipment tires)
- The tire speed ratings (original equipment tires)

Engine ID and VIN Derivative Location

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

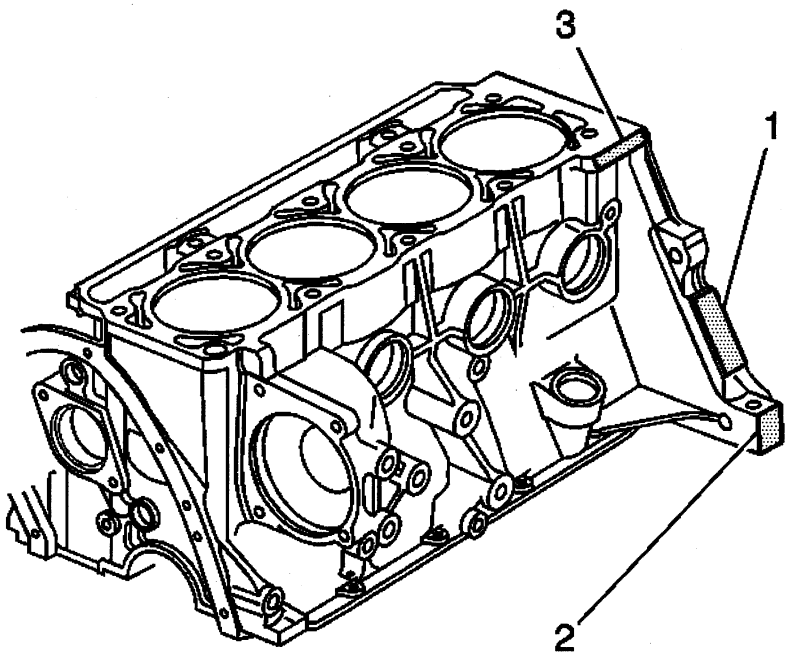
LX9, 3.5L Engine VIN Derivative Location

The Vehicle Identification Number - VIN derivative (1) for 3.5L LX9 is stamped or laser etched on the left side rear of the engine block. The Vehicle Identification Number - VIN derivative is nine digits long and can be used to determine if a vehicle contains the original engine.



- The first digit identifies the division.
- The second digit identifies the model year.
- The third digit identifies the assembly plant.
- The fourth through ninth digits are the last six digits of the Vehicle Identification Number - VIN.

L61, 2.2 L Engine VIN Derivative Location



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

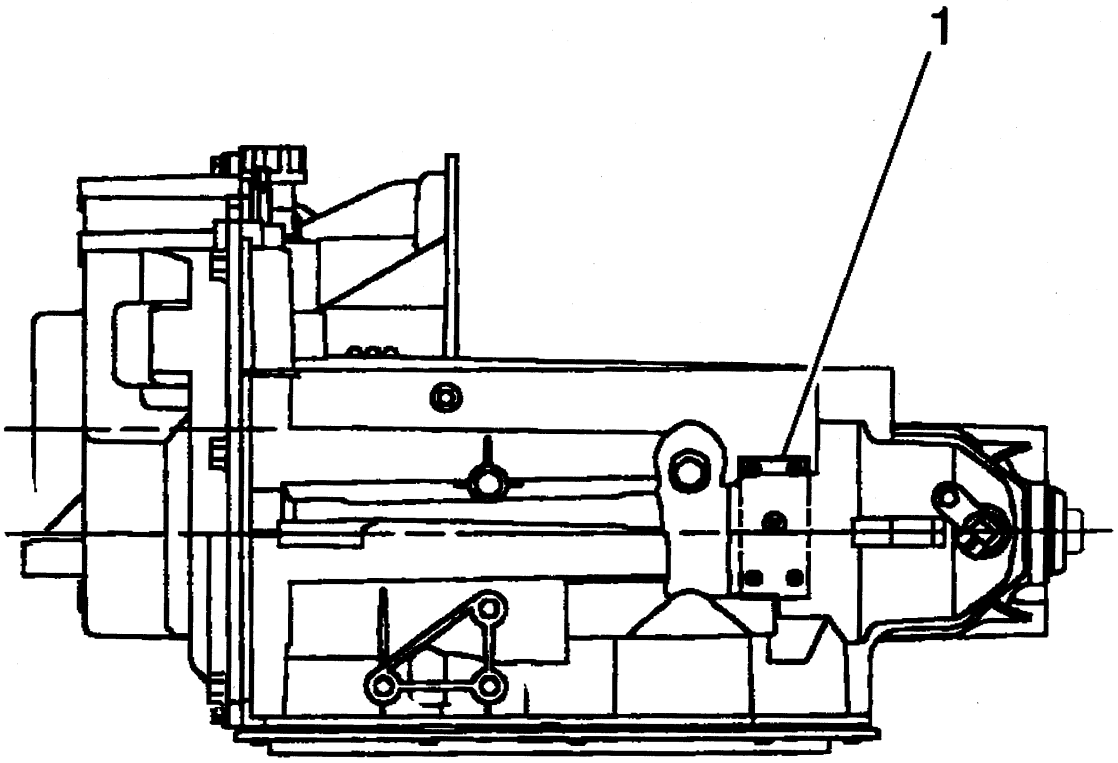
The engine code letter is the eight digit of the VIN, which identifies the engine.

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

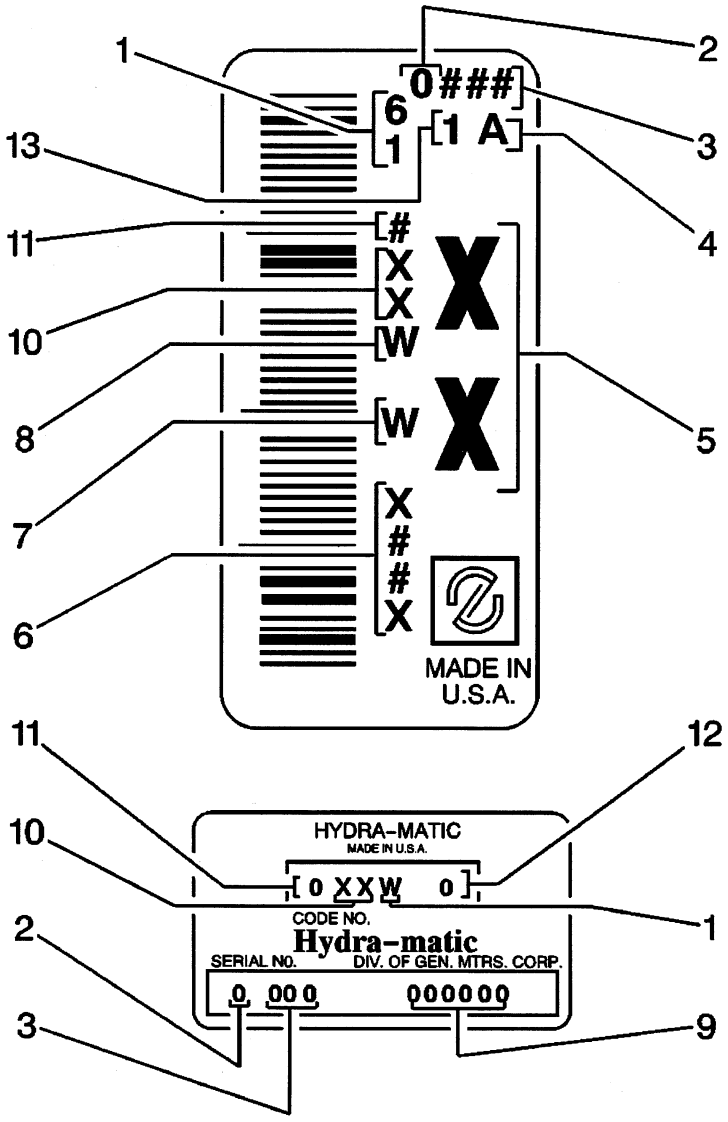
The primary location for the engine ID is on front of the rocker cover (1).

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

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



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

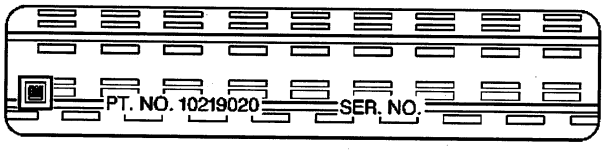


(1) Transaxle (1) Transaxle (2) Calendar Year (2) Calendar Year (3) Julian Date or Day of the Year (3) Julian Date or Day of the Year (4) Shift (A=First Shift, B=Second Shift, C=Third Shift) (5) Model (6) Serial Number in Base Code 31 (7) Plant (8) Hydramatic 4T40 E (9) Serial Number (10) Model (10)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

Engine and Transmission Usage

Body Type	Car Line (Division)	Engine Size	Fuel System	Engine RPO	Transmission Used	Transmission RPO
Z/S Z/T Z/U	Chevrolet Malibu Chevrolet Malibu LS Chevrolet Malibu LT	3.5L, V6	SFI	LX9	4T45-E	MN5
Z/S Z/T	Chevrolet Malibu Chevrolet Malibu LS	2.2L, V6	SFI	L61	4T45-E	MN5

Labeling - Anti-Theft



Notice

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

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

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

RPO Code List

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

RPO	Description
AG1	Seat, Power 6-Way adj.
AK5	Restraint System Front Seat, Inflatable, Driver and Passenger
AP3	Lock Control, Entry, Remote, Keyless Entry, Start
AP9	Net Convenience
AU0	Lock Control, Entry Remote Entry
AY1	Restraint System Seat, Inflatable, Driver and PASS, Roof Side
A51	Seat FRT BKT, Custom
B37	Covering Floor MAT, RT and RR, AUX
CF5	Sun Roof, Glass, Sliding, Electric
C60	HVAC System Air Conditioner, Front Manual Controls
C68	HVAC System Air Conditioner, FRT, AUTO, Electronic Controls.
DD8	Mirror, I/S R/V LT Sensitive
DE9	Sunshade RR Passenger Compartment
DK6	Console Roof Interior
DL8	Mirror O/S LH and RH, Remote Control, Electric, Heated
DNR	Equipment Dealer Installed
DT3	Box Rear Stowage Compartment
D49	Mirrors O/S LH and RH, Remote Control, Electric, Manual Fold
E90	Pocket Front Seat Back, Driver
E91	Pocket Front Seat Back, PASS
FAI	Plant Code Fairfax, KS, USA
FEO	Suspension System FRT and RR, Active
FR9	Ratio Transaxle Final Drive 3.29
FY1	Ratio Transaxle Final Drive 3.63
F83	Transaxle Ratio, Final Drive 3.05
JF4	Pedal Adjustable, Power
JL9	Brake System PWR, FRT DISC, RR Drum, Cast Iron, Antilock, FRT and RR WHL
JM4	Brakes System Power, Front Disc, Rear Drum, Cast Iron, Antilock, Front and Rear Wheel
J41	Brake System PWR, FRT Disc, RR Drum, Cast Iron
KA1	Heater Seat, FRT
KC4	Engine Oil Cooling System
K05	Engine Block Heater
K34	Cruise Control Automatic, Electronic
K64	Generator 115 AMP
LX9	Engine Gas, 6 CYL, 3.5L, SFI, V6, GM
L61	Engine Gas, 4 CYL, 2.2L, MFI, ALUM, DOHC
MN5	Transmission, Automatic 4 Speed, 4T45-E
MX0	Merchandised Transmission Automatic Provisions, Overdrive
NF9	Emission System General Unleaded
NR0	Steering Wheel Leather Wrapped, Spokes
NT9	Emission System Federal, Tier 2 Phase-Out
NU4	Emission System California LEV2 PLUS
NW7	Traction Control Fuel Filter Management Only
NO5	Lock Control Fuel Filler Cap
N46	Steering Wheel Spokes
PA7	Wheel 15 X 6.5, Aluminum
PB4	Lock Control Wheel

