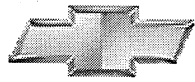


# **Chevrolet**



## **Astro Van**



### **2004**



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## **Product Information**

### **2004 Chevrolet Astro Provides Unmatched Capability**

Chevy Astro is ideal for active, outdoor-oriented families or for those whose commercial applications demand plenty of power and capacity. With standard seating for up to eight, and 170 cubic feet (4,825L) of cargo space with the rear seats removed, Astro has plenty of room for people or cargo - or both.

The 2004 Chevrolet Astro - the most capable mid-size van around - remains unmatched by its segment's competitors in terms of cargo capacity, towing capability and comfortable eight-passenger seating.

### **Safety and security features**

While transporting the family or on the job, Astro protects its passengers and cargo with extensive safety and security features: standard driver and front passenger air bags, child security sliding door, battery-rundown protection and PASSLock theft-deterrent system. A lockout provision also prevents the driver door from locking if the key is inadvertently left in the ignition.

With its incomparable room and strength, Astro is a natural for carrying kids' soccer teams, taking a camping trip or towing a boat. And a world-class brake system adds to Astro's solid reputation as a dependable Chevy Truck.

Astro's optional all-wheel-drive system continues to enhance vehicle safety. The system operates in rear-wheel drive until it senses rear-wheel slippage, then transfers torque to the front axle to help regain traction.

Also, Astro's interior provides energy-absorbing foam behind trim panels, moldings, the headliner and all other vital areas to protect occupants from potential head injuries.

### **Practical, affordable**

Astro continues to be more affordable for retail and fleet customers alike. Buyers also have flexible ordering options to tailor vehicles to their requirements.

All models feature larger, standard 16-inch wheels and tires. Base models have steel wheels. Aluminum wheels are standard on all uplevel LS and LT models. Tires are P215/70R16 all-season steel-belted radials.

The standard world-class four-wheel power disc, four-wheel ABS brake system, with a highly responsive Hydroboost hydraulic assist power brake booster and GM's Dynamic Rear Proportioning, provides quicker, more controlled stops and additional safety alerts. The reserve power assist system will continue to provide sufficient power assist to stop the van if the engine stalls or is turned off.

### **Standard Vortec power**

The duty-proven Vortec 4300 4.3L V-6 mated to a Hydra-Matic 4L60-E four-speed automatic overdrive transmission makes up the Astro drivetrain. The V-6 engine provides 190 horsepower (142 kw) with 250 lb.-ft. (339 Nm) of torque for easy passing and towing. Multi-port fuel injection makes engine operation smooth and long-lasting.

Vortec power contributes to Astro's 5,400-pound (2,449 kg) maximum trailer weight rating - 5,700 pounds (2,565 kg) for the cargo van - which the typical active Astro owner appreciates.

### **New For 2004**

- New standard 16-inch wheels

## Model Lineup

	<b>Engine</b> <b>Vortec 4300 4.3L V6</b>	<b>Transmission</b> <b>4-speed auto (Hydra-Matic 4L60-E)</b>
LS	S	S
LT	S	S
Cargo	S	S

## Specifications

### Overview

Models:	Astro passenger, cargo van, rear- or all-wheel-drive
Body style / driveline:	Cargo and 7-8 passenger vans with sliding side door, front engine, rear- or all-wheel drive
Construction:	unibody/sub-frame
EPA vehicle class:	mid-size van
Manufacturing location:	Baltimore, Maryland
Key competitors:	Ford Windstar, Dodge Caravan

### Engine

Type:	Vortec 4300 4.3L V-6 (LU3)	
Displacement (cu in / cc):	262 / 4300	
Bore & stroke (in / mm):	4.00 x 3.48 / 101.6 x 88.4	
Block material:	cast iron	
Cylinder head material:	cast iron	
Valvetrain:	overhead valve / 2 valves per cylinder	
Ignition system:	direct composite distributor, platinum-tipped spark plugs, low-resistance spark plug wires	
Fuel delivery:	sequential fuel injection, multi-point fuel injection (MPI)	
Compression ratio:	9.2:1	
Horsepower (hp / kw @ rpm):	190 / 142 @ 4400	
Torque (lb-ft / Nm @ rpm):	250 / 339 @ 2800	
Recommended fuel:	87 octane	
Maximum engine speed (rpm):		5600
Emissions system:	3-way catalytic converter, positive crankcase ventilation, evaporative collection system	
Estimated fuel economy mpg (city / highway / combined):	RWD 16 / 20 / 18; AWD 14 / 17 / 15	

### Transmission

Type:	Hydra-Matic 4L60-E 4-speed electronic automatic with overdrive and torque converter	
	<b>Gear ratios (:1):</b>	
First:		3.06
Second:		1.63
Third:		1
Fourth:		0.7
Reverse:		2.29
Final drive ratio:	3.42:1 (optional); 3.73:1 (optional)	

### Chassis/Suspension

Front:	RWD: independent short/long arm (SLA) with coil springs AWD: independent short/long arm (SLA) with torsion bars
Rear:	rigid axle with variable-rate, gas-charged shock absorbers and steel multileaf springs
Steering type:	variable-ratio recirculating ball-type; integral power
Steering ratio:	16/13:1
Steering wheel turns, lock-to-lock:	RWD: 3.1; AWD: 2.7
Turning circle, curb-to-curb (ft / m):	RWD: 40.5 / 12.3; AWD: 43.8 / 13.4

### Brakes

Type:	Hydroboost hydraulic power, 4-wheel disc, 4-wheel ABS, with DRP, audible pad-wear sensors; front, low-drag twin-piston calipers
Rotor diameter x thickness (in / mm):	front: RWD 11.86 x 1.04 / 301 x 26; AWD 11.57 x 1.25 / 294 x 32 rear: 9.5 x 2 / 241 x 51
Total swept area (sq in / sq cm):	front: 239 / 1546; rear: 119 / 770

### Wheels/Tires

Wheel size & type:	base: 16-inch x 6.5-inch steel; LS, LT: 16 x 7-inch brushed aluminum
Tires:	P215/70R16 all-season, steel-belted radials

## Dimensions

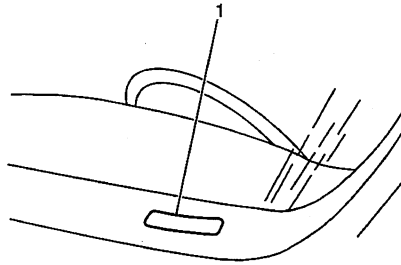
Exterior	
Wheelbase (in / mm):	111.2 / 2825
Overall length (in / mm):	189.8 / 4821
Overall width (in / mm):	77.5 / 1969
Overall height (in / mm):	75 / 1903
Track (in / mm):	front: 65.1 / 1654
	rear: 65.1 / 1654
Minimum ground clearance (in / mm):	6.8 / 173
Ground to top of rear load floor (in / mm):	25.9 / 658
Step-in height (in / mm):	
RWD cargo door:	front: 18.9 / 480; side: 20.7 / 526
AWD cargo door:	front: 18.8 / 478; side: 20.6 / 523
RWD, AWD passenger door:	front: 18.6 / 472; side: 20.2 / 513
Curb weight (lb / kg):	
RWD cargo:	3964 / 1798
RWD passenger:	4321 / 1960
AWD cargo:	4402 / 1996
AWD passenger:	4605 / 2088
Weight distribution (% front / rear):	
RWD cargo:	59 / 41
RWD passenger:	56 / 44
AWD cargo:	61 / 39
AWD passenger:	56 / 44
Cargo Area	
Cargo volume (cu ft / L):	first row: 170.4 / 4825*;
	second row: 104.4 / 2956*;
	third row: 41.3 / 1169*
Width between wheelhousings (in / mm):	51.6 / 1310
Load floor length (in / mm):	
To console:	126 / 3200
To back of front seats:	98.6 / 2504
To back of middle seats:	61.7 / 1567
To back of rear seats:	28.4 / 722
Interior height (in / mm):	47.2 / 1199

\* Maximum first-row volume with middle and second seats removed; second-row volume behind second seat; third-row volume behind third seat.

Interior	First Row	Second Row	Third Row	
Seating capacity, 8 total:	2	3	3	
Head room (in / mm):	39.2 / 996	37.9 / 963	38.7 / 983	
Leg room (in / mm):	41.6 / 1057	36.5 / 927	38.5 / 978	
Shoulder room (in / mm):	64 / 1626	67.1 / 1704	67.1 / 1704	
Hip room (in / mm):	64.9 / 1649	50.9 / 1293	57.1 / 1450	
Capacities	RWD Cargo	AWD Cargo	RWD Passenger	AWD Passenger
GVWR, standard (lb / kg):	5600 / 2540	5850 / 2653	5900 / 2676	6100 / 2766
Payload (lb / kg):	1685 / 764	1666 / 756	1764 / 800	1667 / 756
Trailer towing maximum, w/3.73 axle ratio (lb / kg):	5700 / 2586	5500 / 2495	5400 / 2449	5100 / 2313
Maximum tongue weight (lb / kg):	200 / 90.9 with weight-carrying hitch; 10-15 percent of trailer weight with weight-distributing hitch and sway control			
Fuel tank (gal / L):	27 / 102			
Engine oil (qt / L):	4.5 / 4.3			
Cooling system (qt / L):	13.5 / 12.7; 16.5 / 15.6 with rear heater			

## 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	United States
2	Manufacturer	G	General Motors
3	Division	C T	C - Chevrolet Truck T - GMC Truck
4	GVWR/Brake System	D E	5,001 - 6,000/Hydraulic 6,001 - 7,000/Hydraulic
5	Truck Line/Chassis Type	M L	M - Small Van - 4x2 L - Small Van - AWD
6	Series	1 6	½ Ton Nominal ½ Ton Luxury
7	Body Type	9	Extended Van
8	Engine Type	X	4.3L V6 EFI (L35)
9	Check Digit	--	Check Digit
10	Model Year	4	2004
11	Plant Location	B	Baltimore, MD
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:

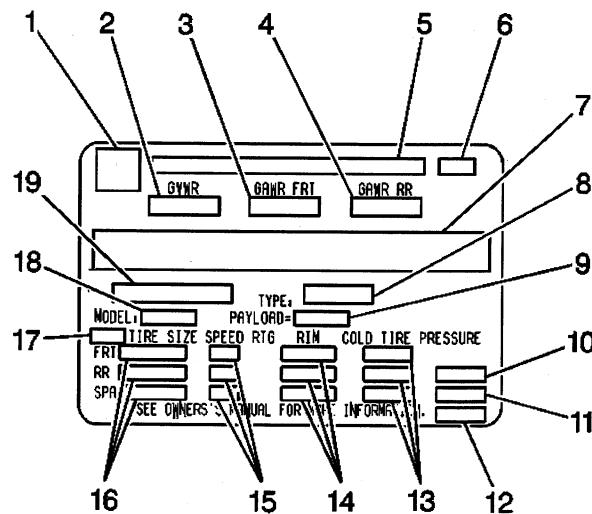
Position	Definition	Character	Description
1	GM Division Identifier	G	General Motors
2	Model Year	4	2004
3	Assembly Plant	B X	Baltimore, MD E.E.M.S.
4-9	Plant Sequence Number	--	Plant Sequence Number

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	2
2	10
3	11
4-5	12-17



## Label Certification w/o RPO Z49



- (1) GM Logo
- (2) Gross Vehicle Weight Rating
- (3) Gross Axle Weight Rating - Front
- (4) Gross Axle Weight Rating - Rear
- (5) Name Of Manufacturer
- (6) Final Manufacturer's Date
- (7) Manufacturer's Statement
- (8) Model Designation
- (9) Payload
- (10) DUAL - When Equipped
- (11) Front Axle Reserve - When Equipped
- (12) Total Capacity - When Required
- (13) Tire Pressure
- (14) Rim Size
- (15) Speed Rating - When Required
- (16) Tire Size
- (17) GVW Rating Code
- (18) Engineering Model
- (19) Vehicle Identification Number

The vehicle certification label displays the following assessments:

- The Gross Vehicle Weight Rating (GVWR)
- The Gross Axle Weight Rating (GAWR) -- Front and Rear
- The vehicle's payload rating
- The original equipment tire sizes and the recommended tire pressures

Gross vehicle weight (GVW) is the weight of the vehicle and everything it carries. Include the following items when figuring the GVW:

- The base vehicle weight (factory weight)
- The weight of all vehicle accessories, like the winches or the plows
- The weight of the driver and the passengers
- The weight of the cargo

The gross vehicle weight must not exceed the Gross Vehicle Weight Rating.

## 2004 Chevrolet Astro Restoration Kit

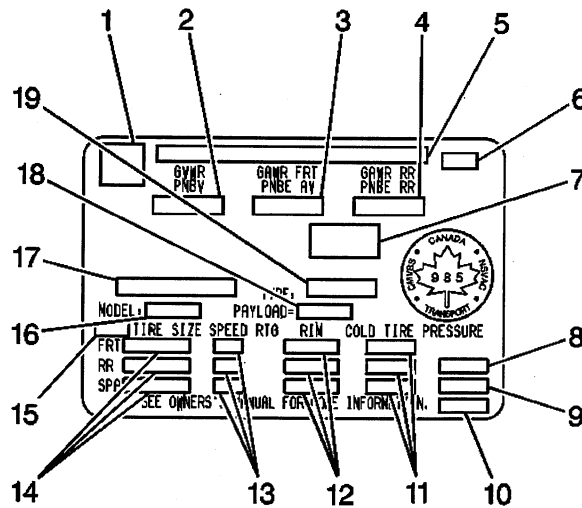
The front gross axle weight rating (GAWR FRT) is the weight exerted on the front axle. The rear gross axle weight rating (GAW RR) is the weight exerted on the rear axle. The front and rear gross axle weights must not exceed the front and rear gross axle weight ratings.