RPO	Description
PF3	Wheel 15 X 6.5, Aluminum
PYO	Wheel 16 X 6.5, Aluminum
QB5	Wheel 16 X 6.5, Steel
QD1	Wheel 16 X 6.5, Aluminum, Styled
QMR	Tire All P205/65R15/N BL R/PE ST TL AL2
QPE	Tire All P215/60R16/N BL R/PE ST TL AL2
SSG	Graphic Switch Function Symbol
T43	Rear Spoiler
UC6	Radio AM/FM Stereo, Seek/Scan, RDS, Multiple Compact DISC, AUTO Tone Control, Clock, ETR
UE1	Communication System Vehicle G.P.S. 1
UG1	Opener Garage Door, Universal
UK3	Control Steering Wheel, Accessory
UK6	Radio Control RR Seat and Earphone Jacks
UN0	Radio, AM/FM, Stereo, Seek/Scan, Compact Disc, Auto Tone, Clock
UP0	Radio, AM/FM, Stereo, Seek/Scan, Auto Reverse Music Search Cassette, CD, Auto Tone, Clock
UW4	Speaker System 4, Custom
UZ6	Speaker System, 6, Premium
U1C	Radio AM/FM Stereo, Seek/Scan, CD, Clock, ETR
U19	Metric Scale Instrument Cluster
U2K	Digital Audio System S-Band
U32	Entertainment PKG Rear Seat, Player, DVD
U73	Antenna Fixed, Radio
U77	Antenna RR Window, Radio
VG9	Protector Wax, Exterior Body
VH5	Plate Vehicle Identification
VR6	Hook Tie Down
Z49	Export Canadian Modification, Mandatory Base Equipment

Technical Information

Maintenance and Lubrication

Capacities - Approximate Fluid

Application	Specification	
	Metric	English
Important: All capacities are approximate. When adding, be sure to fill to the appropriate level, as recommended in this manual.		
Air Conditioning Refrigerant R134a	0.6 kg	1.1 lb
Automatic Transaxle Complete Overhaul	9.0 L	9.5 qt
Engine Cooling		
2.2L L61 Engine	6.5 L	6.9 qt
3.5L LX9 Engine	9.6 L	10.1 qt
Engine Oil with Filter		
2.2L L61 Engine	4.7 L	5 qt
3.5L LX9 Engine	4.7 L	5 qt
Fuel Tank	62.5 L	16.5 gal
Power Steering System	0.7 L	1.5 pt
Wheel Nut Torque	140 N·m	100 lb ft

Maintenance Items

Item	Part Number
Engine Air Cleaner/Filter	GM P/N 24577608 AC Delco® P/N A-1615C
Engine Oil Filter	
2.2L L61 Engine	GM P/N 24460713 AC Delco® P/N PF-2244G
3.5L LX5 Engine	GM P/N 24460713 AC Delco® P/N PF-47
Spark Plugs	
2.2L L61 Engine	GM P/N 25337472 Delco® P/N 41-081
3.5L LX9 Engine	GM P/N 12568387 AC Delco® P/N 41-101
Windshield Wiper Blades	
Passenger Side Length 48.0 cm (19.0 in)	GM P/N 22688086 AC Delco® P/N
Driver Side Length 56.0 cm (22.0 in)	GM P/N 22688087 AC Delco® P/N

Tire Inflation Pressure Specifications

Application	Metric	English
Front and Rear Tires	205 kPa	30 psi
Compact Spare	420 kPa	60 psi

Fluid and Lubricant Recommendations

Application	Fluid/Lubricant
Automatic Transaxle	DEXRON®-III Automatic Transmission Fluid.
Engine Coolant	A 50/50 mixture of clean, drinkable water and use only DEX-COOL® Coolant.
Engine Oil	Engine oil with the American Petroleum Institute Certified for Gasoline Engines Starburst symbol of the proper viscosity.
Hinges, Hood and Door	Multi-Purpose Lubricant, Superlube® GM P/N 12346241 (Canadian P/N 10953474).
Hood Latch Assembly, Secondary Latch, Pivots, Spring Anchor and Release Pawl	Lubriplate® Lubricant Aerosol GM P/N 12346293 or (Canadian P/N 992723) or equivalent lubricant meeting requirements of NLGI #2, Category LB or GC-LB.
Hydraulic Brake System	Delco Supreme 11® Brake Fluid equivalent DOT-3 Brake Fluid.
Key Lock Cylinders	Multi-Purpose Lubricant, Superlube® GM P/N 12346241 (Canadian P/N 10953474).
Power Steering System	GM Power Steering Fluid GM P/N 89021184 or (Canadian P/N 89021186).
Weatherstrip Conditioning	Dielectric Silicone Grease GM P/N 12345579 (Canadian P/N 992887).
Windshield Washer Solvent	GM Optikleen® Washer Solvent.

Descriptions and Operations

Power Steering System Description

The power steering system reduces the amount of effort needed to steer the vehicle. The system uses the powertrain control module (PCM), body control module (BCM), power steering control module (PSCM), discrete battery voltage supply circuit, steering shaft torque sensor, steering wheel position sensor, power steering motor, driver information center (DIC), and the serial data circuit to perform the system functions. The PSCM and the power steering motor are serviced as an assembly and are serviced separately from the steering column assembly. The steering shaft torque sensor and the steering wheel position sensor are not serviced separately from each other or from the steering column assembly. The steering column assembly does not include the power steering motor and module assembly.

Steering Shaft Torque Sensor

The PSCM uses the steering shaft torque sensor as it's main input for determining steering direction and the amount of assists needed. The steering column has an input shaft, from the steering wheel to the torque sensor, and an output shaft, from the torque sensor to the steering shaft coupler. The input and output shafts are separated by a section of torsion bar, where the torque sensor is located. The sensor is a 5 volt dual analog inverse signal device with a valid signal voltage range of 0.25-4.75 volts. When applying torque to the steering column shaft during a right turn, the sensor's signal 1 voltage increases, while the signal 2 voltage decreases within the valid signal voltage range. When applying torque to the steering column shaft during a left turn, the signal 1 voltage decreases, wile the signal 2 voltage increases within the valid signal voltage range. The PSCM recognizes this change in signal voltage as steering direction and steering column shaft torque.

Steering Wheel Position Sensor

The PSCM uses the steering position sensor to determine the steering system on center position. Since the power steering motor provides a slight amount of return to center assist, the PSCM will command the power steering motor to the steering system center position and not beyond. The sensor is a 5 volt dual analog triangle signal device with a valid signal voltage range of 0-5 volts. The sensors signal 1 and signal 2 voltage values will increase and decrease within the valid voltage range, and stay within 2.5-2.8 volts of each other as the steering wheel is turned.

Power Steering Motor

The power steering motor is a 12 volt brushless DC reversible motor with a 65 amp rating. The motor assists steering through a worm gear and reduction gear located in the steering column housing.

Power Steering Control Module (PSCM)

The PSCM uses a combination of steering shaft torque sensor input, vehicle speed, calculated system temperature and steering tuning to determine the amount of steering assist. When the steering wheel is turned, the PSCM uses signal voltage from the steering shaft torque sensor to detect the amount of torque and steering direction being applied to the steering column shaft and then command the proper amount of current to the power steering motor. The PSCM receives a vehicle speed message from the PCM via the serial data circuit. At low speeds more assist is provided for easy turning during parking maneuvers. At high speeds, less assist is provided for improved road feel and directional stability. The PSCM nor the power steering motor are designed to handle 65 amps continuously. If the power steering system is exposed to excessive amounts of static steering conditions, the PSCM will go into a protection mode to avoid thermal damage to the power steering components. In this mode the PSCM will limit the amount of current commanded to the power steering motor which reduces system temperature and steering assist levels. The PSCM must also be setup with the correct steering tuning which are different in relation to the vehicles powertrain configuration, sedan, coupe, tire and wheel size etc.. The PSCM has the ability to detect malfunctions within the power steering system. Any malfunction detected will cause the DIC to display the POWER STEERING warning message and/or the service vehicle soon indicator.

Steering Wheel and Column

The electric power steering (EPS) system reduces the amount of effort needed to steer the vehicle. The steering column is integrated with an assist mechanism which contains a hub gear fitted onto the lower steering shaft. The hub gear mates with a worm gear that is driven by the EPS motor, which is serviced separately from the steering column. The steering column is serviced as a complete assembly only. Disassembly of the column beyond the procedures included may lead to malfunction of the steering system.

Assist Mechanism

The assist mechanism is located at the bottom of the steering column. It contains the assist mechanism input shaft (driven by the EPS motor), the lower steering shaft, the hub gear and both the torque sensor and the steering position sensor. These sensors provide information to the power steering control module (PSCM), which is serviced as a unit with the EPS motor.

Steering Shaft Torque Sensor

The PSCM uses the steering shaft torque sensor as its main input for determining steering direction and the amount of assist needed. The steering column has an input shaft, from the steering wheel to the torque sensor, and an output shaft, from the torque sensor to the steering shaft coupler. The input and output shafts are separated by a section of torsion bar, where the torque sensor is located. The sensor is a 5-volt dual analog inverse signal device with a valid signal voltage range of 0.25-4.75 volts. When applying torque to the steering column shaft during a right turn, the sensor signal 1 voltage increases, while the signal 2 voltage decreases within the valid signal voltage range. When applying torque to the steering column shaft during a left turn, the signal 1 voltage decreases, wile the signal 2 voltage increases within the valid signal voltage range. The PSCM recognizes this change in signal voltage as steering direction and steering column shaft torque.

Steering Wheel Position Sensor

The PSCM uses the steering position sensor to determine the steering system on center position. Since the motor/module provides a slight amount of return to center assist, the PSCM will command the motor/module to the steering system center position and not beyond. The sensor is a 5-volt dual analog triangle signal device with a valid signal voltage range of 0-5 volts. The sensors signal 1 and signal 2 voltage values will increase and decrease within the valid voltage range, and stay within 2.5-2.8 volts of each other as the steering wheel is turned.

Suspension Description and Operation

Front Suspension

The front suspension has 2 primary purposes:

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

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

This requires that the steering knuckle be suspended between a lower control arm and a strut assembly. The lower control arm attaches from the steering knuckle at the outermost point of the control arm. The attachment is through a ball and socket type joint. The innermost end of the control arm attached at 2 points to the vehicle frame through semi-rigid bushings. The upper portion of the steering knuckle is

attached to a strut assembly. The strut assembly then connects to the vehicle body by way of an upper bearing. The steering knuckle is allowed to travel up and down independent of the vehicle body structure and frame.