The payload rating defines the vehicle's maximum allowable cargo load. The cargo load includes the driver and the passengers. The payload rating is based on the vehicle's factory installed equipment. Deduct from the payload rating the weight of accessories added to the vehicle after the final date of manufacture .

The vehicle may have a Gross Combination Weight Rating (GCWR). The Gross Combination Weight Rating refers to the total maximum weight of the loaded tow vehicle (including driver and passengers) and a loaded trailer.

The vehicle's tires must be the proper size and properly inflated for the load the vehicle is carrying.

## Label Certification with RPO Z49



- (1) Logo
- (2) Gross Vehicle Weight Rating
- (3) Gross Axle Weight Rating - Front
- (4) Gross Axle Weight Rating - Rear
- (5) Name of Manufacturer
- (6) Final Manufacturer's Date
- (7) RFI Statement - Canada Only
- (8) DUAL - When Equipped
- (9) Front Axle Reserve - When Equipped
- (10) Total Capacity - When Required
- (11) Tire Pressure
- (12) Rim Size
- (13) Speed Rating - When Required
- (14) Tire Size
- (15) GVW Rating Code
- (16) Engineering Model
- (17) Vehicle Identification Number
- (18) Payload
- (19) Model Designation

The vehicle certification label displays the following assessments:

- The Gross Vehicle Weight Rating (GVWR)
- The Gross Axle Weight Rating (GAWR) -- Front and Rear
- The vehicle's payload rating
- The original equipment tire sizes and the recommended tire pressures

Gross vehicle weight (GVW) is the weight of the vehicle and everything it carries. Include the following items when figuring the GVW:

- The base vehicle weight factory weight
- The weight of all vehicle accessories, like the winches or the plows
- The weight of the driver and the passengers
- The weight of the cargo

The gross vehicle weight must not exceed the Gross Vehicle Weight Rating.

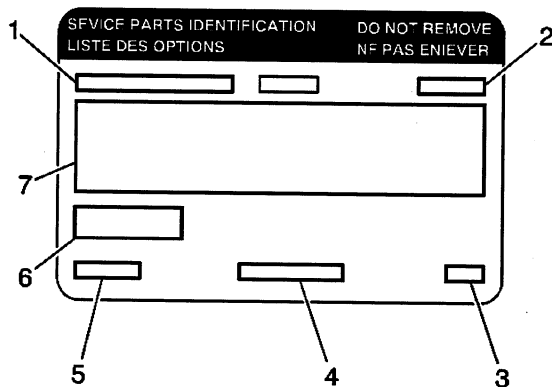
The front gross axle weight rating (GAWR FRT) is the weight exerted on the front axle. The rear gross axle weight rating (GAW RR) is the weight exerted on the rear axle. The front and rear gross axle weights must not exceed the front and rear gross axle weight ratings.

The payload rating defines the vehicle's maximum allowable cargo load. The cargo load includes the driver and the passengers. The payload rating is based on the vehicle's factory installed equipment. Deduct from the payload rating the weight of accessories added to the vehicle after the final date of manufacture .

The vehicle may have a Gross Combination Weight Rating (GCWR). The Gross Combination Weight Rating refers to the total maximum weight of the loaded tow vehicle including driver and passengers and a loaded trailer.

The vehicle tires must be the proper size and properly inflated for the load the vehicle is carrying.

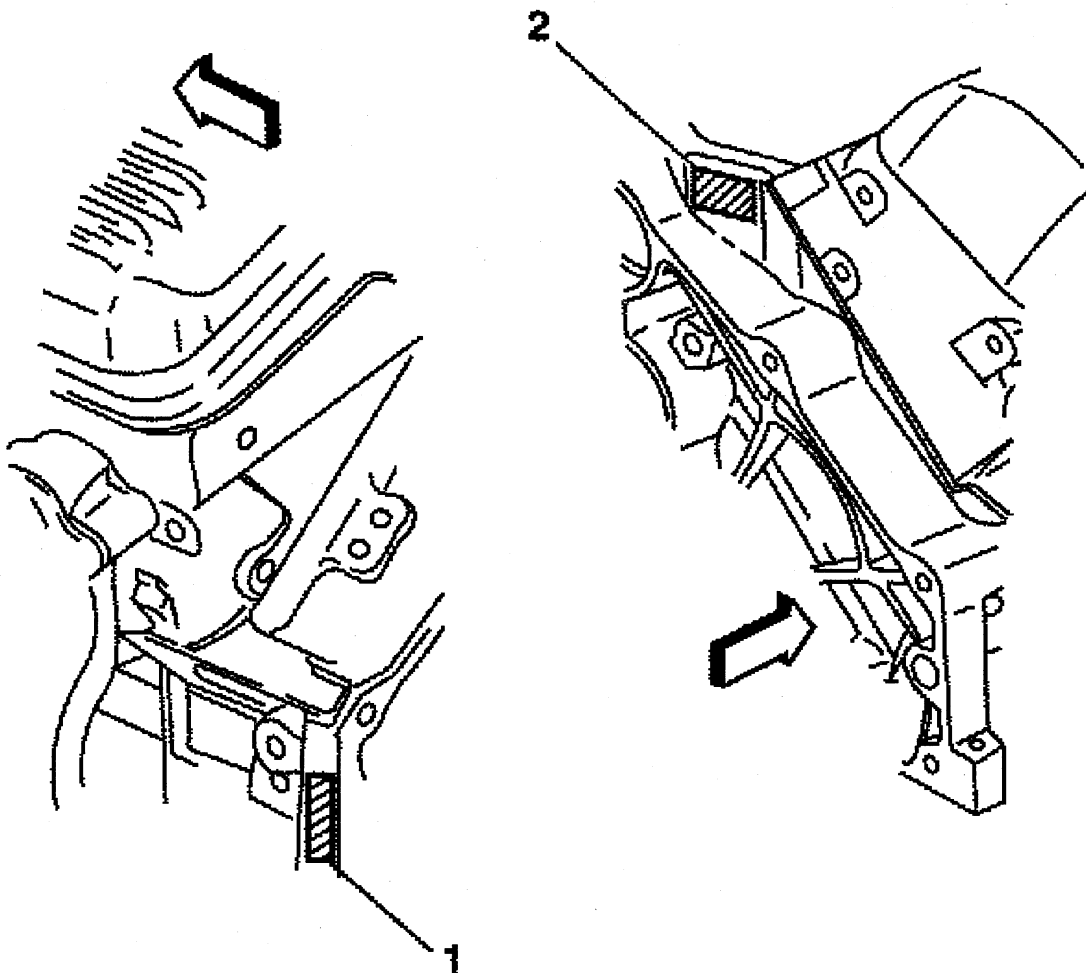
### Service Parts Identification Label (SPID)



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

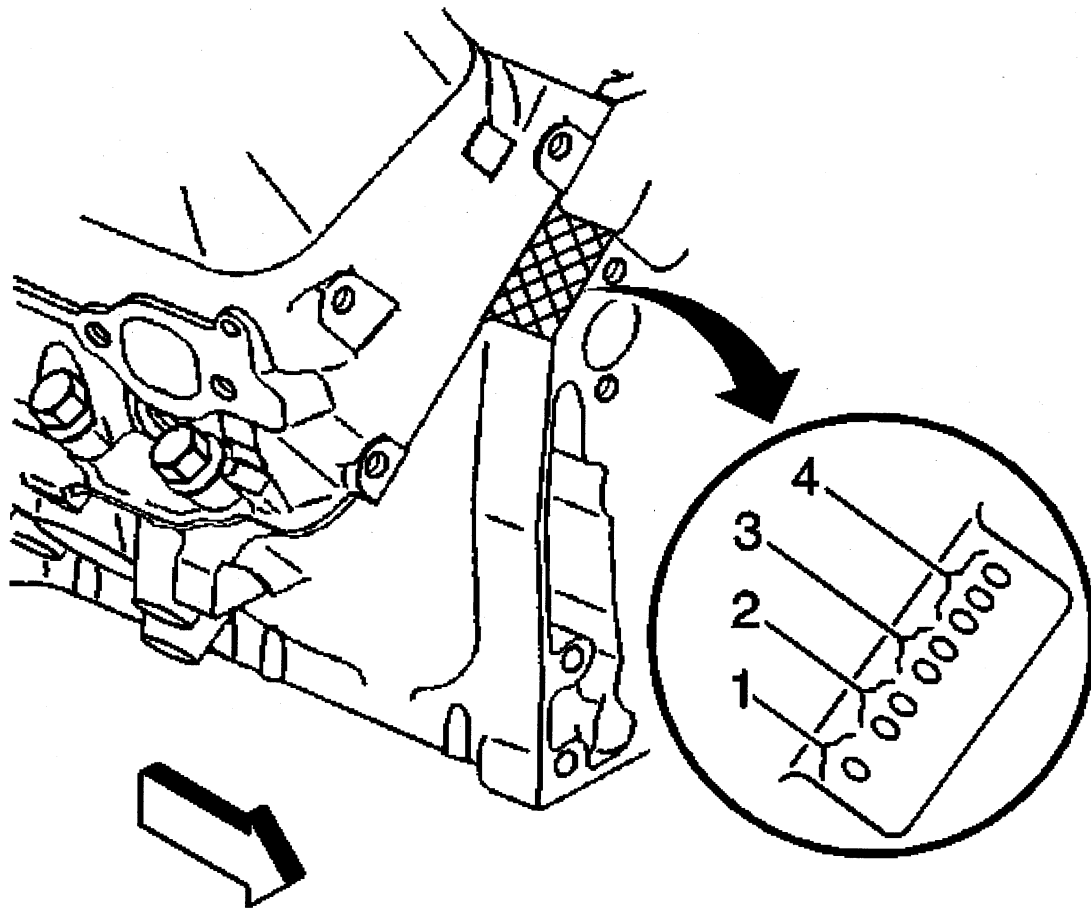
The service parts identification label is placed on the vehicle in order to help service and parts personnel identify the vehicle's original parts and the vehicle's original options.

## Engine ID and VIN Derivative Location 4.3L



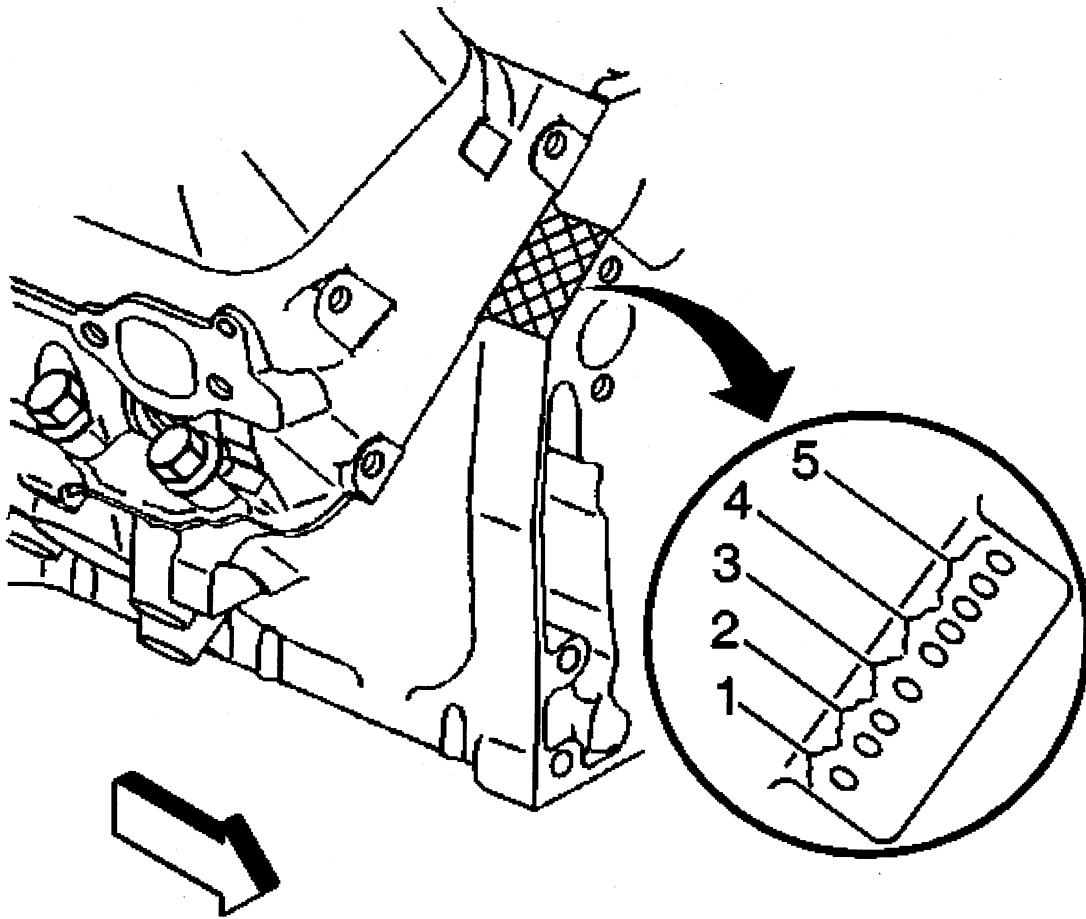
The Vehicle Identification Number (VIN) Derivative is located on the left side rear of the engine block (1) or on the right side rear (2) and typically is a nine digit number stamped or laser etched onto the engine at the vehicle assembly plant.

- 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).



Engines built at the Tonawanda engine plant have the engine identification number located at the right front top of the engine block.

- The first digit (1) is the source code.
- The second and third digits (2) are the month of build.
- The fourth and fifth digits (3) are the date of build.
- The sixth, seventh, and eighth digits (4) are the broadcast code.