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

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

Rear Suspension

The rear suspension system on this vehicle is of the independent link type. Rear suspension adjustment is achieved through adjustable toe links and lower control arms. The rear coil springs are retained between the Body and the lower control arm. Rubber insulators isolate the coil spring at both top and bottom. The rear suspension consists of two shock absorbers attached to the Knuckle and the reinforced body areas.

The rear suspension system performs the following functions:

- Maintains the relationship of the rear axle to the body.
- Controls the torque reaction on acceleration and braking.

The suspension system consists of the following components:

- Support Assembly
- Coil Springs and Insulators
- Stabilizer Shaft, Insulators and Stabilizer Links
- Toe Links
- Upper Control Arms
- Lower Control Arms
- Trailing Arms
- Knuckles
- Wheel Bearing/Hub
- Shock Absorbers

Wheels and Tires

General Description

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

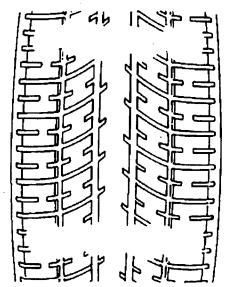
The following factors have an important influence on tire life:

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

The following factors increase tire wear:

- Heavy cornering
- Excessively rapid acceleration
- Heavy braking

Tread Wear Indicators Description



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

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

Metric Wheel Nuts and Bolts Description

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

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

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

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

Tire Inflation Description

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

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

Inspect the tire pressure when the following conditions apply:

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

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

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

Inflation Pressure Conversion (Kilopascals to PSI)

kPa	psi	kPa	psi
140	20	215	31
145	21	220	32
155	22	230	33
160	23	235	34
165	24	240	35
170	25	250	36
180	26	275	40

kPa	psi	kPa	psi
185	27	310	45
190	28	345	50
200	29	380	55
205	30	415	60
Conversion: 6.9 kPa = 1 psi			

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

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

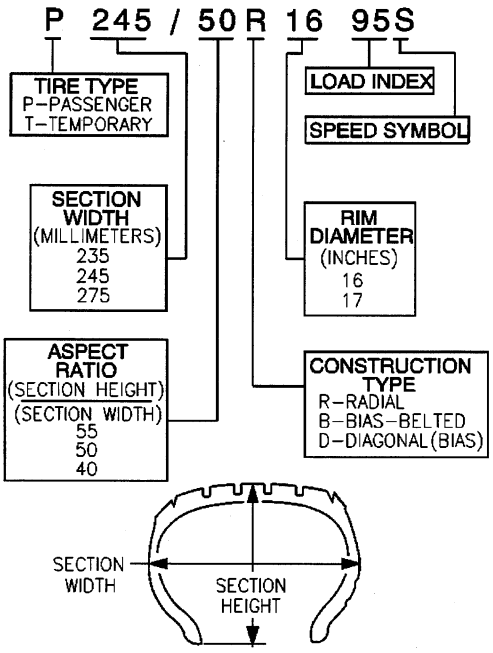
Tires with a lower than recommended pressure can cause the following conditions:

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

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

- Uneven braking
- Steering lead
- Reduced vehicle handling

P-Metric Sized Tires Description



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

Driveline System Description and Operation

Wheel Drive Shafts

Front wheel drive axles are flexible assemblies.

Front wheel drive axles consist of the following components:

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

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

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

Boots (Seals) And Clamps

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

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

The boot (seal) provides the following functions:

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

Important

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

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

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

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

- The housing
- The front wheel drive shaft

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

- Abusive handling

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

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

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

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

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

Front Wheel Drive Shaft Constant Velocity Joint (Outer Joint)

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

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

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

Braking System Description and Operation

Hydraulic Brake System Description and Operation

System Component Description

The hydraulic brake system consists of the following:

Hydraulic Brake Master Cylinder Fluid Reservoir

Contains supply of brake fluid for the hydraulic brake system.

Hydraulic Brake Master Cylinder

Converts mechanical input force into hydraulic output pressure.

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

Hydraulic Brake Pressure Balance Control System

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

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

Hydraulic Brake Pipes and Flexible Brake Hoses

Carries brake fluid to and from hydraulic brake system components.

Hydraulic Brake Wheel Apply Components

Converts hydraulic input pressure into mechanical output force.

System Operation

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

Brake Assist System Description and Operation

System Component Description

The brake assist system consists of the following:

Brake Pedal

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

Brake Pedal Pushrod

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

Vacuum Brake Booster

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

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

Vacuum Source

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

Vacuum Source Delivery System

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

System Operation

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

Disc Brake System Description and Operation

System Component Description

The disc brake system consists of the following components:

Disc Brake Pads

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

Disc Brake Rotors

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

Disc Brake Pad Hardware

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

Disc Brake Caliper Hardware

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

System Operation

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

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 pedal to apply the disc brake pads towards the friction surface of the brake rotor.

Threaded park brake actuators are also used to control clearance between the disc brake pads and the friction surface of the brake rotor.

System Operation

Park brake apply input force is received by the park brake pedal assembly being applied. The input force is multiplied by the pedal 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 which apply the disc brake pads towards the friction surface of the brake rotor in order to prevent the rotation of the rear tire and wheel assemblies. The park brake pedal assembly releases an applied park brake system when it is released and returned to the at rest position.

ABS Description and Operation

Antilock Brake System

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

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

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

Engine Description and Operation

Engine Mechanical – 2.2L (L61)

Mechanical Specifications

Application	Specification	
	Metric	English
General Data		
Engine Type	Inline 4 Cylinder	
Displacement	2.2 L	134 CID
RPO	L61	
Liter (VIN)	F	
Bore	85.992-86.008 mm	3.3855-3.3861 in
Stroke	94.6 mm	3.727 in
Compression Ratio	10:01	
Balance Shaft		
Bearing Clearance	0.030-0.063 mm	0.0012-0.0025 in
Bearing Diameter - Inside - Carrier	20.050-20.063 mm	0.7894-0.7899 in
Bearing Diameter - Outside - Carrier	41.975-41.995 mm	1.6526-1.6534 in
Bearing Journal Diameter	20.000-20.020 mm	0.7874-0.7882 in
Bushing Clearance	0.033-0.102 mm	0.0013-0.0040 in
Bushing Diameter - Inside	36.776-36.825 mm	1.4479-1.4498 in
Bushing Journal Diameter	36.723-36.743 mm	1.4458-1.4466 in
End Play	0.100-0.300 mm	0.0020-0.0118 in
Block		
Balance Shaft Bearing Bore Diameter - Carrier	42.000-42.016 mm	1.6535-1.6542 in
Balance Shaft Bushing Bore Diameter	40.763-40.776 mm	1.6048-1.6054 in
Crankshaft Main Bearing Bore Diameter	64.068-64.082 mm	2.5224-2.5229 in
Cylinder Bore Diameter	85.992-86.008 mm	3.3855-3.3861 in
Cylinder Bore Out-of-Round - Maximum	0.010 mm	0.0004 in
Cylinder Bore Taper - Maximum	0.010 mm	0.0004 in
Cylinder Head Deck Surface Flatness - Transverse	0.030 mm	0.0012 in
Cylinder Head Deck Surface Flatness - Longitude	0.050 mm	0.002 in
Cylinder Head Deck Surface Flatness - Overall	0.08 mm	0.0031 in
Camshaft		
Camshaft End Play	0.040-0.144 mm	0.0016-0.0057 in
Camshaft Journal Diameter	26.935-26.960 mm	1.0604-1.0614 in
Camshaft Thrust Surface	21.000-21.052 mm	0.8268-0.8252 in
Connecting Rod		
Connecting Rod Bearing Clearance	0.029-0.069 mm	0.0011-0.0027 in
Connecting Rod Bore Diameter - Bearing End	52.118-52.134 mm	2.0519-2.05252 in
Connecting Rod Bore Diameter - Pin End	20.007-20.021 mm	0.7877-0.7882 in
Connecting Rod Side Clearance	0.070-0.370 mm	0.0028-0.0146 in
Connecting Rod Straightness - Bend - Maximum	0.021 mm	0.0083 in
Connecting Rod Straightness - Twist - Maximum	0.04 mm	0.0157 in
Crankshaft		
Connecting Rod Journal Diameter	49.000-49.014 mm	1.9291-1.9297 in
Crankshaft End Play	0.050-0.380 mm	0.0012-0.0150 in
Crankshaft Main Bearing Clearance	0.031-0.067 mm	0.0012-0.0026 in
Crankshaft Main Journal Diameter	55.994-56.008 mm	2.2045-2.2050 in

Application	Specification	
	Metric	English
Cylinder Head		
Surface Flatness - Block Deck - Transverse	0.030 mm	0.0012 in
Surface Flatness - Block Deck - Longitude	0.050 mm	0.002 in
Surface Flatness - Block Deck - Overall	0.1 mm	0.004 in
Valve Guide Bore - Exhaust	6.000-6.012 mm	0.2362-0.2367 in
Valve Guide Bore - Intake	6.000-6.012 mm	0.2362-0.2367 in
Valve Lifter Bore Diameter - Stationary Lash Adjusters	12.013-12.037 mm	0.4730-0.4739 in
Lubrication System		
Oil Pressure - Minimum - [commat]1000 RPM	344.75-551.60 kPa	50-80 psi
Oil Capacity	4.8L	5.0 quarts
Piston Rings		
Piston Ring End Gap - First Compression Ring	0.20-0.40 mm	0.008-0.016 in
Piston Ring End Gap - Second Compression Ring	0.35-0.55 mm	0.014-0.022 in
Piston Ring End Gap - Oil Control Ring - Rails	0.25-0.76 mm	0.010-0.030 in
Piston Ring to Groove Clearance - First Compression Ring	0.04-0.08 mm	0.0015-0.0031 in
Piston Ring to Groove Clearance - Second Compression Ring	0.030-0.069 mm	0.0012-0.0027 in
Piston Ring to Groove Clearance - Oil Control Ring	0.090-0.106 mm	0.0035-0.0042 in
Piston Ring Thickness - First Compression Ring	1.170-1.190 mm	0.0461-0.0469 in
Piston Ring Thickness - Second Compression Ring	1.471-1.490 mm	0.0579-0.0587 in
Piston Ring Thickness - Oil Control Ring - Rail - Maximum	0.43 mm	0.0169 in
Piston Ring Thickness - Oil Control Ring - Spacer	1.574-1.651 mm	0.0620-0.0650 in
Pistons and Pins		
Piston - Piston Diameter - [commat]14.5 mm up	85.967-85.982 mm	3.3845-3.3851 in
Piston - Piston Pin Bore Diameter	20.002-20.007 mm	0.07875-0.7877 in
Piston - Piston Ring Grove Width - Top	1.23-1.25 mm	0.0484-0.0492 in
Piston - Piston Ring Grove Width - Second	1.52-1.54 mm	0.0598-0.0606 in
Piston - Piston Ring Grove Width - Oil Control	2.52-2.54 mm	0.0992-0.1000 in
Piston - Piston To Bore Clearance	0.010-0.041 mm	0.0004-0.0016 in
Pin - Piston Pin Clearance to Connecting Rod Bore	0.007-0.026 mm	0.0003-0.0010 in
Pin - Piston Pin Clearance to Piston Pin Bore	0.002-0.012 mm	0.0001-0.0005 in
Pin - Piston Pin Diameter	19.995-20.000 mm	0.7872-0.7874 in
Pin - Piston Pin End Play	0.19-1.16 mm	0.0075-0.0461 in
Valve System		
Valves - Valve Face Runout - Maximum	0.04 mm	0.0016 in
Valves - Valve Seat Runout - Maximum	0.05 mm	0.0020 in
Valves - Valve Stem Diameter - Intake	5.955-5.970 mm	0.2344-0.2355 in
Valves - Valve Stem Diameter - Exhaust	5.935-5.950 mm	0.2337-0.2343 in
Valves - Valve Stem to Guide Clearance - Intake	0.030-0.057 mm	0.0012-0.0022 in
Valves - Valve Stem to Guide Clearance - Exhaust	0.050-0.077 mm	0.0020-0.0026 in
Valve Lifters - Valve Lifter Diameter - Stationary Lash Adjuster	11.986-12.000 mm	0.0005-0.0020 in
Valve Lifters - Valve Lifter-to-Bore Clearance - Stationary Lash Adjuster	0.013-0.051 mm	3.2210-3.2299 in
Valve Springs - Valve Spring Load - Closed - [commat]22.5 mm	245.0-271.0 N. - Eng Spec.	
Valve Springs - Valve Spring Load - Open - [commat]32.5 mm	525.0-575.0 N. - Eng Spec.	

Fastener Tightening Specifications

Application	Specification	
	Metric	English
A/C Compressor to Block Bolt	20 N·m	15 lb ft
Balance Shaft Adjustable Chain Guide Bolt	10 N·m	89 lb in
Balance Shaft Bearing Carrier to Block Bolt	10 N·m	89 lb in
Balance Shaft Fixed Chain Guide Bolt	10 N·m	89 lb in
Balance Shaft Sprocket Bolt	50 N·m	37 lb ft
Cam Cover to Cylinder Head Bolt	10 N·m	89 lb in
Cam Cover to Ground Cable Bolt	10 N·m	89 lb in
Cam Cover to Ground Cable Stud	10 N·m	89 lb in
Camshaft Bearing Cap Bolt	10 N·m	89 lb in
Camshaft Sprocket Bolt		
First Pass	85 N·m	63 lb ft
Final Pass	30 degrees	
Camshaft Timing Chain Tensioner	75 N·m	55 lb ft
Chain Guide Plug	90 N·m	59 lb ft
Connecting Rod Bolt Torque		
First Pass	25 N·m	18 lb ft
Final Pass	100 degrees	
Crankshaft Position Sensor Bolt	10 N·m	89 lb in
Crankshaft Pulley Bolt		
First Pass	100 N·m	74 lb ft
Final Pass	125 degrees	
Cylinder Head Air Bleed Tube	15 N·m	11 lb ft
Cylinder Head Bolt		
First Pass	30 N·m	22 lb ft
Final Pass	155 degrees	
Cylinder Head Front Chaincase Bolt	35 N·m	26 lb ft
Cylinder Head Oil Gallery Plug	35 N·m	26 lb ft
Dipstick Guide to Intake Manifold Bolt	10 N·m	89 lb in
Drive Belt Tensioner Bolt	45 N·m	33 lb ft
EGR Cover Bolt	25 N·m	18 lb ft
Elek. ICM Cover Bolt	10 N·m	89 lb in
Engine Coolant Temperature Sensor	22 N·m	16 lb ft
Engine Lift Bracket Front Bolt	25 N·m	18 lb ft
Engine Lift Bracket Rear Bolt	25 N·m	18 lb ft
Exhaust Manifold to Cylinder Head Nut	14 N·m	124 lb in
Exhaust Manifold to Cylinder Head Stud	10 N·m	89 lb in
Exhaust Manifold Pipe Flange Stud	16 N·m	12 lb ft
Flexplate (AMT) Bolt		
First Pass	53 N·m	39 lb ft
Final Pass	25 degrees	
Flywheel (SMT) Bolt		
First Pass	53 N·m	39 lb ft
Final Pass	25 degrees	
Front Cover to Block Bolt	25 N·m	18 lb ft
Front Lift Bracket Bolt	25 N·m	18 lb ft
Fuel Pipe Bracket Bolt	10 N·m	89 lb in
Fuel Rail Bracket Stud	10 N·m	89 lb in
Generator to Block Bolt	23 N·m	17 lb ft
Heat Shield to Exhaust Manifold Bolt	23 N·m	17 lb ft
Ignition Coil Bolt	10 N·m	89 lb in

Application	Specification	
	Metric	English
Intake Camshaft Rear Cap Bolt	25 N·m	18 lb ft
Intake Manifold to Cylinder Head Bolt	10 N·m	89 lb in
Intake Manifold to Cylinder Head Nut	10 N·m	89 lb in
Intake Manifold to Cylinder Head Stud	6 N·m	53 lb in
Knock Sensor Bolt	25 N·m	18 lb ft
Oil Filter Housing Cover	25 N·m	18 lb ft
Oil Pan Drain Plug	25 N·m	18 lb ft
Oil Pan to Block Bolts	25 N·m	18 lb ft
Oil Pressure Switch	22 N·m	16 lb ft
Oil Pump Cover Bolt	6 N·m	53 lb in
Oil Pump Pressure Relief Valve Plug	40 N·m	30 lb ft
Oxygen Sensor	42 N·m	31 lb ft
Power Steering Pump Blockout Plate	25 N·m	18 lb ft
Rear Lift Bracket Bolt	25 N·m	18 lb ft
Spark plug	20 N·m	15 lb ft
Starter Motor to Block Bolt	53 N·m	39 lb ft
Thermostat Housing to Block Bolts	10 N·m	89 lb in
Throttle Body Bolt	10 N·m	89 lb in
Throttle Body Nut	10 N·m	89 lb in
Throttle Body Stud	6 N·m	53 lb in
Timing Adjustable Chain Guide Bolt	10 N·m	89 lb in
Timing Chain Oil Nozzle Bolt	10 N·m	89 lb in
Timing Fixed Chain Guide Bolt	10 N·m	89 lb in
Timing Upper Chain Guide Bolt	10 N·m	89 lb in
Vent Tube to Cylinder Head	15 N·m	11 lb ft
Water Jacket Drain Plug	20 N·m	15 lb ft
Water Pipe Support Bracket Bolt	10 N·m	89 lb in
Water Pump Access Cover Bolt	7 N·m	62 lb in
Water Pump/Balance Shaft Chain Tensioner Bolt	10 N·m	89 lb in
Water Pump Bolts	25 N·m	18 lb ft
Water Pump Sprocket Bolt	10 N·m	89 lb in

Engine Component Description

Cylinder Block

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

Crankshaft

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

Connecting Rod and Piston

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

Oil Pan

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

Balance Shaft Assembly

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

Cylinder Head

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

Valves

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

Camshaft

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

Valve Lifters

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

Camshaft Cover

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

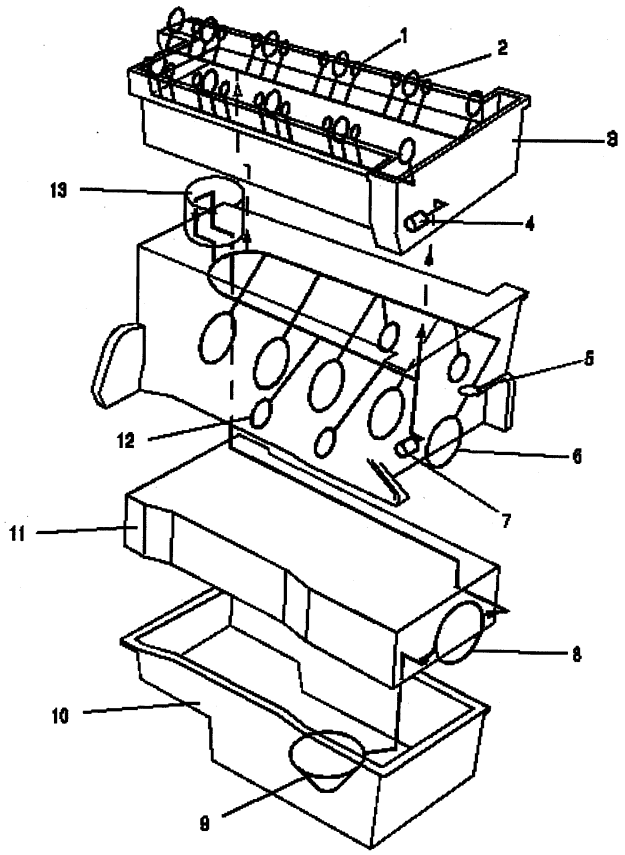
Camshaft Drive

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

Intake and Exhaust Manifold

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

Lubrication



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

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

Cast passages feed each hydraulic element adjuster and drilled passages feed each camshaft bearing surface. An engine oil pressure switch or sensor is installed at the end. Oil returns to the oil pan through passages cast into the cylinder head. The timing chain lubrication drains directly into the oil pan.

Drive Belt System Description

The drive belt system consists of the following components:

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

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

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

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

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

Engine Mechanical – 3.5L (LX9)

Mechanical Specifications

Application	Specification	
	Metric	English
General Data		
Engine Type	60 degree V-6	
Displacement	3.5L	214 cu in
RPO	LX9	
VIN	8	
Bore	94 mm	3.70 in
Stroke	84 mm	3.31 in
Compression Ratio	9.8:1	
Firing Order	123456	
Spark Plug Gap	1.52 mm	0.060 in
Block		
Camshaft Bearing Bore Diameter - Front and Rear	51.03-51.08 mm	2.009-2.011 in
Camshaft Bearing Bore Diameter - Middle #2, #3	50.77-50.82 mm	1.999-2.001 in
Crankshaft Main Bearing Bore Diameter	72.1535-72.1695 mm	2.840-2.841 in
Crankshaft Main Bearing Bore Out-of-Round	0.008 mm	0.00031 in
Cylinder Bore Diameter	93.991-94.009 mm	3.700-3.701 in
Cylinder Bore Out-of-Round - Diameter - Production	0.020 mm	0.0008 in
Cylinder Bore Out-of-Round - Diameter - Service	0.025 mm	0.001 in
Cylinder Bore Taper - Production	0.020 mm	0.0008 in
Cylinder Bore Taper - Service	0.025 mm	0.001 in
Cylinder Head Deck Height	224 mm	8.818 in
Cylinder Head Deck Surface Flatness	0.05 mm per 152 mm	0.0019 in per 6 in
Valve Lifter Bore Diameter	21.417-21.455 mm	0.843-0.844 in
Camshaft		
Camshaft Bearing Inside Diameter	47.516-47.541 mm	1.871-1.872 in
Camshaft Journal Diameter	47.443-47.468 mm	1.868-1.869 in
Camshaft Journal Out-of-Round	0.025 mm	0.001 in
Camshaft Lobe Lift - Exhaust	6.9263 mm	0.2727 in
Camshaft Lobe Lift - Intake	6.9263 mm	0.2727 in
Cooling System		
Capacity	12.4 liters	13.1 quarts
Thermostat Full Open Temperature	195 degrees	
Connecting Rod		
Connecting Rod Bearing Clearance	0.18-0.062 mm	0.0007-0.017 in
Connecting Rod Bore Diameter	60.322-60.338 mm	2.375-2.376 in
Connecting Rod Bore Out-of-Round	0.006 mm	0.00023 in
Connecting Rod Length - Center to Center	150 mm	5.9 in
Connecting Rod Side Clearance	0.200-0.241 mm	0.008-0.009 in
Connecting Rod Journal Diameter	57.122-57.138 mm	2.249-2.250 in
Crankshaft		
Connecting Rod Journal Diameter	57.122-57.138 mm	2.248-2.249 in
Connecting Rod Journal Out-of-Round	0.005 mm	0.0002 in
Connecting Rod Journal Taper	0.008 mm	0.0003 in
Connecting Rod Journal Width	21.92-22.08 mm	0.863-0.869 in
Crankshaft End Play	0.060-0.210 mm	0.0024-0.0083 in