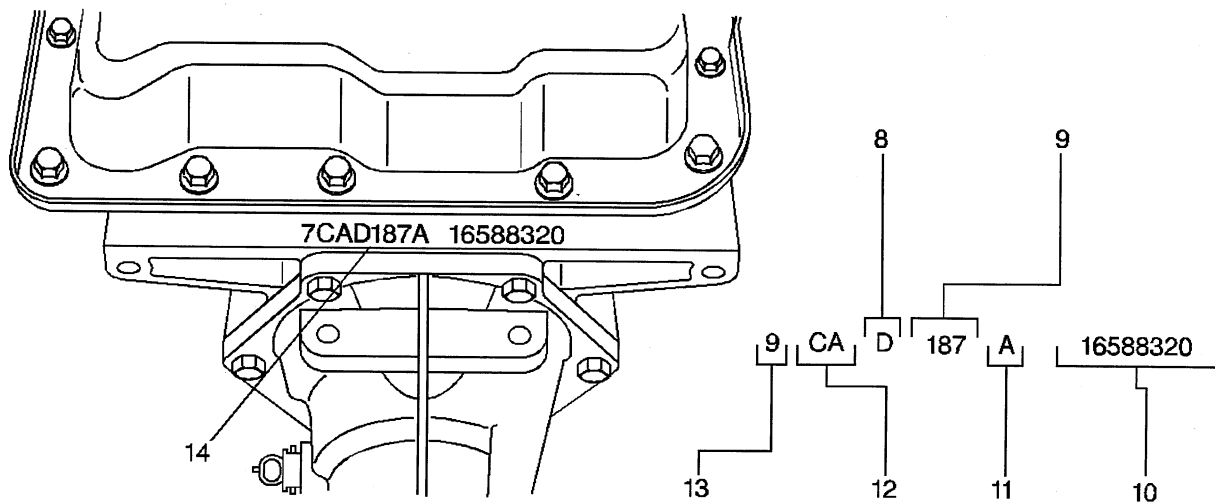
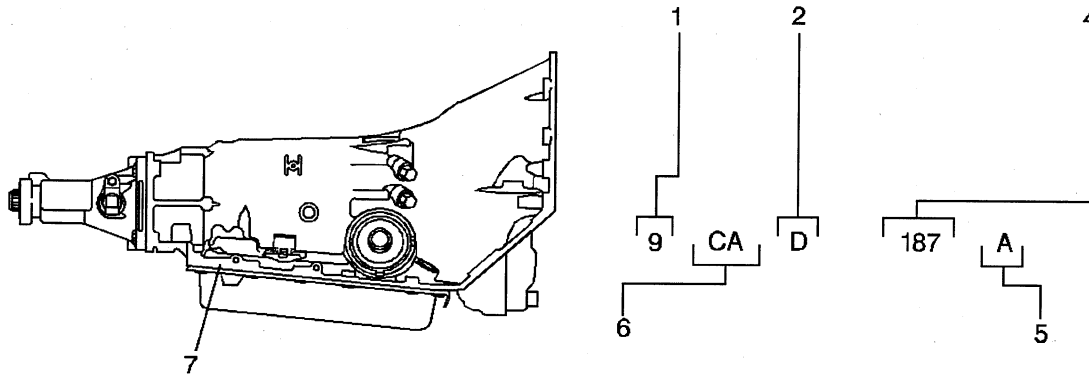


Engines built at the Romulus engine plant have the engine identification number located at the right front top of the engine block.

- The first digit (1) is the source code.
- The second and third digits (2) are the month of build.
- The fourth digit (3) is the hour of the build.
- The fifth and sixth digits (4) are the date of build.
- The seventh, eighth, and ninth digits (5) are the broadcast code.

## Transmission ID and VIN Derivative Location

### 4L60-E Transmission ID Location



- (1) Model Year
- (2) Hydra-Matic 4L60-E
- (4) Julian Date (or Day of the Year)
- (5) Shift Built (A, B, J = First Shift; C, H, W = Second Shift)
- (6) Model
- (7) Transmission ID Location
- (8) Hydra-Matic 4L60-E
- (9) Julian Date (or Day of the Year)
- (10) Serial No.
- (11) Shift Built (A, B, J = First Shift; C, H, W = Second Shift)
- (12) Model
- (13) Model Year
- (14) Transmission ID Location



## Engine and Transmission Usage

Model	Engine	Transmission
M110 (05)	4.3L V6 (LU3)	4 Spd. Auto. (M30)
M110 (06)	4.3L V6 (LU3)	4 Spd. Auto. (M30)
L110 (05)	4.3L V6 (LU3)	4 Spd. Auto. (M30)
L110 (06)	4.3L V6 (LU3)	4 Spd. Auto. (M30)

Model Codes:

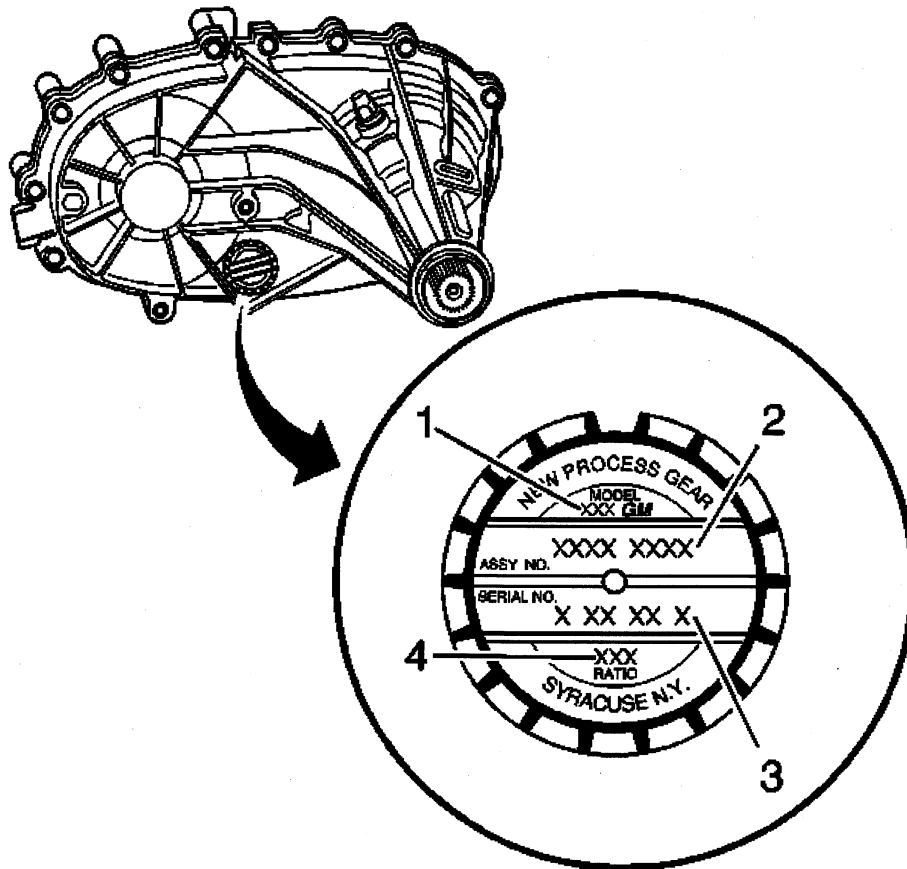
M--Rear Wheel Drive

L--Automatic Four Wheel Drive

05--Cargo Van

06--Passenger Van

## Transfer Case Identification

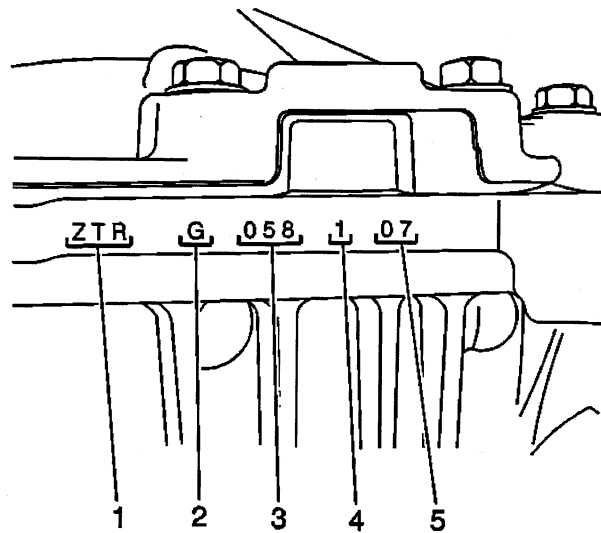


An identification tag is attached to the rear half of the transfer case. The tag provides the following information:

- 1 Model number (1)
  - A First Digit--1 =Single Speed, 2=Two-Speed
  - B Second Digit--2 = T-Utility, 3 =T-Truck, L-Van, 4 or 6 = K-Truck and Utility
  - C Third Digit--1 = Manual, 3 = Electric Shift, 6 = Automatic, 9 = All Wheel Drive
- 2 Assembly number (2)
- 3 Serial number (Date and Shift Code) (3)
- 4 Low range reduction ratio (4)

The information on this tag is necessary for servicing the transfer case. If the tag is removed or becomes dislodged during service operations, keep the identification tag with the unit.

## Axle Identification – Front



- (1) Broadcast Code
- (2) Supplier Code (G = American Axle)
- (3) Julian Date (Day of Year)
- (4) Shift Built (1 = First Shift; 2 = Second Shift) (Optional for 8.25" and 9.25" axles)
- (5) Hour Built

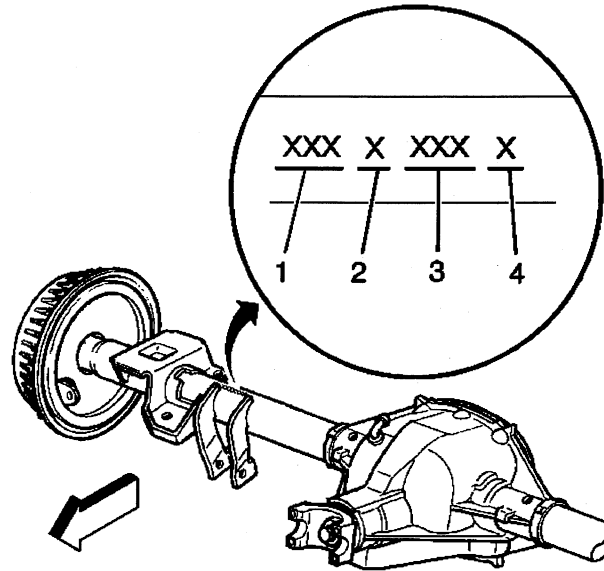
Front axle identification information is stamped on the top of the differential carrier assembly.

The following broadcast codes identifies the axle ratio:

Broadcast Code	Ratio
ZTM	3.08
ZTN, ZTU, ZTW, ZSY, ZA2, ZC2	3.42
ZTP, ZTR, ZTS, ZTX, ZSZ, ZB2, ZD2	3.73
ZTT, ZF2	4.10
ZH2	4.56

The information on the differential carrier assembly is necessary for servicing.

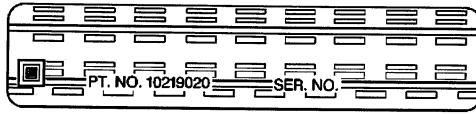
## Axle Identification – Rear



- (1) Rear Axle Ratio
- (2) Build Source (C = Buffalo; K = Canada)
- (3) Julian Date
- (4) Shift Built (1 = First; 2 = Second)

All rear axles are identified by a broadcast code on the right axle tube near the carrier. The rear axle identification and manufacturer's codes must be known before attempting to adjust or to repair axle shafts or the rear axle case assembly. Rear axle ratio, differential type, manufacturer, and build date information is stamped on the right axle tube on the forward side.