Application	Specification	
	Metric	English
Crankshaft Main Bearing Journal Width	23.9-24.1 mm	0.941-0.949 in
Crankshaft Main Bearing Clearance	0.019-0.064 mm	0.0008-0.0025 in
Crankshaft Main Journal Diameter	67.239-67.257 mm	2.6473-2.6483 in
Crankshaft Main Journal Out-of-Round	0.005 mm	0.0002 in
Crankshaft Main Journal Taper	0.008 mm	0.0003 in
Crankshaft Rear Flange Runout	0.04 mm	0.0016 in
Cylinder Head		
Combustion Chamber Depth - at Measurement Point	2.2 mm	0.087 in
Surface Finish - Maximum	2.8 RA	
Surface Flatness - Block Deck	0.08 mm Per 152 mm	0.003 in Per 6 in
Surface Flatness - Exhaust Manifold Deck	0.1 mm	0.004 in
Surface Flatness - Intake Manifold Deck	0.1 mm	0.004 in
Valve Guide Bore - Exhaust	8.01 mm	0.315 in
Valve Guide Bore - Intake	8.01 mm	0.315 in
Valve Guide Installed Height	16.6 mm	0.654 in
Lubrication System		
Oil Capacity - with Filter	3.8 liter	4.0 quarts
Oil Capacity - without Filter	3.3 liter	3.5 quarts
Oil Pressure - @ 1850 RPM	207-310 kPa	30-45 PSI
Oil Pump		
Gear Diameter	38.05-38.10 mm	1.498-1.500 in
Gear Pocket - Depth	30.53-30.59 mm	1.202-1.204 in
Gear Pocket - Diameter	38.176-38.226 mm	1.503-1.505 in
Gears Lash	0.094-0.195 mm	0.0037-0.0077 in
Relief Valve-to-Bore Clearance	0.038-0.089 mm	0.0015-0.0035 in
Piston Ring End Gap		
First Compression Ring	0.18-0.39 mm	0.007-0.015 in
Second Compression Ring	0.48-0.74 mm	0.019-0.029 in
Oil Control Ring	0.25-0.74 mm	0.010-0.029 in
Piston Ring to Groove Clearance		
First Compression Ring	0.03-0.076 mm	0.001-0.003 in
Second Compression Ring	0.04-0.078 mm	0.002-0.003 in
Oil Control Ring	0.09 mm	0.004 in
Piston Ring Thickness		
First Compression Ring	1.164-1.190 mm	0.046-0.047 in
Second Compression Ring	1.472-1.490 mm	0.058 in
Oil Control Ring - Maximum	2.440 mm	0.096 in
Piston		
Piston Diameter - production	93.980-94.020 mm	3.7-3.701 in
Piston Diameter - service limit	93.960 mm	3.699 in
Piston Pin Bore Diameter	24.008-24.013 mm	0.9452-0.9454 in
Piston Ring Groove Width	1.23-1.255 mm	0.048-0.049 in
Piston to Bore Clearance - production	-0.029 to +0.029 mm	-0.0011 to +0.011 in
Piston to Bore Clearance - service limit - Maximum	0.080 mm	0.003 in

Application	Specification	
	Metric	English
Pin		
Piston Pin Clearance to Connecting Rod Bore - Press Fit	-0.022 to +0.044 mm	-0.0008 to +0.0017 in
Piston Pin Clearance to Piston Pin Bore	0.008-0.016 mm	0.0003-0.0006 in
Piston Pin Diameter	23.997-24.000 mm	0.9447-0.9448 in
Piston Pin Length	59.87-60.13 mm	2.35-2.36 in
Valves		
Valve Face Angle	45 degrees	
Valve Seat Angle	46 degrees	
Valve Seat Depth - Intake - from deck face	7.9-8.1 mm	0.311-0.318 in
Valve Seat Depth - Exhaust - from deck face	8.9-9.1 mm	0.350-0.358 in
Valve Seat Width - Intake	1.55-1.80 mm	0.061-0.071 in
Valve Seat Width - Exhaust	1.70-2.0 mm	0.067-0.079 in
Valve Stem-to-Guide Clearance	0.026-0.068 mm	0.0010-0.0027 in
Valve Lifters/Push Rods		
Push Rod Length - Intake	144.2 mm	5.67 in
Push Rod Length - Exhaust	152.5 mm	6.0 in
Valve Springs		
Valve Spring Free Length	50.0 mm	1.91 in
Valve Spring Installed Height	44.2 mm	1.74 in
Valve Spring Load - Closed	343 N [commat]44.2 mm	77 lb 1.74 in
Valve Spring Load - Open	1041 N [commat]33 mm	234 lb 1.299 in
Valve Spring Total Number of Coils	7.10	

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Camshaft Position Sensor Bolt	10 N·m	89 lb in
Camshaft Sprocket Bolt	140 N·m	103 lb ft
Camshaft Thrust Plate Screw	10 N·m	89 lb in
Connecting Rod Bearing Cap Bolt		
First Pass	25 N·m	18 lb ft
Final Pass	110 degrees	
Coolant Drain Plug	19 N·m	14 lb ft
Coolant Temperature Sensor	23 N·m	17 lb ft
Crankshaft Balancer Bolt		
First Pass	70 N·m	52 lb ft
Final Pass	70 degrees	
Crankshaft Main Bearing Cap Bolt/Stud		
First Pass	50 N·m	37 lb ft
Final Pass	77 degrees	
Crankshaft Oil Deflector Nut	25 N·m	18 lb ft
Crankshaft Position Sensor Stud - Side of Engine Block	10 N·m	89 lb in
Cylinder Head Bolt		
First Pass	60 N·m	44 lb ft
Final Pass	95 degrees	
Drive Belt Tensioner Bolt	50 N·m	37 lb ft
EGR Valve Assembly Bolt	30 N·m	22 lb ft

Application	Specification	
	Metric	English
EGR Valve Pipe Bolt - Exhaust Manifold	30 N·m	22 lb ft
EGR Valve Pipe Bolt - EGR	25 N·m	18 lb ft
Engine Front Cover Bolt		
Large Bolt	55 N·m	41 lb ft
Medium Bolt	55 N·m	41 lb ft
Small Bolt	27 N·m	20 lb ft
Engine Mount Strut and A/C Compressor Bracket Bolt	50 N·m	37 lb ft
Engine Mount Strut and Lift Bracket Bolt - Engine Lift Rear	50 N·m	37 lb ft
Engine Mount Strut and Generator Bracket Bolt	50 N·m	37 lb ft
Engine Mount Strut and Support Bracket Bolt	25 N·m	18 lb ft
Engine Oil Pressure Indicator Switch	16 N·m	12 lb ft
Engine Wiring Harness Bracket Bolt	13 N·m	115 lb in
EVAP Purge Valve Bolt	10 N·m	89 lb in
Exhaust Manifold Heat Shield Bolt	10 N·m	89 lb in
Exhaust Manifold Nut	16 N·m	12 lb ft
Exhaust Manifold Stud	18 N·m	13 lb ft
Flywheel Bolt	70 N·m	52 lb ft
Front Oil Gallery Plug - Small	19 N·m	14 lb ft
Front Oil Gallery Plug - Large	33 N·m	24 lb ft
Fuel Feed Pipe to Fuel Injector Rail Bolt	10 N·m	89 lb in
Fuel Injector Rail Bolt	10 N·m	89 lb in
Heated Oxygen Sensor	42 N·m	31 lb ft
Heater Inlet Pipe Nut	25 N·m	18 lb ft
Heater Inlet Pipe Stud	35 N·m	26 lb ft
Ignition Coil Bracket Bolt/Nut/Stud	25 N·m	18 lb ft
Intake Manifold Coolant Pipe Bolt	10 N·m	89 lb in
Knock Sensor	25 N·m	18 lb ft
Lower Intake Manifold Bolt - Center	20 N·m	15 lb ft
Lower Intake Manifold Bolt - Corner	25 N·m	18 lb ft
MAP Sensor Bolt	10 N·m	89 lb in
Oil Filter Adapter Bolt	25 N·m	18 lb ft
Oil Filter	30 N·m	22 lb ft
Oil Filter Bypass Hole Plug	19 N·m	14 lb ft
Oil Filter Fitting	39 N·m	29 lb ft
Oil Level Indicator Tube Bolt	25 N·m	18 lb ft
Oil Pan Bolt	25 N·m	18 lb ft
Oil Pan Drain Plug	25 N·m	18 lb ft
Oil Pan Side Bolt	50 N·m	37 lb ft
Oil Pump Cover Bolt	10 N·m	89 lb in
Oil Pump Drive Clamp Bolt	36 N·m	27 lb ft
Oil Pump Mounting Bolt	41 N·m	30 lb ft
PCV Tube Clip bolt - Foul Air	10 N·m	89 lb in
Piston Oil Nozzle Bolt	10 N·m	89 lb in
Rear Oil Gallery Plug - 1/4 inch	19 N·m	14 lb ft
Rear Oil Gallery Plug - 3/8 inch	33 N·m	24 lb ft
Spark Plug - Initial Installation	20 N·m	15 lb ft
Spark Plug - After Initial Installation	15 N·m	11 lb ft
Thermostat Bypass Pipe to Engine Front Cover Bolt	10 N·m	89 lb in
Thermostat Bypass Pipe to Throttle Body Nut/Bolt	10 N·m	89 lb in
Throttle Body Bolt	10 N·m	89 lb in
Throttle Body Stud	6 N·m	53 lb in

Application	Specification	
	Metric	English
Timing Chain Dampener Bolt	21 N·m	15 lb ft
Upper Intake Manifold Bolt/Stud	25 N·m	18 lb ft
Valve Lifter Guide Bolt	10 N·m	89 lb in
Valve Rocker Arm Bolt	32 N·m	24 lb ft
Valve Rocker Arm Cover Bolt	10 N·m	89 lb in
Water Outlet Bolt	25 N·m	18 lb ft
Water Pump Bolt	10 N·m	89 lb in
Water Pump Pulley Bolt	25 N·m	18 lb ft