## 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 Code	Description
AG1	Seat Adjuster: Power, 6-way, Driver
AJ1	Windows: Deep Tint, all Except W/S and DRS
AL4	Rear Bucket Seat
ANO	Seat Adjuster: Manual, 6-way, Lumbar, Driver and Passenger
AP2	Rear Restraint Shoulder Belt, Anchor - Delete
AP9	Net: Convenience
AQ4	Seat: Rear
AR1	Restraint System Delete
ATZ	Rear Seat - Delete
AU0	Lock Control: Remote Entry
AU3	Lock Control: Side Door, Electric
AU5	Lock Control Remote Entry, Low Power
AV5	Seat: Front Bucket, High Back
A08	Window: Body, Right Side
A12	Window: Rear, Stationary, Back Door
A13	Window: Side Door, Stationary
A19	Window: Side Rear Door, Swing Out
A31	Window: Power Operated, Side
A57	Seat: Passenger, Auxiliary, Folding
BAG	Parts Package Export
BAL	Plant Code: Baltimore, MD, GM T&B
BVE	Running Boards: Side
BX2	Molding: Body Side, Lower, Extra Wide
B37	Covering: Floor Mats, Front & Rear, Auxiliary
C36	Heater: Auxiliary
C4F	GVW Rating 5,900 lbs
C49	Defogger: Rear Window, Electric
C5G	5600 lbs GVW Rating
C5M	6100 lbs GVW Rating
C69	Air Conditioning: Rear
C7X	GVW Rating 5850 lbs
C95	Lamp: Interior, Roof, Courtesy and Dual Reading
DH2	Mirror: I/S, Front Vanity LH & RH, Illum., with Dual Sunshade
DK8	Console: Roof Interior, Deluxe
D34	Mirror Inside Front Van, Left and Right Sunshade, No Illumination
D44	Mirror: Outside, Painted
D48	Mirror: Outside, Remote Control, Electric, Painted
EB6	GVW Rating 6050 lbs
EVA	Test DVT, EVAP Emission Requirement
E54	Body Equipment: Rear Door, w/End Gate Window
F0F	Fleet Incentive Tourism Industry Inc. DBA Budget Sales & Leasing
GT4	Rear Axle 3.73 Ratio
GU6	Rear Axle: 3.42 Ratio
G80	Axle Positraction Limited Slip
JH1	Hydraulic Brake Power, Disc/Disc, 6400 lbs
K05	Engine Block Heater
K34	Cruise Control: Automatic, Electronic

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K53	Fuel Sender, Robust Fuel System
K68	Generator: 105 Ampere
LU3	Engine Gas, 6 Cyl, 4.3L, MFI, V6, 90 Deg
M30	Transmission: Hydra-Matic 4L60-E, 4-Speed Automatic, Electronic
NA3	Emission System Japan
NC8	Emission System California ULEV
NF2	Emission System Federal, Tier 1
NF4	Emission System: Clean Fuel Fleet
NN8	Emission Override Unleaded Fuel, Export
NP5	Wrapped Leather Steering Wheel
NT9	Emission System Federal, Tier 2 Phase-Out
NU4	Emission System California LEV2 Plus
N12	Exhaust System: Rear Exit
N33	Steering Column: Tilt Type
N46	Steering Wheel: Four Spokes
PF4	Wheel 16 x 7, Aluminum
PF9	Wheel 16 x 7, Aluminum Cast
QRD	Tire All P215/70R16-99S BW PE/ST TL ALS
QTP	Tire All 215/70R16-100T BW PE/ST TL HWY
TAK	Fleet Sales Early Order Incentive
TL1	Grille: Special
TR2	Lamp Turn Signal, Enlarged
T62	Daytime Running Lighting - Delete
T72	Left Hand Headlamps, Rule of the Road
T89	Tail and Stop Lamp, Export
UC2	Speedometer Inst., Kilometers & Miles, Kilometer Odometer, Positive Bias
UD4	Vehicle Speed Alarm, 120 K/h
UG1	Garage Door Opener, Universal
UK1	Japanese Radio Frequencies
UK6	Rear Seat Radio Control and Earphone Jacks
UL0	Radio AM/FM Stereo, Seek/Scan, Auto Reverse Music Search Cassette, Auto Tone, Clock, ETR
UL8	Saudi Arabian Frequencies
UM7	Radio: AM/FM Stereo, Seek/Scan, Clock, ETR
UN0	Radio: AM/FM Stereo, Seek/Scan, Compact Disc, Auto Tone, Clock, ETR
UP0	Radio: AM/FM Stereo, Seek/Scan, Auto Reverse, Music Search, Cassette, Compact Disc Player, Auto Tone, Clock, ETR
UQ1	Radio: Provisions for Stereo
UY7	Truck Trailer Wiring Harnes, HD
U19	Speedometer Inst., Kilometer and Miles, Kilometer Odometer
U73	Antenna: Fixed, Radio
VB1	Label Shipping, Japan
VC4	Label Price/Fuel Economy, Puerto Rico
VC5	Label Shipping, Except US, US Possessions, or Japan
VC7	Label Price/Fuel Economy, Guam
VE1	Provision Options Japan
VG8	Vehicle Buyer Notice Label
VJ1	License Plate Rear Mounting Package - Japanese
VK5	Seat: Temporary, For Shipping
VLS	Label, VIN Secondary, Vehicle Identification Number
VL6	Front License Plate, Front Mounting Package - Japanese
VPH	Vehicle Preparation Overseas Delivery
VP6	Noise Control
VR4	Traioler Hitch Weight Distributing Platform

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VR6	Hook Tie Down
VT3	Rear Bumper, Export
VXS	Vehicle: Complete
VXT	Vehicle: Incomplete
V10	Provision Options, Cold Climate
V54	Luggage Carrier: Roof, Painted
V73	Vehicle Statement: US/Canada
V78	Vehicle Statement - Delete
V87	Vehicle Statement Gulf States Organization
V98	Factory Delivery Processing
WX7	Wiring Provisions
XRD	Front Tire P215/70R16-99S BW PE/ST TL ALS
XTP	Front Tire 215/70R16-100T BW PE/ST TL HWY
X88	Conversion Nameplate: Chevrolet
YB9	Paint: Interior, Delete
YC5	Convenience Package Decor Level #5
YC6	Convenience Package Decor Level #6
YC7	Convenience Package Decor Level #7
YF7	Sales Package: Recreational Vehicle Upfitter
YRD	Rear Tire P215/70R16-99S BW PE/ST TL ALS
YTP	Rear Tire 215/70R16-100T BW PE/ST TL HWY
ZP0	Seating Arrangement: Temporary Driver
ZP7	Seating Arrangement: Seven Passenger
ZP8	Seating Arrangement: Eight Passenger
ZW9	Body Equipment: Base Body or Chassis
ZX2	Seating Arrangement: Driver & Passenger, Highback
ZY1	Color Combination: Solid
ZY2	Color Combination: Two Tone
Z49	Base Equipment: Canadian Mandatory
Z5X	Mirror Provisions, Arabic Language
Z82	Trailer Provisions: Special Equipment, Heavy Duty
Z88	Conversion Nameplate: GMC

## Technical Information

### Maintenance and Lubrication

#### Capacities - Approximate Fluid

Application	Specification	
	Metric	English
<b>Axles</b>		
• Front Axle	1.2 liters	2.6 pints
• Rear Axle - Standard	1.7 liters	3.5 pints
• Rear Axle - Locking	1.7 liters	3.5 pints
<b>Engine Cooling System</b>		
• 4.3L (VIN W) - w/ C36 (Rear Heater)	15.6 liters	16.5 quarts
• 4.3L (VIN W) - w/o C36 (Rear Heater)	12.8 liters	13.5 quarts
<b>Engine Crankcase</b>		
• 4.3L (VIN W)	4.3 liters*	4.5 quarts*
• Fuel Tank	101.8 liters	27 gallons
<b>Transmission</b>		
• 4L60-E (Drain and Refill)	4.7 liters*	5 quarts*
• 4L60-E (Complete Overhaul)	10.6 liters*	11 quarts*
<b>Transfer Case</b>		
New Venture Gear (NP4)	1.9 Liters	2.0 Quarts
<b>Power Steering Capacity</b>	0.99 liters*-1.360 liters*	1.05 quarts*-1.44 quarts*

\* Approximate

#### Maintenance Items

Usage	Type
Air Cleaner Filter	AC Type 1163C
Engine Oil Filter	AC Type PF-47
Fuel Filter	AC Type GF-481
Positive Crankcase Ventilation (PCV) Valve	AC Type CV769C
Spark Plugs	AC Type 41-932 (GAP 1.52 mm, 0.060 in)
<b>Wiper Blades</b>	
• Front	Trico 22110158, Pin Type 18 in (45.7 cm) Length
• Rear	Trico 22154396, Pin Type 14 in (35.5 cm) Length

#### Tire Inflation Pressure Specifications

Application	Specification	
	Metric	English
Front and Rear Tires	240 kPa	35 psi
Compact spare	420 kPa	60 psi



**Fluid and Lubricant Recommendations**

Usage	Fluid/Lubricant
Engine Oil	Engine Oil with the American Petroleum Institute Certified For Gasoline Engines Starburst symbol of the proper viscosity.
Engine Coolant	A 50/50 mixture of clean, drinkable water and use only GM Goodwrench DEX-COOL® or Havoline® DEX-COOL® (orange-colored, silicate-free) coolant conforming to GM specification 6277M.
Engine Coolant Supplemental Sealer	<b>DO NOT</b> use cooling system seal tabs, or similar compounds, unless otherwise instructed. The use of cooling system seal tabs, or similar compounds, may restrict coolant flow through the passages of the cooling system or the engine components. Restricted coolant flow may cause engine overheating and/or damage to the cooling system or the engine components/assembly.
Hydraulic Brake System	Delco Supreme 11® Brake Fluid (GM P/N 12377967 or equivalent DOT-3 Brake Fluid).
Windshield Washer Solvent	GM Optikleen® Washer Solvent (GM P/N 1051515 or equivalent).
Hydraulic Clutch System	Hydraulic Clutch Fluid (GM P/N 12345347 or equivalent DOT-3 Brake Fluid).
Park Brake Cable Guides	Chassis Lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI Grade 2, Category LB or GC-LB.
Power Steering System	GM Power Steering Fluid (GM P/N 1052884-1 pint, 1050017-1 quart, or equivalent).
Manual Transmission	<ul style="list-style-type: none"> <li>L4 engine: Manual Transmission Fluid with 5% Friction modifier (GM P/N 12377916).</li> <li>V6 engine: Synchromesh Transmission Fluid (GM P/N 12345349).</li> </ul>
Automatic Transmission	DEXRON®-III Automatic Transmission Fluid with a G-License Number (G-xxxx). The G-License Number will be found on the back label.
Key Lock Cylinders	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241 or equivalent).
Chassis Lubrication	Chassis Lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI Grade 2, Category LB or GC-LB.
Front Wheel Bearings-RWD	Wheel Bearing Lubricant meeting requirements of NLGI Grade 2, Category GC or GC-LB (GM P/N 1051344 or equivalent).
Rear Axle (Standard)	Axle Lubricant (GM P/N 1052271) or SAE 80W-90 GL-5 Gear Lubricant.
Rear Axle (Locking Differential)	Axle Lubricant, use only GM Part No. 1052271 (in Canada use Part No. 10950849). Do not add friction modifier.
Transfer Case	DEXRON®-III Automatic Transmission Fluid.
Automatic Transfer Case	Automatic Transfer Case Fluid (GM P/N 12378396 or equivalent).
Column Shift Linkage	Chassis Lubricant (GM P/N 12377985 or equivalent) meeting requirements of NLGI Grade 2, Category LB or GC-LB.
Floor Shift Linkage	Chassis Lubricant (GM P/N 12377985 or equivalent) meeting requirements of NLGI Grade 2, Category LB or GC-LB.
Propeller Shaft Slip Splines and Universal Joints	Chassis Lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI Grade 2, Category LB or GC-LB.
Clutch Pushrod to Fork Joint	Chassis Lubricant (GM P/N 12377985 or equivalent) or lubricant meeting requirements of NLGI Grade 2, Category LB or GC-LB.
Constant Velocity Universal Joint	Chassis Lubricant (GM P/N 12377895 or equivalent) or lubricant meeting requirements of NLGI Grade 2, Category LB or GC-LB.
Hood Latch Assembly, Pivots and Spring Anchor, Release Pawl	Lubriplate® Lubricant Aerosol (GM P/N 12346293 or equivalent) or lubricant meeting requirements of NLGI Grade 2, Category LB or GC-LB.
Hood and Door Hinges	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241 or equivalent).

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Endgate Mounted Spare Tire Carrier (if equipped), Outer Endgate Handle Pivot Points and Hinges	Multi-Purpose Lubricant, Superlube® (GM P/N 12346241 or equivalent).
Weatherstrip conditioning	Dielectric Silicone Grease (GM P/N 12345579 or equivalent).
Weatherstrip squeaks	Synthetic Grease with Teflon, Loctite Superlube® (GM P/N 12371287 or equivalent).

## Descriptions and Operations

### Power Steering System

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

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

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

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

- A recirculating ball system
- A rack and pinion system

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

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

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

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

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

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

### Steering Linkage

The steering linkage connects both of the front wheels to the steering gear through the pitman arm. The steering linkage consists of the following components:

- The inner tie rod
- The outer tie rod
- The relay rod
- The connecting rod
- The idler arm(s)
- The pitman arm

The inner and the outer tie rods attach to the steering knuckle and the relay rod by ball studs. The two idler arms support the relay rod. The idler arms pivot on a support that is attached to the frame rail. The idler arm support is threaded in order to allow the height adjustment of the arm on the support. The height

adjustment allows the linkage to clear the suspension as the linkage moves from lock to lock. The original equipment is installed at a preset specification.

The relay rod is attached to the connecting rod. The connecting rod is used in order to maintain the proper geometry in the steering linkage. The connecting rod attaches to, and is supported by, the pitman arm.

The pitman arm is driven by the steering gear. Each joint has a lubrication fitting. The inner pivots use prevailing torque nuts, the outer tie rods use castellated nuts. Replace the prevailing torque nuts and cotter pins any time service removal is necessary.

The overall condition of the steering linkage affects the steering performance. Improper, and possibly dangerous steering action will result if any of the steering linkage displays the following conditions:

- Bent
- Damaged
- Worn
- Poorly lubricated

Check the steering geometry and the front wheel alignment whenever any steering linkage components are repaired or replaced.

## **Steering Wheel and Column**

The steering wheel and column has 4 primary functions:

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

### **Vehicle Steering**

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

### **Vehicle Security**

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

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

### **Driver Convenience**

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

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

## **Driver Safety**

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

## **Suspension Description and Operation**

### **Front Suspension**

#### **Coil Spring**

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 vehicle's 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 an upper and a lower control arm. 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 control arm attaches to the frame in the same fashion. Between the lower control arm and a spring seat on the vehicle's frame, under tension, is a coil spring.

This up and down motion of the steering knuckle as the vehicle travels over bumps is absorbed predominantly by the coil spring. The vertical movement of the steering knuckle as the vehicle travels over irregular road surfaces will tend to compress the spring and spring tension will lead the spring to return to the original, at-rest state. This action isolates the vehicle from the road surface. The upper and lower control arms are 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.

A shock absorber is used in conjunction with this system in order to dampen out the oscillations of the coil spring. A shock absorber is a basic hydraulic cylinder. The shock is filled with oil and has a moveable shaft that connects to a piston inside the shock absorber. 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.

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 vehicle's handling characteristics on turns.