Engine Component Description

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

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

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

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

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

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

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

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

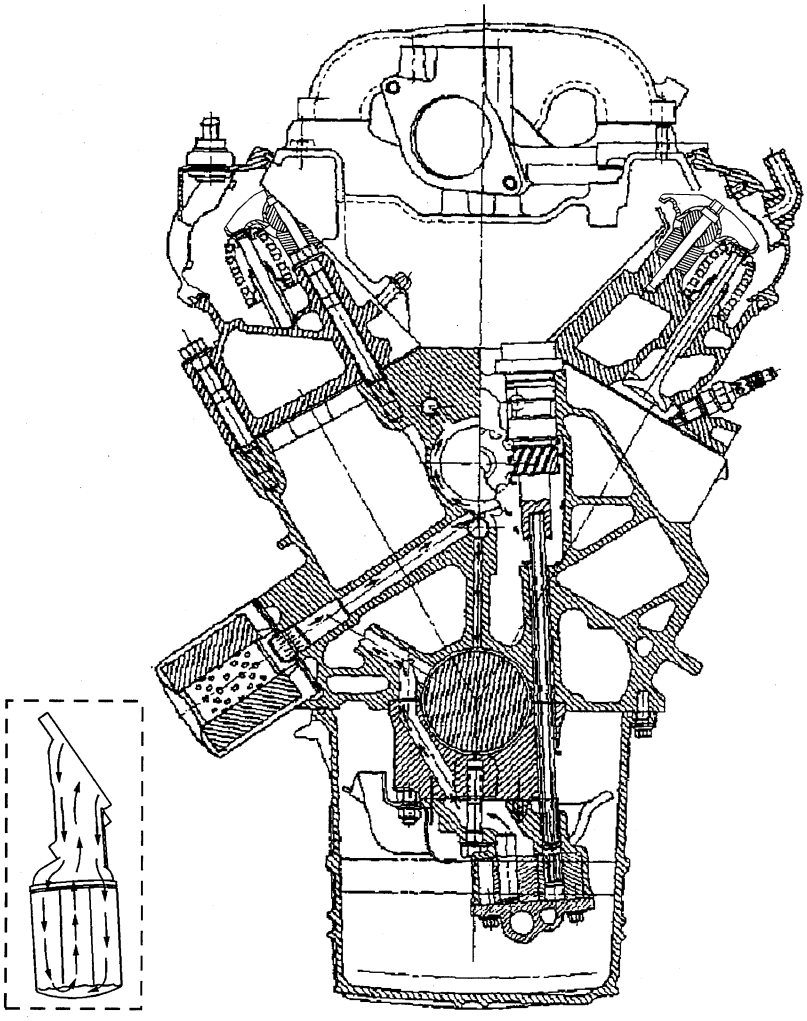
A roller rocker type valve train is used. Motion is transmitted from the camshaft through the hydraulic roller lifter and from the pushrod to the roller rocker arm. The rocker arm pivots on the needle roller bearings. The rocker arm transmits the camshaft motion to the valve. The rocker arm pedestal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

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

The exhaust manifolds are cast nodular iron.

Lubrication System Description

Front View



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

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

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

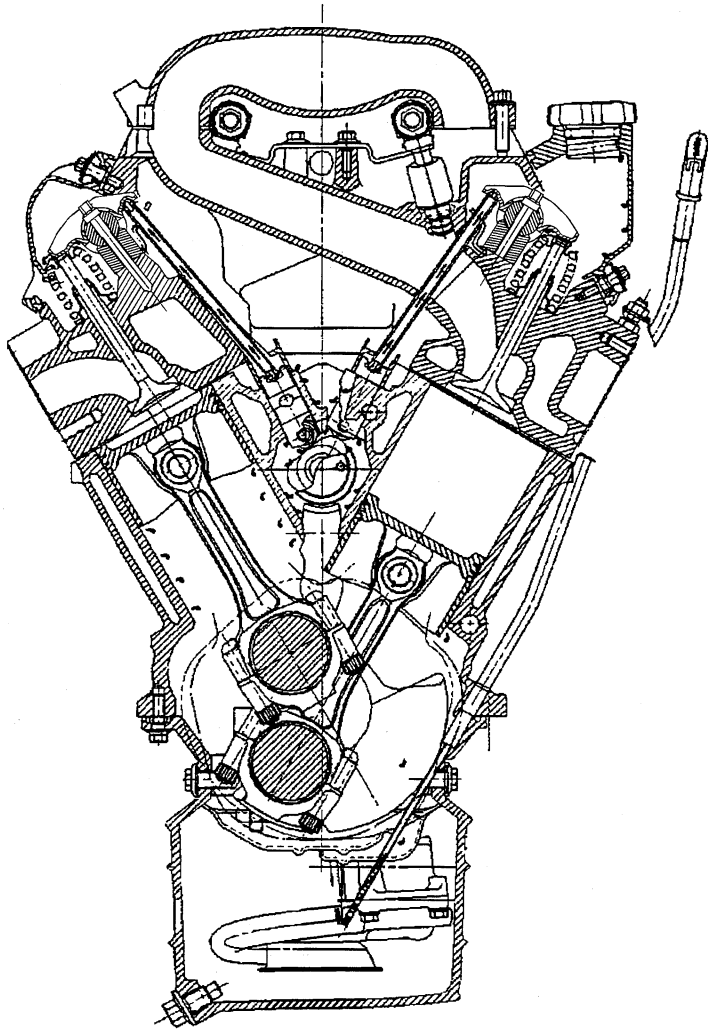
The bypass is designed to open at 69-83 kPa (10-12 psi).

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

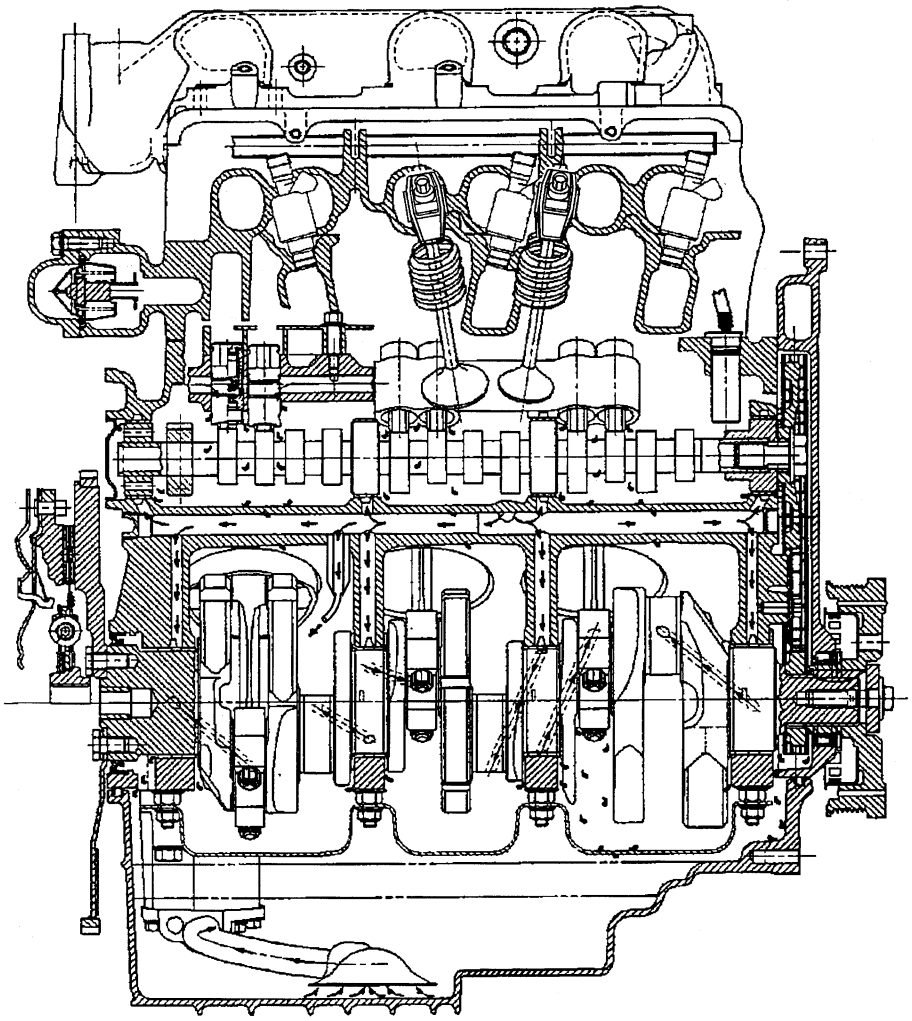
The piston oil nozzle lubricates the pistons and cylinder walls in cylinders 5 and 6. A nonserviceable check valve integrated into the nozzle prevents oil bleed down from the nozzle when the engine is not running.

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

Rear View



Right View



Drive Belt System Description

See drive belt system description above.

Engine Cooling

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Lower Radiator Support Bracket Bolt	60 N·m	44 lb ft
Transmission Oil Cooler Line Nut at Transmission	7 N·m	62 lb in
Transmission Oil Cooler Line Quick Connect Fitting	20 N·m	15 lb ft
Transmission Oil Cooler Line Stud at Transmission	7 N·m	62 lb in
Upper Radiator Support Bracket Bolt	10 N·m	89 lb in

Cooling System Description and Operation

Coolant Heater

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

Cooling System

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

Cooling Cycle

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

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

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

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

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

Coolant

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

Radiator

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

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

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

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

Pressure Cap

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

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

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

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

Coolant Recovery System

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

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

Air Baffles and Seals

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

Water Pump

The water pump is a centrifugal vane impeller type pump. The pump consists of a housing with coolant inlet and outlet passages and an impeller. The impeller is mounted on the pump shaft and consists of a

series of flat or curved blades or vanes on a flat plate. When the impeller rotates, the coolant between the vanes is thrown outward by centrifugal force.

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

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

Thermostat

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

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

Transmission Oil Cooler

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

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

Engine Electrical

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Battery Hold-Down Retainer Bolt	25 N·m	18 lb ft
Battery Tray Bracket Bolts	16 N·m	12 lb ft
Cable to Solenoid Nut	12 N·m	106 lb in
Drive Belt Idler Pulley Bolt	50 N·m	37 lb ft
Drive Belt Tensioner Bolt	50 N·m	37 lb ft
Flywheel Inspection Cover Bolt	10 N·m	89 lb in
Generator Bolt - 2.2L	22 N·m	16 lb ft
Generator Bolt/Stud	50 N·m	37 lb ft
Generator Bracket Bolt	50 N·m	37 lb ft
Generator Nut - 3.5L	30 N·m	22 lb ft
Generator Terminal Bolt - 2.2L	20 N·m	15 lb ft
Generator Terminal Nut - 3.5L	17 N·m	13 lb ft
Negative Battery Cable Bolt	17 N·m	13 lb ft
Positive Battery Cable Bolt	17 N·m	13 lb ft
Starter Bolt	40 N·m	30 lb ft
Starter Solenoid Battery Terminal Nut	10 N·m	89 lb in
Starter Solenoid S Terminal Nut	5 N·m	4 lb ft

Battery Usage

Application	Specification
L61, LX9	
Cold Cranking Amperage	525 A
Amp Hour Rating	54 AH
Reserve Capacity Rating	90 Minutes
Replacement Battery Number	75-5YR

Battery Temperature vs Minimum Voltage

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

Starter Motor Usage

Application	Specification
L61	PG260-D
LX9	PG260-D

Generator Usage

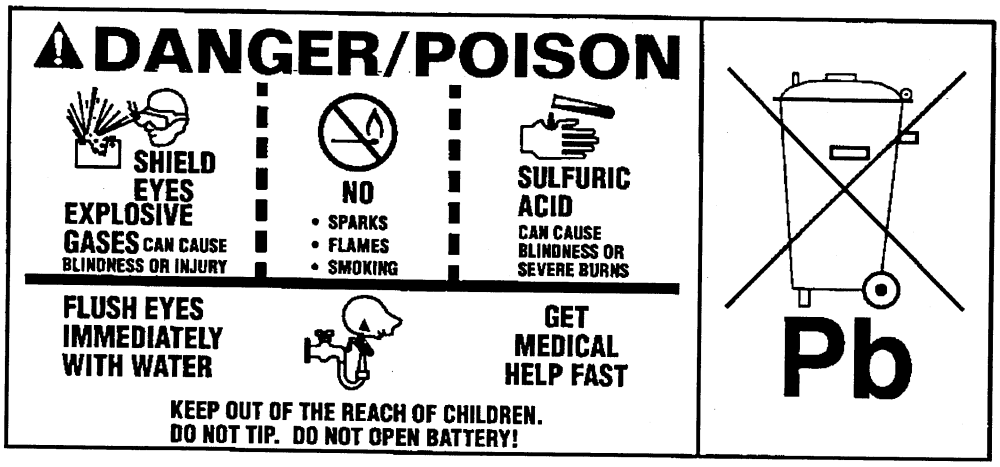
Application	Specification
Model	Valeo TG11
Rated Output	115 A
Load Test	80 A

Battery Description and Operation

Caution

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

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



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

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

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

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

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

CATALOG NO.

1819

CCA	LOAD TEST
770	380
REPLACEMENT MODEL 100 – 6YR	

A battery has 2 ratings:

- Reserve capacity
- Cold cranking amperage

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

Reserve Capacity

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

Cold Cranking Amperage

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

Circuit Description

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

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

Starting System Description and Operation

The PG-260D is a non-repairable starter motor. It has pole pieces that are arranged around the armature. Both solenoid windings are energized. The pull-in winding circuit is completed to the ground through the starter motor. The windings work together magnetically to pull and hold in the plunger. The plunger moves the shift lever. This action causes the starter drive assembly to rotate on the armature shaft spline as it engages with the flywheel ring gear on the engine. Moving at the same time, the plunger also closes the solenoid switch contacts in the starter solenoid. Full battery voltage is applied directly to the starter motor and it cranks the engine.

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

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

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

Circuit Description (Key Start)

For ignition switch power modes refer to Body Control System Description and Operation in Computer/Integrating Systems. Once the ignition is placed in the Run/Crank position, the control circuit of the Run/Crank relay is grounded by the body control module (BCM). With the Run/Crank relay switch closed, battery positive voltage flows through it and on to the park/neutral position (PNP) switch. With the PNP switch in either the Park or Neutral position, battery positive voltage will flow to the starter relay coil supply voltage input terminal of the powertrain control module and the coil side of the starter relay. Placing the ignition in the START position sends a message to the powertrain control module (PCM) requesting engine start. If the PCM has determined that the transmission is in Park or Neutral and theft is not active, it will ground the control circuit of the starter relay. Battery positive voltage will then flow through the switch side of the starter relay to the S terminal of the starter solenoid, cranking the engine.

Remote Vehicle Start (RVS)

To operate the function, first press and release the lock button on the key fob, then press the remote vehicle start (RVS) button for 2 seconds. The vehicle park lamps will be illuminated to indicate that the engine is running. The vehicle doors will be able to be unlocked. The RVS function is allowed to start the vehicle 2 times for 10-minute intervals. If the body control module (BCM) receives a second request for an RVS event while already operating in RVS then the first timer times out and then the second timer starts. If the RVS button was pressed for the first time and then 7 minutes later the RVS button was pressed a second time, the total time for the RVS event would be 17 minutes. When the RVS button is pressed for the second time, the first 10-minute interval automatically stops and the BCM starts counting the second 10-minute interval. After the first event times out, 10 minutes, the second event must be requested within 20 minutes or the function is disabled.

RVS can be deactivated by pressing the RVS button on the key fob, pressing the hazard switch, or inserting the ignition key and cycling it to the ON position and then OFF again. There are also other safety and security measures that will deactivate RVS, these include depressing the accelerator pedal or opening the hood. RVS will not function with any current or history codes set. The park lights will flash once when the RVS signal is received by the BCM, but the vehicle will not start.

RVS is designed to transition for RVS to normal key ON, engine run operation without any apparent change to the customer except inserting the ignition key and turning it to the RUN position.

While in RVS mode all modules that are powered by the Run/Crank shall be active and understand that RVS is active. All on-board diagnostics (OBD) II functions shall also be active.

The current state of RVS can be viewed through the driver information center (DIC) display under the Remote Start the display will read either On or Off.

The HVAC preset RVS settings are as follows:

- Inside air temperature input below 22°C (72°F) the HVAC system will set the blower motor speed to high speed, set the mode door to the defrost position, set the temperature door to the full hot position and set the recirculation door to the outside air position.
- Inside air temperature input above 26°C (79°F) the HVAC system will set the blower motor speed to high speed, set the mode door to the panel position, set the temperature door to the full cold position, request air conditioning (A/C) compressor operation and set the recirculation door to the recirculate position.
- Inside air temperature input between 22°C (72°F) and 26°C (79°F) the HVAC system will set the blower motor speed to a medium speed, set the mode door to the panel position, set the temperature door to the full cold position, request A/C compressor operation and set the recirculation door to the outside air position.

Once the ignition switch is placed to the RUN position the HVAC system reverts back to its last known setting.

Disable RVS

To disable the remote vehicle start (RVS) function perform the following steps:

1. All doors must be closed.
2. Turn ON the ignition, with the engine OFF.
3. Press the Menu button on the driver information center (DIC) until REMOTE START is displayed.
4. Press the Enter button on the DIC until ON is displayed.

The current state of RVS can be viewed through the DIC display under the Remote Start the display will read either On or Off.

Enable RVS

To enable the remote vehicle start (RVS) function perform the following steps:

1. Turn ON the ignition, with the engine OFF.
2. Press the Menu button on the driver information center (DIC) until REMOTE START appears on the display.
3. Press the Enter button on the DIC and then ON is displayed.

The current state of RVS can be viewed through the DIC display under the Remote Start the display will read either On or Off.

Hood Ajar Switch

The hood switch provides status of the hood to the body control module (BCM) for remote vehicle start (RVS) functions. It is integrated into the hood latch assembly. The hood ajar switch provides 2 separate inputs to the BCM. When the hood is closed, the hood ajar open signal circuit is approximately battery voltage. The hood ajar closed signal circuit is pulled low to ground. The opposite occurs when the hood is opened.

Circuit Description (RVS)

The body control module (BCM) is the main controller for remote vehicle start (RVS). It handles the majority of the RVS functions from how long RVS lasts to protecting the vehicle from theft while RVS is active.

Once the BCM receives a signal from the key fob it reviews the following information to determine if a Crank Request message will be sent to the powertrain control module (PCM) to activate RVS:

- Valid hood ajar switch closed signal
- The key is not in the ignition.
- The doors are locked.
- The hazard switch is OFF

The PCM relies on the RVS message from the BCM to enable RVS when the Crank Request signal is received. If the PCM does not receive a valid RVS message from the BCM it will not ground the control circuit of the Crank relay and start the engine. While the PCM is in RVS mode it will cut fuel to the engine if any of the following additional conditions occur:

- Vehicle speed is greater than 0 km/h
- Engine overheating
- Low oil pressure
- The malfunction indicator lamp (MIL) is commanded ON.
- Engine crank time is greater than 30 seconds.
- Engine speed greater than 2,000 RPM for more than 10 seconds.
- Engine speed greater than 4,000 RPM for more than 2 seconds.
- Throttle position (TP) greater than 10 percent for 2 seconds.
- Remote start timer equals 0.

Charging System Description and Operation

Generator

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

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

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

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

Regulator

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

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

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

Engine Controls

Engine Controls – 2.2L (L61)

Ignition System Specifications

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

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Cable Bracket Nuts	10 N·m	89 lb in
Accelerator Pedal Retaining Nuts	30 N·m	22 lb ft
Air Cleaner Duct Clamp	5 N·m	44 lb in
Air Cleaner Element Cover Screws	3 N·m	26 lb in
Air Cleaner Outlet Resonator Clamp	5 N·m	44 lb in
Air Cleaner Outlet Resonator Mounting Bolt	10 N·m	89 lb in
Crankshaft Position (CKP) Sensor Bolts	8 N·m	71 lb in
Engine Coolant Temperature (ECT) Sensor	10 N·m	89 lb in
Evaporative Emission (EVAP) Canister Purge Valve Mounting Bracket Nut	8 N·m	71 lb in
EVAP Canister Retainer Bolt	10 N·m	89 lb in
Exhaust Heat Shield Bolt	2.0 N·m	18 lb in
Exhaust Heat Shield Nut	1.0 N·m	9 lb in
Fuel Filler Hose Clamp	3 N·m	27 lb in
Fuel Filler Pipe Attaching Screw	10 N·m	89 lb ft
Fuel Filter Fitting	27 N·m	20 lb ft
Fuel Pipe Mounting Bolts	6 N·m	53 lb in
Fuel Pipe Retainer Bolts	10 N·m	89 lb in
Fuel Pressure Regulator Retaining Bolts	5 N·m	44 lb in
Fuel Rail Attaching Studs	10 N·m	89 lb in
Fuel Rail Pipe Fittings	10 N·m	89 lb in
Fuel Tank Retaining Strap Bolt	35 N·m	26 lb ft
Heated Oxygen Sensor (H02S) 1	30 N·m	22 lb ft
HO2S 2	41 N·m	30 lb ft
Idle Air Control (IAC) Valve	3 N·m	27 lb in
Ignition Coil Housing Screws	4 N·m	35 lb in
Ignition Control Module (ICM) Cover Bolts	10 N·m	89 lb in
Knock Sensor (KS)	25 N·m	18 lb ft
Spark Plugs	20 N·m	15 lb in
Throttle Body Attaching Bolts and Studs	10 N·m	89 lb in
Throttle Position (TP) Sensor Mounting Screw	2 N·m	18 lb in
Upper Air Cleaner Cover Screws	3 N·m	27 lb in

Engine Controls – 3.5L (LX9)

Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-2-3-4-5-6	
Spark Plug Gap	1.52 mm	0.060 in
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Type	GM P/N 12568387 AC Delco #41-101	
Spark Plug Wire Resistance	4,018 ohms per meter (1,225 ohms per ft)	