#### **Torsion Bar**

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 vehicle's 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 an upper and a lower control arm. 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 is attached at 2 points to the vehicle frame through semi-rigid bushings. The upper control arm attaches to the frame in the same fashion. Attached to the lower control arm is a torsion bar. Torsion bars are steel or steel composite shaft that connects from the lower control arm an adjustable mount at the torsion bar crossmember. The torsion bar functions as a spring in this suspension system. The torsion bar absorbs energy from irregular road surfaces by twisting force along the center axis. The torsion bar has a resistance to this twisting motion and will return to the original, at-rest position similar to that of a spring.

A shock absorber is used in conjunction with this system in order to dampen out the oscillations of the torsion bar. A shock absorber is a basic hydraulic cylinder. The shock is filled with oil and has a moveable shaft that connects to a piston inside the shock absorber. Valves inside the shock absorber offer resistance to oil flow and consequently offer resistance to rapid movement of the piston and shaft. Each end of the shock absorber is connected in such a fashion in order to utilize this recoil action of a torsion bar alone.

Front suspension 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 vehicle's handling characteristics on turns.

## **Rear Suspension**

These vehicles use a leaf spring and a solid rear axle suspension system.

The rear axle assembly is attached to multi-leaf springs with U-bolts. The front ends of the springs are attached to the frame at the front hangers with rubber bushings. The rear ends of the springs are attached to the frame with shackles that use rubber bushings. Shackles allow the springs to change position while the vehicle is in motion.

Two direct double-acting shock absorbers provide ride control. The shock absorbers are angle-mounted between the frame. The shock absorbers are attached with brackets. The brackets are attached to the anchor plate.

The rear spring steel stabilizing shaft helps minimize body roll and sway during cornering. The rear stabilizer shaft is connected to the rear axle and the frame with the following components:

- The rubber insulators
- The clamps
- The link assemblies

## **Wheels and Tires**

### **General Description**

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

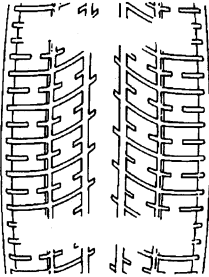
The following factors have an important influence on tire life:

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

The following factors increase tire wear:

- Heavy cornering
- Excessively rapid acceleration
- Heavy braking

### **Tread Wear Indicators Description**



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

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

### **Metric Wheel Nuts and Bolts Description**

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

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

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

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

### **Tire Inflation Description**

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

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

Inspect the tire pressure when the following conditions apply:

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

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

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

### Inflation Pressure Conversion (Kilopascals to PSI)

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

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

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

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

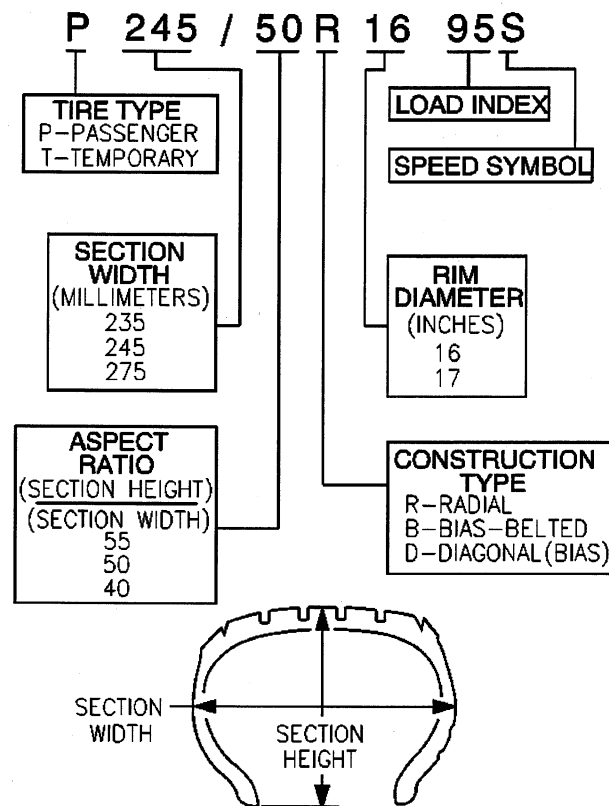
- A tire squeal on turns
- Hard steering
- Rapid wear and uneven wear on the edge of the tread
- Tire rim bruises and tire rim rupture
- Tire cord breakage
- High tire temperatures
- Reduced vehicle handling
- High fuel consumption
- Soft riding

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

- Uneven braking
- Steering lead
- Reduced vehicle handling



## P-Metric Sized Tires Description

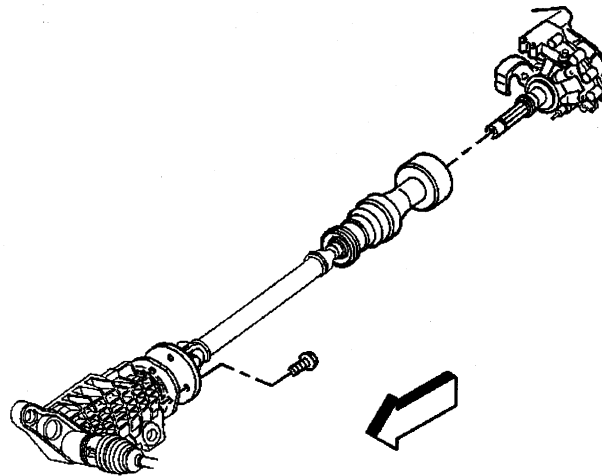


Most P-metric tire sizes do not have exact corresponding alphanumeric tire sizes. Replacement tires should be of the same tire performance criteria (TPC) specification number including the same size, the same load range, and the same construction as those originally installed on the vehicle. Consult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

## **Driveline System Description and Operation**

### **Driveline/Axle – Propeller Shaft**

#### **Constant Velocity Joint Description**



A Constant Velocity (CV) universal joint propeller shaft transmits power from the transfer case to the front differential.

The constant velocity joint allows the driveline angle to adjust according to the up and down movement of the vehicle without disturbing the power flow. The joint consists of an outer bearing retainer and flange, spring, cap, circlip, inner bearing assembly, and wire ring. The inner bearing assembly includes a bearing cage, six ball bearings, and an inner race.

#### **Propeller Shaft Description and Operation**

The front propeller shaft consists of the following components:

- Propeller shaft tube
- Universal joint
- Flange yoke
- Constant velocity joint

The rear propeller shaft consists of the following components:

- Propeller shaft tube
- 2 universal joints
- Slip yoke

#### **Front Propeller Shaft Operation**

The front propeller shaft connects the transfer case to the front axle. It transmits the rotating force from the transfer case to the front axle when the transfer case is engaged.

#### **Rear Propeller Shaft Operation**

The rear propeller shaft connects the transmission or transfer case to the rear axle. It transmits the rotating force from the transmission or transfer case to the rear axle.

### **Propeller Shaft Phasing Description**

The propeller shaft is designed and built with the yoke lugs or ears in line with each other. This produces the smoothest running shaft possible. A propeller shaft designed with built in yoke lugs in line is known as in - phase. An out of phase propeller shaft often causes vibration. The propeller shaft generates vibration from speeding up and slowing down each time the universal joint goes around. The vibration is the same as a person snapping a rope and watching the wave reaction flow to the end. An in phase propeller shaft is similar to 2 persons snapping a rope at the same time and watching the waves meet and cancel each other out. A total cancellation of vibration produces a smooth flow of power in the drive line. All splined shaft slip yokes are keyed in order to ensure proper phasing.

### **Universal Joint Description**

The universal joint is connected to the propeller shaft. The universal consist of 4 caps with needle bearings and grease seals mounted on the trunnions of a cross or spider. These bearings and caps are greased at the factory and no periodic maintenance is required. The bearings and caps are pressed into the yokes and held in place with snap rings, except for 2 bearings on some models witch are strapped onto the pinion flange of the differential. Universal joints are designed to handle the effects of various loads and rear axle windup conditions during acceleration and braking. The universal joint operates efficiently and safely within the designed angle variations. when the design angles are exceeded, the operational life of the joint decreases.

### **Wheel Drive Shafts Description and Operation**

Front Wheel Drive Shafts are flexible assemblies which consist of the following components:

- Front wheel drive shaft constant velocity joint (outer joint).
- Front wheel drive shaft tri-pot joint (inner joint).
- 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, and moves with an in and out motion.
- The front wheel drive shaft constant velocity joint is flexible but can not move in and out.

The Wheel Drive Shaft is a balanced shaft that transmits rotational force from the front differential to the front wheels when the transfer case is engaged. The wheel drive shaft is mounted to the front differential by bolting the flange of the wheel drive shaft to the flange on the inner output shaft of the front differential. The other end of the wheel drive shaft is splined to fit into and drive the hub assembly when the transfer case is engaged. The tri-pot joint and constant velocity joint on the wheel drive shaft allows the shaft to be flexible to move with the suspension travel of the vehicle.

### **Front Drive Axle Description and Operation**

The Front Drive Axle consist of the following components:

- Differential Carrier Housing
- Differential Assembly
- Left and Right Output Shafts
- Inner Axle Shaft Housing
- Inner Axle Shaft

The front axle on the four-wheel-drive model vehicle does not have a central disconnect feature. The axle uses a conventional ring and pinion gear set in order to transmit the driving force of the engine to the wheels. The open differential allows the wheels to turn at different rates of speed while the axle continues to transmit the driving force. This prevents tire scuffing when going around corners and premature wear on internal axle parts. The ring and pinion set and the differential are contained within the carrier. The axle identification number on top of the differential carrier assembly or on a label on the right half of differential carrier assembly. The drive axles are completely flexible assemblies consisting of inner and outer constant velocity CV joints protected by thermoplastic boots and connected by a wheel drive shaft.

## Rear Drive Axle Description and Operation

Rear Axles for this vehicle consist of the following components:

- Differential axle housing
- Differential carrier
- Right and left axle tubes
- Right and left axle shafts

A open differential has a set of 4 gears. Two are side gears and 2 are pinion gears. Some differentials have more than 2 pinion gears. Each side gear is splined to an axle shaft so each axle shaft ; so that each axle shaft turns when its side gear rotates. The pinion gears are mounted on a differential pinion shaft, and the gears are free to rotate on this shaft. The pinion shaft is fitted into a bore in the differential case and is at right angles to the axle shafts. Power is transmitted through the differential as follows: the drive pinion rotates the ring gear. The ring gear being bolted to the differential case, rotates the case, The differential pinion, as it rotates the case, forces the pinion gears against the side gears. When both wheels have equal traction, the pinion gears do not rotate on the pinion shaft because of input force on the pinion gear is equally divided between the 2 side gears. Therefore, the pinion gears revolve with the pinion shaft, but do not rotate around the shaft itself. The side gears, being splined to the axle shafts and in mesh with the pinion gears rotate the axle shafts. If a vehicle were always driven in a straight line, the ring and pinion gears would be sufficient. The axle shaft could be solidly attached to the ring gear and both driving wheels would turn at equal speed. However, if it became necessary to turn a corner, the tires would scuff and slide because the differential allows the axle shafts to rotate at different speeds. When the vehicle turns a corner, the inner wheel turns slower than the out wheel and slows its rear axle side gear (as the shaft is splined to the side gear). The rear axle pinion gears will roll around the slowed rear axle side gear, driving the rear axle side gear wheel faster.

## Locking Differential Description and Operation

The locking differential consists of the following components:

- Differential case - 1 or 2 piece
- Locking differential spider - 2 piece case only
- Pinion gear shaft - 1 piece case only
- Differential pinion gear shaft lock bolt - 1 piece case only
- 2 clutch discs sets
- Locking differential side gear
- Thrust block
- Locking differential clutch disc guides
- Differential side gear shim
- Locking differential clutch disc thrust washer
- Locking differential governor
- Latching bracket
- Cam plate assembly
- Differential pinion gears
- Differential pinion gear thrust washers

The optional locking differential (RPO G80) enhances the traction capability of the rear axle by combining the characteristics of a limited-slip differential and the ability of the axle shafts to "lock" together when uneven traction surfaces exist. The differential accomplishes this in 2 ways. First by having a series of clutch plates at each side of the differential case to limit the amount of slippage between each wheel. Second, by using a mechanical locking mechanism to stop the rotation of the right differential side gear, or the left differential side gear on the 10.5 inch axle, in order to transfer the rotating torque of the wheel without traction to the wheel with traction. Each of these functions occur under different conditions.

### Limited-Slip Function

Under normal conditions, when the differential is not locked, a small amount of limited-slip action occurs. The gear separating force developed in the right-hand (left-hand side on 10.5 inch axle) clutch pack is primarily responsible for this.

The operation of how the limited-slip function of the unit works can be explained when the vehicle makes a right-hand turn. Since the left wheel travels farther than the right wheel, it must rotate faster than the ring gear and differential case assembly. This results in the left axle and left side gear rotating faster than the differential case. The faster rotation of the left-side gear causes the pinion gears to rotate on the pinion shaft. This causes the right-side gear to rotate slower than the differential case.

Although the side gear spreading force produced by the pinion gears compresses the clutch packs, primarily the right side, the friction between the tires and the road surface is sufficient to overcome the friction of the clutch packs. This prevents the side gears from being held to the differential case.

### Locking Function

Locking action occurs through the use of some special parts:

- A governor mechanism with 2 flyweights
- A latching bracket
- The left side cam plate and cam side gear

When the wheel-to-wheel speed difference is 100 RPM or more, the flyweights of the governor will fling out and one of them will contact an edge of the latching bracket. This happens because the left cam side gear and cam plate are rotating at a speed different, either slower or faster, than that of the ring gear and differential case assembly. The cam plate has teeth on its outer diameter surface in mesh with teeth on the shaft of the governor.

As the side gear rotates at a speed different than that of the differential case, the shaft of the governor rotates with enough speed to force the flyweights outward against spring tension. One of the flyweights catches its edge on the closest edge of the latching bracket, which is stationary in the differential case. This latching process triggers a chain of events.

When the governor latches, it stops rotating. A small friction clutch inside the governor allows rotation, with resistance, of the governor shaft while one flyweight is held to the differential case through the latching bracket. The purpose of the governor's latching action is to slow the rotation of the cam plate as compared to the cam side gear. This will cause the cam plate to move out of its detent position.

The cam plate normally is held in its detent position by a small wave spring and detent humps resting in matching notches of the cam side gear. At this point, the ramps of the cam plate ride up on the ramps of the cam side gear, and the cam plate compresses the left clutch pack with a self-energizing action.

As the left clutch pack is compressed, it pushes the cam plate and cam side gear slightly toward the right side of the differential case. This movement of the cam side gear pushes the thrust block which compresses the right-hand side gear clutch pack.

At this point, the force of the self-energizing clutches and the side gear separating force combine to hold the side gears to the differential case in the locking stage.

The entire locking process occurs in less than 1 second. The process works with either the left or right wheel spinning, due to the design of the governor and cam mechanism. A torque reversal of any kind will unlatch the governor, causing the cam plate to ride back down to its detent position. Cornering or deceleration during a transmission shift will cause a torque reversal of this type. The differential unit returns to its limited-slip function.

The self-energizing process would not occur if it were not for the action of one of the left clutch discs. This energizing disc provides the holding force of the ramping action to occur. It is the only disc which is splined to the cam plate itself. The other splined discs fit on the cam side gear.

If the rotating speed of the ring gear and differential case assembly is high enough, the latching bracket will pivot due to centrifugal force. This will move the flyweights so that no locking is permitted. During vehicle driving, this happens at approximately 32 km/h (20 mph) and continues at faster speeds.

When comparing the effectiveness of the locking differential, in terms of percent-of-grade capability to open and limited-slip units, the locking differential has nearly 3 times the potential of the limited-slip unit under the same conditions.

### **Locking Differential Torque-Limiting Disc**

The locking differential design was modified in mid-1986 to include a load-limiting feature to reduce the chance of breaking an axle shaft under abusive driving conditions. The number of tangs on the energizing disc in the left-hand clutch pack was reduced allowing these tangs to shear in the event of a high-torque engagement of the differential locking mechanism.

At the time of failure of the load-limiting disc, there will be a loud bang in the rear axle and the differential will operate as a standard differential with some limited-slip action of the clutch packs at low torques.

The service procedure, when the disc tangs shear, involves replacing the left-hand clutch plates and the wave spring. It is also necessary to examine the axle shafts for twisting because at high torques it is possible to not only shear the load-limiting disc, but to also twist the axle shafts.

### **New Venture Gear 136 Automatic Transfer Case**

During normal driving situations, the Auto 4WD mode is active. During the Auto 4WD mode, the transfer case shift control module monitors rear wheel slip speed, based on the inputs from both the front and rear propshaft speed sensors. When the vehicle experiences a rear wheel slip condition, the transfer case shift control module sends a pulse width modulated (PWM) signal to an electronic motor, transfer case encoder motor. This motor rotates the transfer case sector shaft, applying a clutch pack. This clutch pack is designed to deliver a variable amount of torque, normally delivered to the rear wheels, and transfers it to the front wheels. Torque is then ramped up to the front wheels, until the front propshaft speed sensor matches that of the rear propshaft speed sensor. Torque is then ramped down, until torque is completely removed from the front wheels or until rear wheel slip is once again detected. The process then repeats.

## **Braking System Description and Operation**

### **Hydraulic Brake System**

#### **System Component Description**

The hydraulic brake system consists of the following:

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

Contains supply of brake fluid for the hydraulic brake system.

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

Converts mechanical input force into hydraulic output pressure.

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

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

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

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

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

Carries brake fluid to and from hydraulic brake system components.

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

Converts hydraulic input pressure into mechanical output force.

#### **System Operation**

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

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

#### **System Component Description**

The brake assist system consists of the following:

##### **Brake Pedal**

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

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

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

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

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

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

##### **Vacuum Source**

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

## **Vacuum Source Delivery System**

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

### **System Operation**

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

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

### **System Component Description**

The disc brake system consists of the following components:

#### **Disc Brake Pads**

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

#### **Disc Brake Rotors**

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

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

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

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

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

### **System Operation**

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

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

### **System Component Description**

The park brake system consists of the following:

#### **Park Brake Pedal Assembly**

Receives and transfers park brake system apply input force from driver to park brake cable system.

#### **Park Brake Release Handle Assembly**

Releases applied park brake system when pulled.

#### **Park Brake Cables**

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

#### **Park Brake Cable Adjuster**

Removes slack in park brake cables.



### **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.

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

Uses multiplied input force from apply lever to expand park brake shoe toward the friction surface of the drum-in-hat portion of the rear brake rotor.

Threaded park brake actuators are also used to control clearance between the park brake shoe and the friction surface of the drum-in-hat portion of the rear brake rotor.

### **Park Brake Shoe**

Applies mechanical output force from park brake actuator to friction surface of the drum-in-hat portion of the rear brake rotor.

## **System Operation**

Park brake apply input force is received by the park brake pedal assembly being depressed, 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 expand the park brake shoe toward the friction surface of the drum-in-hat portion of the rear brake rotor in order to prevent the rotation of the rear tire and wheel assemblies. The park brake release handle assembly releases an applied park brake system when it is pulled reward.

## **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 Component Description**

#### **Balance Shaft**

The cast iron balance shaft is mounted in the crankcase above and in-line with the camshaft. A camshaft gear drives the gear attached to the balance shaft. The front end of the balance shaft is supported by a ball-type bearing. The rear end of the balance shaft uses a sleeve-type bearing.

#### **Camshaft**

The steel camshaft is supported by four bearings pressed into the engine block. The camshaft timing chain sprocket mounted to the front of the camshaft is driven by the crankshaft sprocket through a camshaft timing chain.

#### **Crankshaft**

The cast nodular iron crankshaft is supported by four crankshaft bearings. The number four crankshaft bearing at the rear of the engine is the end thrust bearing. The crankshaft bearings are retained by bearing caps that are machined with the engine block for proper alignment and clearances. The crankshaft position sensor reluctor ring has three lugs used for crankshaft timing and is constructed of powdered metal. The crankshaft position sensor reluctor ring has a slight interference fit onto the crankshaft and an internal keyway for correct positioning.

#### **Cylinder Heads**

The cast iron cylinder heads have one intake and one exhaust valve for each cylinder. A spark plug is located between the valves in the side of the cylinder head. The valve guides and seats are integral to the cylinder head. The 4.3L heavy duty applications have pressed in exhaust valve seats. The valve rocker arms are positioned on the valve rocker arm supports and retained by a bolt.

#### **Engine Block**

The cast iron engine block has six cylinders arranged in a V shape with three cylinders in each bank. Starting at the front side of the engine block, the cylinders in the left bank are numbered 1-3-5 and cylinders in the right bank are numbered 2-4-6 (when viewed from the rear). The firing order of the cylinders is 1-6-5-4-3-2. The cylinders are encircled by coolant jackets.

#### **Exhaust Manifolds**

The cast iron exhaust manifolds direct exhaust gases from the combustion chambers to the exhaust system. The left side exhaust manifold has a port for the EGR valve inlet pipe.

#### **Intake Manifold**

The intake manifold is a two-piece design. The upper portion is made from a composite material and the lower portion is cast aluminum. The throttle body attaches to the upper manifold. The lower manifold has an exhaust gas recirculation (EGR) port cast into the manifold for mixture. The (EGR) valve bolts into the lower intake manifold. The Central Sequential Multiport Fuel Injection system uses multiple fuel injectors to meter and distribute fuel to each engine cylinder. The Central (SFI) is retained by a bracket bolted to the lower intake manifold. The fuel meter body also houses the pressure regulator. Metal inlet and outlet fuel lines and nylon delivery tubes connect to the Central (SFI) unit. The delivery tubes independently distribute fuel to each cylinder through nozzles located at the port entrance of each manifold runner where the fuel is atomized.

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

The cast aluminum pistons use two compression rings and one oil control assembly. The piston is a low friction, lightweight design with a flat top and barrel shaped skirt. The piston pins are offset 0.9 mm (0.0354 in) toward the major thrust side (right side) to reduce piston slap as the connecting rod travels from one side of the piston to the other side after a stroke. The piston pins have a floating fit in the piston

and are retained by a press fit in the connecting rod. The connecting rods are forged steel. The connecting rods are machined with the rod cap installed for proper clearances and alignments.

### Valve Train

Motion is transmitted from the camshaft through the hydraulic roller valve lifters and the tubular valve pushrods to the roller type valve rocker arms. The roller type valve rocker arm pivots on a needle type bearing in order to open the valve. The valve rocker arms for each bank of cylinders are mounted to a one piece valve rocker arm support. Each valve rocker arm is retained on the valve rocker arm support and the cylinder head by a bolt. The hydraulic valve lifters keep all the parts of the valve train in constant contact. Each hydraulic valve lifter acts as an automatic adjuster and maintains zero lash in the valve train. This eliminates the need for periodic valve adjustment.

### Engine Mechanical – 4.3L – Specifications

Application	Specification	
	Metric	English
<b>General</b>		
• Engine Type	90 degree V6	
• Displacement	4.3 L	262 CID
• RPO	LU3	
• VIN	X	
• Bore	101.60 mm	4.012 in
• Stroke	88.39 mm	3.480 in
• Compression Ratio	9.2:1	
• Firing Order	1-6-5-4-3-2	
• Spark Plug Gap	1.52 mm	0.060 in
<b>Balance Shaft</b>		
• Bearing Journal Diameter - Rear	38.085-38.100 mm	1.4994-1.500 in
• Bushing Bore Diameter - Rear	0.050-0.088 mm	0.0020-0.0035 in
<b>Block</b>		
• Crankshaft Main Bearing Bore Out-of-Round	0.050 mm	0.002 in
• Cylinder Bore Diameter	101.618-101.643 mm	4.0007-4.0017 in
• Cylinder Bore Out-of-Round - Production	0.017 mm	0.0007 in
• Cylinder Bore Out-of-Round - Service	0.05 mm	0.002 in
• Cylinder Bore Taper - Production Relief Side	0.025 mm	0.0010 in
• Cylinder Bore Taper - Production Thrust Side	0.012 mm	0.0005 in
• Cylinder Bore Taper - Service	0.025 mm	0.0010 in
• Cylinder Head Deck Surface Flatness	0.050-0.152 mm	0.002-0.006 in
<b>Camshaft</b>		
• Camshaft End Play	0.0254-0.2286 mm	0.0010-0.0090 in
• Camshaft Journal Diameter	47.440-47.490 mm	1.8677-1.8696 in
• Camshaft Journal Out-of-Round	0.025 mm	0.001 in
• Camshaft Lobe Lift - Exhaust	7.20-7.30 mm	0.283-0.287 in
• Camshaft Lobe Lift - Intake	6.97-7.07 mm	0.274-0.278 in
• Camshaft Runout	0.065 mm	0.0026 in
<b>Connecting Rod</b>		
• Connecting Rod Bearing Clearance - Production	0.038-0.078 mm	0.0015-0.0031 in
• Connecting Rod Bearing Clearance - Service	0.025-0.063 mm	0.0010-0.0025 in
• Connecting Rod Side Clearance	0.15-0.44 mm	0.006-0.017 in

<b>Crankshaft</b>		
• Connecting Rod Journal Diameter	57.116-57.148 mm	2.2487-2.2497 in
• Connecting Rod Journal Out-of-Round - Production	0.008 mm	0.0003 in
• Connecting Rod Journal Out-of-Round - Service	0.025 mm	0.0010 in
• Connecting Rod Journal Taper - Production	0.010 mm	0.0004 in
• Connecting Rod Journal Taper - Service	0.025 mm	0.0010 in
• Crankshaft End Play	0.050-0.20 mm	0.002-0.008 in
• Crankshaft Main Bearing Clearance #1 - Production	0.02-0.05 mm	0.0008-0.0020 in
• Crankshaft Main Bearing Clearance #2, #3, and #4 - Production	0.028-0.058 mm	0.0011-0.0023 in
• Crankshaft Main Bearing Clearance #1 - Service	0.0254-0.05 mm	0.0010-0.0020 in
• Crankshaft Main Bearing Clearance #2, #3, and #4 - Service	0.025-0.063 mm	0.0010-0.0025 in
• Crankshaft Main Journal Diameter #1	62.199-62.217 mm	2.4488-2.4495 in
• Crankshaft Main Journal Diameter #2 and #3	62.191-62.215 mm	2.4485-2.4494 in
• Crankshaft Main Journal Diameter #4	62.179-62.203 mm	2.4480-2.4489 in
• Crankshaft Main Journal Out-of-Round - Production	0.005 mm	0.0002 in
• Crankshaft Main Journal Out-of-Round - Service	0.025 mm	0.0010 in
• Crankshaft Main Journal Taper	0.007 mm	0.0003 in
<b>Exhaust Manifold</b>		
• Surface Flatness - Flange to Flange	0.25 mm	0.010 in
• Surface Flatness - Individual Flange	0.05 mm	0.002 in
<b>Intake Manifold</b>		
• Surface Flatness	0.10 mm	0.004 in
<b>Lubrication System</b>		
• Oil Capacity for C/K, G/H with Filter	4.3 L	4.5 qt
• Oil Capacity for C/K, G/H without Filter	3.8 L	4 qt
• Oil Capacity for S/T, M/L with Filter	4.7 L	5 qt
• Oil Capacity for S/T, M/L without Filter	4.3 L	4.5 qt
• Oil Pressure - at 1,000 RPM	42 kPa	6 psi
• Oil Pressure - at 2,000 RPM	125 kPa	18 psi
• Oil Pressure - at 4,000 RPM	166 kPa	24 psi
<b>Piston Rings</b>		
• Piston Ring End Gap - First Compression Ring - Production	0.25-0.40 mm	0.010-0.016 in
• Piston Ring End Gap - Second Compression Ring - Production	0.38-0.58 mm	0.015-0.023 in
• Piston Ring End Gap - Oil Control Ring - Production	0.25-0.76 mm	0.010-0.029 in
• Piston Ring End Gap - First Compression Ring - Service	0.25-0.50 mm	0.010-0.020 in
• Piston Ring End Gap - Second Compression Ring - Service	0.38-0.80 mm	0.015-0.031 in
• Piston Ring End Gap - Oil Control Ring - Service	0.005-0.090 mm	0.0002-0.0035 in
• Piston Ring to Groove Clearance - First Compression Ring - Production	0.030-0.070 mm	0.0012-0.0027 in
• Piston Ring to Groove Clearance - Second Compression Ring - Production	0.076-0.280 mm	0.0030-0.0110 in
• Piston Ring to Groove Clearance - Oil Control Ring - Production	0.046-0.196 mm	0.0018-0.0077 in