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Cable Bracket Retaining Bolts	13 N·m	115 lb in
Accelerator Cable Bracket Retaining Nut	10 N·m	89 lb in
Accelerator Pedal Retaining Bolt	3 N·m	27 lb in
Air Cleaner Duct Clamps	2 N·m	18 lb in
Air Cleaner Housing Nuts	10 N·m	89 lb in
Air Cleaner Retainer Screws	6 N·m	40 lb in
Air Cleaner Upper Cover Bolt	2.3 N·m	20 lb in
Camshaft Position (CMP) Sensor Retaining Bolt	8 N·m	71 lb in
Crankshaft Position 7X (CKP) Sensor Bolts	11 N·m	97 lb in
Crankshaft Position 24X (CKP) Sensor Bolts	10 N·m	89 lb in
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
EVAP Canister Purge Valve Retaining Bolt	10 N·m	89 lb in
EVAP Canister Retainer Bolt	10 N·m	89 lb in
Exhaust Gas Recirculation (EGR) Pipe Bolt	25 N·m	18 lb ft
Exhaust Gas Recirculation Pipe Nut	25 N·m	18 lb ft
Exhaust Gas Recirculation Valve Bolts	30 N·m	22 lb ft
Exhaust Shield Bolt	2 N·m	18 lb in
Exhaust Shield Nut	1 N·m	9 lb in
Fuel Feed and Return Pipes to Fuel Rail	17 N·m	13 lb ft
Fuel Filler Hose Clamp	3 N·m	27 lb in
Fuel Filler Pipe Attaching Screw	10 N·m	89 lb in
Fuel Filter Fitting	27 N·m	20 lb ft
Fuel Pipe Mounting Bolts	6 N·m	53 lb in
Fuel Pipe Retainer Bolt	25 N·m	18 lb ft
Fuel Pressure Regulator Attaching Screw	8.5 N·m	75 lb in
Fuel Rail Attaching Bolts	10 N·m	89 lb in
Fuel Tank Retaining Strap Bolts	35 N·m	26 lb ft
Heated Oxygen Sensors (HO2S)	41 N·m	30 lb ft
Idle Air Control (IAC) Valve Attaching Screws	3 N·m	27 lb in
Ignition Coil to Ignition Control Module Screws	4.5 N·m	40 lb in
Knock Sensor (KS)	19 N·m	14 lb in
Manifold Absolute Pressure (MAP) Sensor Retaining Screws	3 N·m	27 lb in
PCM Connector Screws	8 N·m	71 lb in
Spark Plugs	15 N·m	11 lb ft
Throttle Body Retaining Nuts or Bolts	10 N·m	89 lb in
Throttle Position (TP) Sensor Screws	2 N·m	18 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 it is bad enough, it can damage your engine.

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

Notice

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

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

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

Exhaust System

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Exhaust Crossover Pipe Bolt-3.5L	25 N·m	18 lb ft
Exhaust Crossover Pipe Heat Shield Bolt-3.5L	10 N·m	89 lb in
Exhaust Manifold Heat Shield Bolt-2.2L	25 N·m	18 lb ft
Exhaust Manifold Heat Shield Bolt-3.5L	18 N·m	12 lb ft
Exhaust Manifold Nut-2.2L	12 N·m	9 lb ft
Exhaust Manifold Nut-3.5L	16 N·m	12 lb ft
Exhaust Manifold Pipe to Exhaust Manifold Nut	45 N·m	33 lb ft
Exhaust Muffler Inlet Pipe Clamp Nut	50 N·m	37 lb ft
Flex Decoupler to Exhaust Manifold Nut-2.2L	35 N·m	26 lb ft
Intermediate Pipe to 3-Way Catalytic Converter Bolt	34 N·m	25 lb ft

Exhaust System Description

Important

Use of non-OEM parts may cause driveability concerns.

General Description

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

Exhaust Manifold

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

Resonator

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

Catalytic Converter

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

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

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

The catalyst in the converter is not serviceable.

Exhaust Pipe Description

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

Muffler

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

Transmission/Transaxle Description and Operation

Automatic Transmission – 4T40E/4T45E

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, Z
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

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Bottom Pan to Case - M6 x 1.0 x 19.0 - Qty 12	12 N·m	106 lb in
Case Cover	24 N·m	18 lb ft
Case Side Cover	20 N·m	15 lb ft
Channel Plate to Case - M6 x 1.0 x 28.0 - Qty 6	12 N·m	106 lb in
Channel Plate to Case - M6 x 1.0 x 63.0 - Qty 2	12 N·m	106 lb in
Channel Plate to Driven Sprocket Support - M6 x 1.0 x 28.0 - Qty 2	14 N·m	124 lb in
Clip, Wiring Harness - M6 x 1.0 x 15.0 - Qty 1	12 N·m	106 lb in
Converter Shield	10 N·m	89 lb in
Cooler Pipes at Case	8 N·m	71 lb in
Cooler Pipes at Radiator	20-40 N·m	15-30 lb ft
Cover Assembly, Intermediate 4th Servo to Case - M6 x 1.0 x 28.0 - Qty 3	12 N·m	106 lb in
Cover, Lo/Reverse Servo to Case - M6 x 1.0 x 28.0 - Qty 3	12 N·m	106 lb in
Cover, Side to Case - M8 x 1.25 x 28.0 - Qty 10	20 N·m	15 lb ft
Cover, Side to Case (Stud) - M8 x 1.25 x 28.0 - Qty 1	20 N·m	15 lb ft
Flywheel to Torque Converter	62 N·m	46 lb ft
Oil Check Plug	14 N·m	124 lb in
Oil Feed Tube Bolts	14 N·m	124 lb in
Oil Pan to Case	10 N·m	89 lb in
Park/Neutral Position Switch to Case	24 N·m	18 lb ft
Plug, Pipe - 1/8-27 NPTF - Qty 2	12 N·m	106 lb in
Pressure Switch Assembly Bolts	12 N·m	106 lb in
Pump, Valve Body to Channel Plate - M6 x 1.0 x 63.0 - Qty 1	12 N·m	106 lb in
Pump, Valve Body to Channel Plate - M6 x 1.0 x 90.0 -Qty 6	12 N·m	106 lb in
Pump, Valve Body, Channel Plate to Case - M6 x 1.0 x 103.0 - Qty 1	12 N·m	106 lb in
Sensor, Input Speed - M6 x 1.0 x 15.0 (Qty 1)	12 N·m	106 lb in
Sensor, Output Speed Stud - M6 x 1.0 x 15.0 - Qty 1	12 N·m	106 lb in
Shift Lever to Transmission Nut	20 N·m	15 lb ft
Spacer, Channel Plate to Driven Sprocket Support - M6 x 1.0 x 70.0 - Qty 2	14 N·m	124 lb in
Speed Sensor Housing to Case	11 N·m	97 lb in
Spring and Roller Assembly, Detent to Channel Plate - M6 x 1.0 x 19.0 - Qty 1	12 N·m	106 lb in
Support Assembly, Drive Sprocket to Case - M6 x 1.0 x 17.2 - Qty 6	12 N·m	106 lb in
TFP Switch, Valve Body, Channel Plate - M6 x 1.0 x 51.0 - Qty 3	12 N·m	106 lb in
TFP Switch, Valve Body, Channel Plate - M6 x 1.0 x 63.0 - Qty 1	12 N·m	106 lb in
TFP Switch, Valve Body, Channel Plate to Case - M6 x 1.0 x 90.0 - Qty 2	12 N·m	106 lb in
Transmission Mount Bracket Bolts	120 N·m	89 lb ft
Transmission Mount - Front	130 N·m	96 lb ft
Transmission Mount - Rear	122 N·m	90 lb ft
Transmission Mount - Side	66 N·m	49 lb ft
Transmission Mount Thrubolt - Front	75 N·m	55 lb ft
Transmission Mount Thrubolt - Rear	120 N·m	89 lb ft
Transmission Mount Thrubolt - Side	55 N·m	41 lb ft
Transmission to Engine Mount Bolts	90 N·m	66 lb ft
Tube Assembly, Transmission Oil to Case - M6 x 1.0 x 19.0 - Qty 2	12 N·m	106 lb in
Tube Assembly, Transmission Oil to Forward Clutch Support - M6 x 1.0 x 19.0	12 N·m	106 lb in
Tube Assembly, Transmission Oil to Lo/Reverse Servo Cover - M6 x 1.0 x 19.0	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

Fluid Capacity Specifications

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

Transmission Component and System Description

Transmission General Description

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

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

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

Componants

The mechanical components of this unit are as follows:

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

The electrical components of this unit are as follows:

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

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

Automatic Transmission Shift Lock Control Description

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

- The automatic transmission shift lock control solenoid.
- The automatic transmission shift lock control switch.
- The park/neutral position switch.

With the ignition in the ON position, battery positive voltage is supplied to the park/neutral position switch. With the transmission in the PARK position the contacts in the park/neutral position switch are closed and voltage flows through the normally closed contacts of the automatic transmission shift lock control switch to the automatic transmission shift lock control solenoid. The automatic transmission shift lock control solenoid is permanently ground. This energizes the automatic transmission shift lock control solenoid and locks the shift lever in the PARK position. When the driver presses the brake pedal the contacts in the automatic transmission shift lock control switch open, de-energizing the automatic transmission shift lock control solenoid. This allows the shift lever to move out of the PARK position.

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Abbreviations and Meanings

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

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

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

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

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

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

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

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

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

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

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

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Conversion - English/Metric

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

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

Equivalents - Decimal and Metric

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

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

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Fasteners

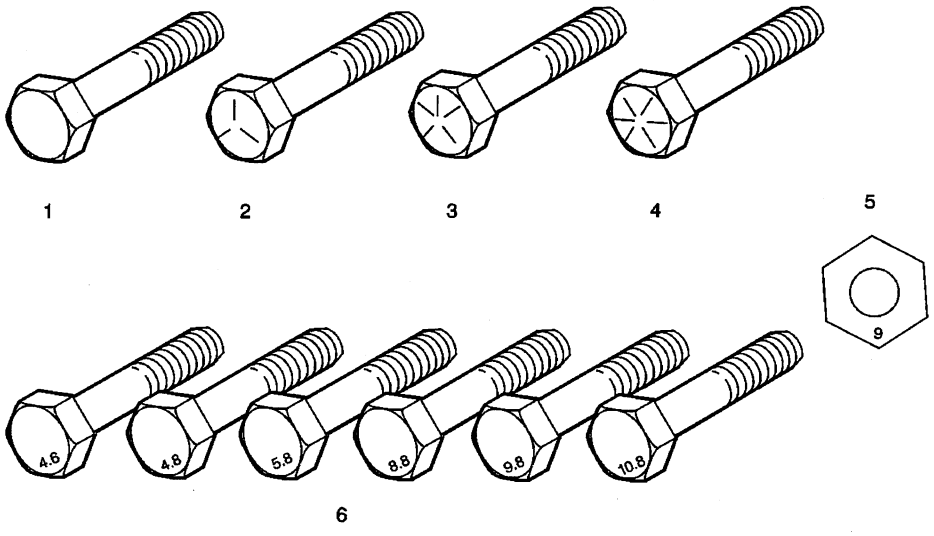
Metric Fasteners

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

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

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

Fastener Strength Identification



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

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

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

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

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

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

Prevailing Torque Fasteners

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

All Metal Prevailing Torque Fasteners

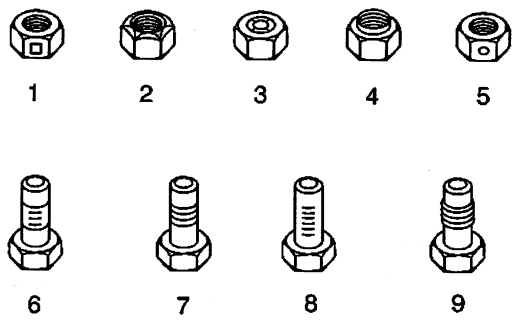
These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

Nylon Interface Prevailing Torque Fasteners

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

Adhesive Coated Fasteners

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



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

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

A prevailing torque fastener may be reused ONLY if:

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

Metric Prevailing Torque Fastener Minimum Torque Development

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

English Prevailing Torque Fastener Minimum Torque Development

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