• Piston Ring to Groove Clearance - First Compression Ring - Service	0.030-0.085 mm	0.0012-0.0033 in
• Piston Ring to Groove Clearance - Second Compression Ring - Service	0.030-0.085 mm	0.0012-0.0033 in
• Piston Ring to Groove Clearance - Oil Control Ring - Service	0.076-0.200 mm	0.0030-0.0079 in
<b>Pistons and Pins</b>		
• Piston - Piston to Bore Clearance - Production	0.018-0.061 mm	0.0007-0.0024 in
• Piston - Piston to Bore Clearance - Service	0.075 mm	0.0029 in
• Pin - Piston Pin Clearance to Connecting Rod Bore - Press Fit	0.012-0.048 mm	0.0005-0.0019 in
• Pin - Piston Pin Clearance to Piston Pin Bore - Production	0.013-0.023 mm	0.0005-0.0009 in
• Pin - Piston Pin Clearance to Piston Pin Bore - Service	0.025 mm	0.0010 in
• Pin - Piston Pin Diameter	23.545-23.548 mm	0.9270-0.9271 in
<b>Valve System</b>		
• Valves - Valve Face Angle	45 degrees	
• Valves - Valve Seat Angle	46 degrees	
• Valves - Valve Seat Runout	0.05 mm	0.002 in
• Valves - Valve Seat Width - Intake	1.016-1.651 mm	0.040-0.065 in
• Valves - Valve Seat Width - Exhaust	1.651-2.489 mm	0.065-0.098 in
• Valves - Valve Stem Oil Seal Installed Height	1-2 mm	0.03937-0.07874 in
• Valves - Valve Stem-to-Guide Clearance - Intake - Production	0.025-0.069 mm	0.0010-0.0027 in
• Valves - Valve Stem-to-Guide Clearance - Intake - Service	0.025-0.094 mm	0.0010-0.0037 in
• Valves - Valve Stem-to-Guide Clearance - Exhaust - Production	0.025-0.069 mm	0.0010-0.0027 in
• Valves - Valve Stem-to-Guide Clearance - Exhaust - Service	0.025-0.094 mm	0.0010-0.0037 in
• Rocker Arms - Valve Rocker Arm Ratio	1.5:1	
• Valve Springs - Valve Spring Free Length	51.3 mm	2.02 in
• Valve Springs - Valve Spring Installed Height - Intake	42.92-43.43 mm	1.670-1.700 in
• Valve Springs - Valve Spring Installed Height - Exhaust	42.92-43.43 mm	1.670-1.700 in
• Valve Springs - Valve Spring Load - Closed	338-374 N @ 43.2 mm	76-84 lb @ 1.70 in
• Valve Springs - Valve Spring Load - Open	832-903 N @ 32.3 mm	187-203 lb @ 1.27 in

**Fastener Tightening Specifications**

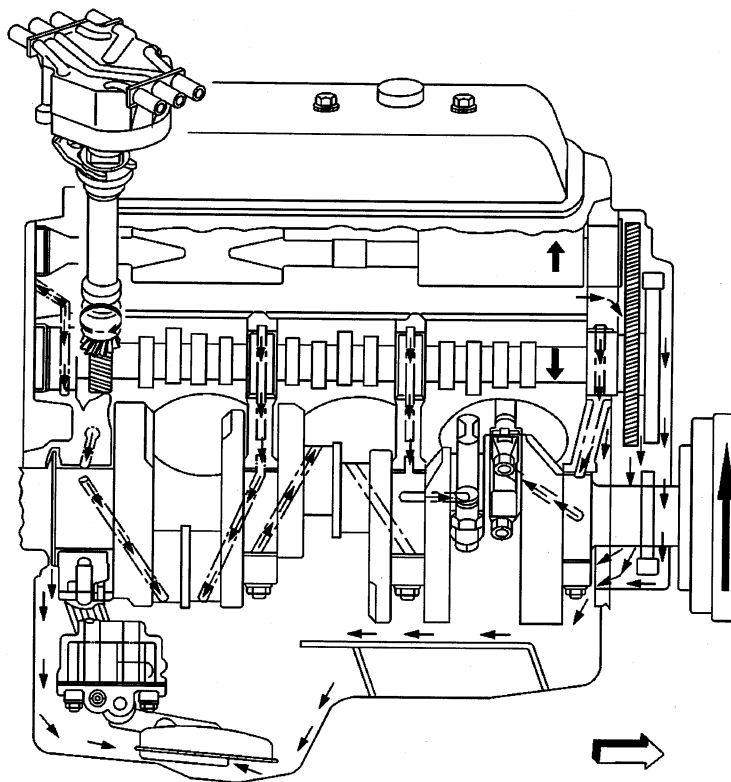
Application	Specification	
	Metric	English
Accelerator Control Cable Bracket Nut	12 N·m	106 lb in
Accelerator Control Cable Bracket Stud to Intake Manifold	6 N·m	53 lb in
Accelerator Control Cable Bracket Stud to Throttle Body	12 N·m	106 lb in
Air Cleaner Adapter Stud	10 N·m	89 lb in
Air Conditioning (A/C) Compressor Side Brace Bolt	25 N·m	18 lb ft
Air Conditioning (A/C) Hose Bracket Nut to Intake Manifold	5 N·m	44 lb in
Air Conditioning (A/C) Pipe Bracket Nut to Rear of Left Cylinder Head	35 N·m	26 lb ft

Balance Shaft Driven Gear Bolt		
• First Pass	20 N·m	15 lb ft
• Final Pass	35 degrees	
Balance Shaft Retainer Bolt	12 N·m	106 lb in
Belt Idler Pulley Bolt	50 N·m	37 lb ft
Body Bolt		
• First Pass in Sequence - All Bolts	35 N·m	26 lb ft
• Final Pass in Sequence - Center Bolts	155 N·m	114 lb ft
• Final Pass in Sequence - Front and Rear Bolts	90 N·m	66 lb ft
Camshaft Retainer Bolt	12 N·m	106 lb in
Camshaft Sprocket Bolt	25 N·m	18 lb ft
Connecting Rod Nut		
• First Pass	27 N·m	20 lb ft
• Final Pass	70 degrees	
Crankshaft Balancer Bolt	95 N·m	70 lb ft
Crankshaft Bearing Cap Bolt - Preferred Method		
• First Pass	20 N·m	15 lb ft
• Final Pass	73 degrees	
Crankshaft Bearing Cap Bolt - Optional Strategy	105 N·m	77 lb ft
Crankshaft Position Sensor Bolt	8 N·m	71 lb in
Crankshaft Pulley Bolt	58 N·m	43 lb ft
Crankshaft Rear Oil Seal Housing Bolt and Nut	12 N·m	106 lb in
Crankshaft Rear Oil Seal Housing Retainer Stud	6 N·m	53 lb in
Cylinder Head Bolt - Preferred Method		
• All Bolts First Pass in Sequence	30 N·m	22 lb ft
• Long Bolts Final Pass in Sequence	75 degrees	
• Medium Bolts Final Pass in Sequence	65 degrees	
• Short Bolts Final Pass in Sequence	55 degrees	
Cylinder Head Bolt - Optional On-Vehicle Strategy		
• First Pass in Sequence	35 N·m	26 lb ft
• Second Pass in Sequence	60 N·m	44 lb ft
• Final Pass in Sequence	90 N·m	66 lb ft
Cylinder Head Core Hole Plug	20 N·m	15 lb ft
Distributor Cap Bolt	2.4 N·m	21 lb in
Distributor Clamp Bolt	25 N·m	18 lb ft
Drive Belt Tensioner Bolt	50 N·m	37 lb ft
Engine Block Coolant Drain Hole Plug	20 N·m	15 lb ft
Engine Block Left Rear Oil Gallery Plug	30 N·m	22 lb ft
Engine Block Left Side Oil Gallery Plug	20 N·m	15 lb ft
Engine Block Oil Gallery Plug	20 N·m	15 lb ft
Engine Block Right Rear Oil Gallery Plug	20 N·m	15 lb ft
Engine Coolant Heater Bolt/Screw	2 N·m	18 lb in
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
Engine Flywheel Bolt	100 N·m	74 lb ft
Engine Front Cover Bolt	12 N·m	106 lb in
Engine Lift Bracket Bolt for J 41427	15 N·m	11 lb ft
Engine Lift Front Bracket Stud	35 N·m	26 lb ft
Engine Mount Bolt to Frame (AWD)	59 N·m	44 lb ft
Engine Mount Bolt to Frame (RWD)	47 N·m	35 lb ft
Engine Mount Bracket Bolt to Engine	64 N·m	47 lb ft
Engine Mount Bracket to Frame Bolt (RWD)	47 N·m	35 lb ft
Engine Mount Bracket to Frame Nut (RWD)	42 N·m	31 lb ft
Engine Mount Frame Bracket Through-bolt	80 N·m	59 lb ft

Engine Mount Frame Bracket Through-bolt Nut	68 N·m	50 lb ft
Engine Mount Nut to Frame (RWD)	42 N·m	31 lb ft
Engine Oil Pressure Gage Sensor	30 N·m	22 lb ft
Engine Oil Pressure Gage Sensor Fitting - Plus Required Angle	15 N·m	11 lb ft
Engine Wiring Harness Bracket Bolt to Generator and Drive Belt Tensioner Bracket	25 N·m	18 lb ft
Engine Wiring Harness Bracket Nut to Evaporative Emission (EVAP) Canister Purge Solenoid Valve	8 N·m	71 lb in
Engine Wiring Harness Bracket Nut to Intake Manifold	12 N·m	106 lb in
Engine Wiring Harness Retainer Bolt to Rear of Right Cylinder Head	36 N·m	27 lb ft
Evaporative Emission (EVAP) Canister Purge Solenoid Valve Nut to Intake Manifold	10 N·m	89 lb in
Exhaust Manifold Bolt/Stud		
• First Pass	15 N·m	11 lb ft
• Final Pass	30 N·m	22 lb ft
Fan and Water Pump Pulley Bolt	25 N·m	18 lb ft
Fuel Meter Body Bracket Bolt	10 N·m	89 lb in
Fuel Pipe Bracket Bolt	6 N·m	53 lb in
Fuel Pipe Bracket Stud to Rear of Cylinder Head	33 N·m	24 lb ft
Fuel Pipe Retainer Nut	3 N·m	27 lb in
Fuel Supply Pipe Nut - Fuel Tank Side	30 N·m	22 lb ft
Generator and Drive Belt Tensioner Bracket Bolt to Engine	41 N·m	30 lb ft
Generator and Drive Belt Tensioner Bracket Stud Nut	41 N·m	30 lb ft
Generator and Drive Belt Tensioner Bracket Stud to Engine	20 N·m	15 lb ft
Ground Wire Bolt to Rear of Cylinder Head	35 N·m	26 lb ft
Ground Wire Nut to Water Outlet Stud	19 N·m	14 lb ft
Ignition Coil Stud	12 N·m	106 lb in
Knock Sensor	25 N·m	18 lb ft
Lower Intake Manifold Bolt		
• First Pass in Sequence	3 N·m	27 lb in
• Second Pass in Sequence	12 N·m	106 lb in
• Final Pass in Sequence	15 N·m	11 lb ft
Negative Battery Cable Stud	40 N·m	30 lb ft
Oil Cooler Pipe Bracket Bolt to Oil Pan	10 N·m	89 lb in
Oil Fill Tube Bolt	25 N·m	18 lb ft
Oil Filter	30 N·m	22 lb ft
Oil Filter Adapter Bolt	21 N·m	15 lb ft
Oil Filter Fitting	55 N·m	41 lb ft
Oil Level Indicator Tube Bolt	12 N·m	106 lb in
Oil Level Indicator Tube Bolt to Transmission Fluid Fill Tube	12 N·m	106 lb in
Oil Pan Baffle Bolt	12 N·m	106 lb in
Oil Pan Bolt and Nut	25 N·m	18 lb ft
Oil Pan Drain Plug	25 N·m	18 lb ft
Oil Pump Bolt to Rear Crankshaft Bearing Cap	90 N·m	66 lb ft
Oil Pump Cover Bolt	12 N·m	106 lb in
Park Brake Bracket Bolt to Frame	24 N·m	18 lb ft
Power Steering Pump Bolt	50 N·m	37 lb ft
Power Steering Pump Bracket Bolt to Engine	41 N·m	30 lb ft
Power Steering Pump Bracket Stud Nut	41 N·m	30 lb ft
Power Steering Pump Bracket Stud to Engine	20 N·m	15 lb ft
Power Steering Pump Rear Bracket Nut to Engine	41 N·m	30 lb ft
Power Steering Pump Rear Bracket Nut to Power Steering Pump	41 N·m	30 lb ft

<b>Spark Plug</b>		
• Initial Installation - NEW Cylinder Head	30 N·m	22 lb ft
• All Subsequent Installations	15 N·m	11 lb ft
<b>Spark Plug Wire Support Bolt</b>	12 N·m	106 lb in
<b>Starter Motor Wiring Harness/Transmission Cooler Pipe Bracket Bolt to Oil Pan</b>	10 N·m	89 lb in
<b>Throttle Body Stud</b>	9 N·m	80 lb in
<b>Timing Chain Tensioner Bolt</b>	12 N·m	106 lb in
<b>Transmission Bolt to Oil Pan</b>	47 N·m	35 lb ft
<b>Transmission Cover Bolt</b>	12 N·m	106 lb in
<b>Transmission Fluid Fill Tube Bolt to Accelerator Control Cable Bracket</b>	6 N·m	53 lb in
<b>Upper Intake Manifold Stud</b>		
• First Pass	5 N·m	44 lb in
• Final Pass	9 N·m	80 lb in
<b>Upper Radiator Hose Support Bracket Nut to Exhaust Manifold Stud</b>	36 N·m	27 lb ft
<b>Valve Lifter Pushrod Guide Bolt</b>	16 N·m	12 lb ft
<b>Valve Rocker Arm Bolt</b>	30 N·m	22 lb ft
<b>Water Outlet Stud</b>	25 N·m	18 lb ft
<b>Water Pump Bolt</b>	45 N·m	33 lb ft

### Lubrication System Description



Full pressure lubrication, through a full-flow oil filter is supplied by a gear-type oil pump. Oil is drawn up through the oil pump screen and passes through the pump to the oil filter. The oil filter is a full-flow paper element unit with an anti-drain back valve. An oil filter bypass valve is used to ensure adequate oil supply, in the event the filter becomes plugged or develops excessive pressure drop. Filtered oil flows into the



main gallery and then to the camshaft, the balance shaft, the rear bearing, and the crankshaft bearings. The valve lifter oil gallery supplies oil to the valve lifters. Oil flows from the valve lifters through the hollow valve pushrods to the valve rocker arms. Oil drains back to the crankcase through the oil drain holes in the cylinder head. The camshaft timing chain is drip fed from the front camshaft bearing. The pistons and piston pins are lubricated by oil splash.

## Drive Belt System Description

The drive belt system consists of the following components:

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

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

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

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

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

## Engine Cooling

### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Coolant Outlet Bolt/Stud	25 N·m	18 lb ft
Coolant Pump Pulley to Water Pump Bolts	25 N·m	18 lb ft
Coolant Pump to Engine Block Bolts	45 N·m	33 lb ft
Cooling Fan Blade to Fan Clutch Bolts	33 N·m	24 lb ft
Cooling Fan Clutch to Water Pump Bolts	56 N·m	41 lb ft
Drive Belt Tensioner Bolt	50 N·m	37 lb ft
Engine Oil Cooler Line Clip Bolt	10 N·m	89 lb in
Engine Oil Cooler Lines to Oil Filter Adapter Assembly Bolt	35 N·m	26 lb ft
Upper Fan Shroud Bolts	15 N·m	11 lb ft

## **Cooling System Description and Operation**

### **Coolant Heater**

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

### **Cooling System**

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

### **Cooling Cycle**

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

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

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

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

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

### **Coolant**

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

### **Radiator**

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

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

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

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

### **Pressure Cap**

The pressure cap seals the cooling system. It contains a blow off or pressure valve and a vacuum or atmospheric valve. The pressure valve is held against its seat by a spring, which protects the radiator from excessive cooling system pressure. The vacuum valve is held against its seat by a spring, which

permits opening of the valve to relieve vacuum created in the cooling system as it cools off. The vacuum, if not relieved, might cause the radiator and/or coolant hoses to collapse.

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

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

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

### **Coolant Recovery System**

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

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

### **Air Baffles and Seals**

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

### **Water Pump**

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

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

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

### **Thermostat**

The thermostat is a coolant flow control component. It's purpose is to help regulate the operating temperature of the engine. It utilizes a temperature sensitive wax-pellet element. The element connects to a valve through a small piston. When the element is heated, it expands and exerts pressure against the

small piston. This pressure forces the valve to open. As the element is cooled, it contracts. This contraction allows a spring to push the valve closed.

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

### **Engine Oil Cooler**

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

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

### **Transmission Oil Cooler**

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

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

## Engine Electrical

### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Battery Negative Cable to Engine Stud	40 N·m	29 lb ft
Battery Negative Cable Terminal Bolt	15 N·m	11 lb ft
Battery Positive Cable Terminal Bolt	15 N·m	11 lb ft
Battery Positive Cable to Starter Motor Nut	9 N·m	80 lb in
Battery Positive Cable to Underhood Electrical Center Nut	9 N·m	80 lb in
Battery Retainer Hold Down Bolt	23 N·m	17 lb ft
Battery Tray Bolts	25 N·m	18 lb ft
Distributor Cap Screws	5 N·m	40 lb in
Distributor Hold Down Bolt	27 N·m	20 lb ft
Distributor Rotor Screws	2 N·m	20 lb in
Engine Harness to Battery Negative Cable Nut	25 N·m	18 lb ft
Generator Mounting Bolts	50 N·m	37 lb ft
Generator Output (BAT) Terminal Nut	18 N·m	13 lb ft
Generator Pulley Nut	100 N·m	74 lb ft
Ground Lead to Radiator Support Stud	45 N·m	33 lb ft
Ignition Coil Hold Down Stud	11 N·m	97 lb in
Spark Plugs (New Head)	30 N·m	22 lb ft
Spark Plugs (Used Head)	15 N·m	11 lb ft
Starter Enable Relay Cable Nut	2 N·m	18 lb in
Starter Motor Mounting Bolts	43 N·m	32 lb ft
Underhood Electrical Center Mounting Bolts	8 N·m	60 lb in

### Battery Usage

Standard	
Cold Cranking Amperage (CCA)	600 A
Reserve Capacity Rating	115 Minutes
Replacement Battery Number	78-6YR
Optional	
Cold Cranking Amperage (CCA)	770 A
Reserve Capacity	115 Minutes
Replacement Model Number	78-7YR

### Battery Temperature vs Minimum Voltage

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

### Starter Motor Usage

Applications	Starter Type
4.3I (LU3)	PG-260G

## Generator Usage

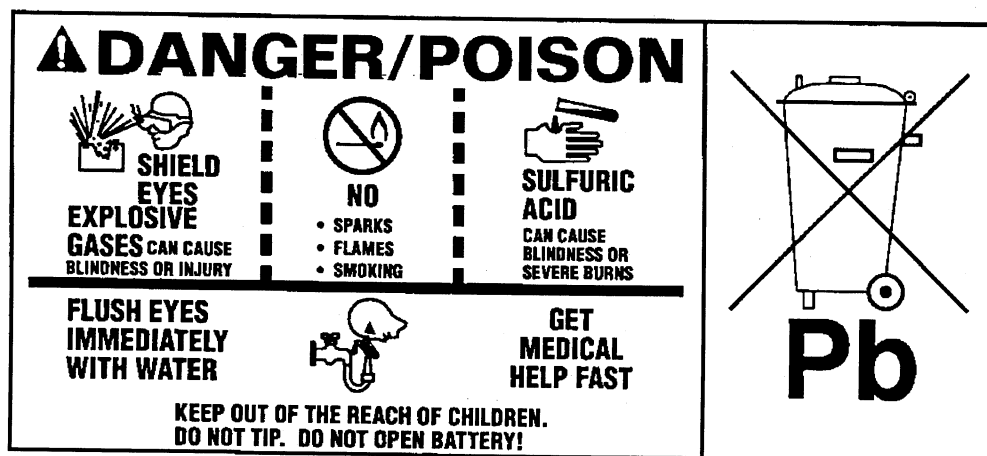
Standard	
Generator Model	AD230
Rated Output	105 A
Load Test Output	73 A

## Battery Description and Operation

### Caution

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

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



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

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

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

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

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

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

A battery has 2 ratings:

- Reserve capacity
- Cold cranking amperage

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

### **Reserve Capacity**

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

### **Cold Cranking Amperage**

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

### **Circuit Description**

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

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

## **Starting System Description and Operation**

### **Cranking Circuit**

The cranking circuit consists of the battery, the starter motor, the ignition switch, and related electrical wiring. There is a fusible link in the wire running from the starter solenoid to the generator. For more information on the cranking circuit, refer to Cranking System Operation.

### **Starter Motor**

The PG-260G is a non-repairable starter motor. It has pole pieces that are arranged around the armature within the starter housing. When the solenoid windings are energized, the pull-in winding circuit is

completed to ground through the starter motor. The hold-in winding circuit is completed to ground through the solenoid. The windings work together magnetically to pull in and hold in the plunger. The plunger moves the shift lever. This action causes the starter drive assembly to rotate on the armature shaft spline as it engages with the flywheel ring gear on the engine. At the same time, the plunger closes the solenoid switch contacts in the starter solenoid. Full battery voltage is then applied directly to the starter motor and it cranks the engine.

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

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

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

## **Charging System Description and Operation**

### **Generator**

The AD-230 generator is non-repairable. They are electrically similar to earlier models. 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
- A voltage regulator

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

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

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

### **Regulator**

The voltage regulator controls the 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 – 4.3L

#### Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-6-5-4-3-2	
Spark Plug Wire Resistance	1,000 ohms per ft	
Spark Plug Torque	15 N·m	11 lb ft
Spark Plug Gap	1.52 mm	0.060 in
Spark Plug Type	R41-932 [AC plug type]	

#### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accelerator Cable Bracket Bolt	25 N·m	18 lb ft
Accelerator Cable Bracket Nut	30 N·m	22 lb ft
Accelerator Control Cable Bracket Fastener	12 N·m	106 lb in
Accelerator Pedal Assembly Bolts	5 N·m	44 lb in
Air Cleaner Outlet Duct Clamp	4 N·m	35 lb in
Air Cleaner Outlet Duct Nut	2 N·m	18 lb in
Air Cleaner Outlet Resonator Adapter Stud	8 N·m	71 lb in
Camshaft Position (CMP) Mounting Screws	2.2 N·m	19 lb in
Camshaft Position (CMP) Sensor Screws	2.2 N·m	19 lb in
Crankshaft Position (CKP) Sensor Mounting Bolt	9 N·m	80 lb in
Coolant Hose Nipple	17 N·m	13 lb ft
Distributor Cap Screws	2.4 N·m	21 lb in
Distributor Mounting Clamp Bolt	25 N·m	18 lb ft
Distributor Rotor Retaining Screws	1.9 N·m	17 lb in
Engine Compartment Rear Fuel Pipe Bracket Bolt	6 N·m	53 lb in
Engine Coolant Temperature (ECT) Sensor	20 N·m	15 lb ft
Engine Wiring Harness Bracket Nut to EVAP Canister Purge Valve Stud	8 N·m	71 lb in
EVAP Canister Purge Valve Mounting Nuts	12 N·m	106 lb in
EVAP Canister Vent Valve Bracket Bolt	10 N·m	89 lb in
Fuel Feed Pipe Fittings to Fuel Filter	27 N·m	20 lb ft
Fuel Fill Hose Clamp	3 N·m	27 lb in
Fuel Filter Mounting Clamp Bolt	11 N·m	97 lb in
Fuel Filler Tube Attaching Screw	11.5 N·m	102 lb in
Fuel Filler Tube to Fuel Filler Pocket Screws	1.9 N·m	17 lb in
Fuel Pipes to Cross Rail Retainer Bolt	11 N·m	97 lb in
Fuel Pipes to Cylinder Head Retainer Stud	33 N·m	24 lb ft
Fuel Pipes to Fuel Meter Body Retaining Nuts	3 N·m	27 lb in
Fuel Pipes to Transmission Retainer Stud	33 N·m	24 lb ft
Fuel Feed and Return Pipe Fittings	30 N·m	22 lb ft
Fuel Return Pipe to Coupler Fitting	27 N·m	20 lb ft
Fuel Tank Strap Bolts	35 N·m	26 lb ft
Heated Oxygen Sensor (HO2S)	42 N·m	31 lb ft
Idle Air Control Valve Attaching Screws	3 N·m	27 lb in
Ignition Coil Bracket Stud	11 N·m	97 lb in
Ignition Coil Mounting Screws	11 N·m	97 lb in
Ignition Module Mounting Screws	3.5 N·m	31 lb in
Injector Retainer Lock Nuts	3 N·m	27 lb in

Knock Sensor (KS) Bolt	25 N·m	18 lb ft
Mass Air Flow/Intake Air Sensor Hose Clamp	4 N·m	35 lb in
Power Brake Fitting	13 N·m	115 lb in
Powertrain Control Module (PCM) Connectors	8 N·m	71 lb in
Spark Plug-New Aluminum Head	20 N·m	15 lb ft
Spark Plug-New Iron Head	30 N·m	22 lb ft
Spark Plug-Used Head	15 N·m	11 lb ft
Steering Linkage Shield Mounting Bolt	33 N·m	24 lb ft
Throttle Body Retaining Studs	9 N·m	80 lb in
Throttle Cable Bracket Bolts	25 N·m	18 lb ft
TP Sensor Bolts	2 N·m	18 lb in
Vacuum Module Attaching Bolts	8 N·m	71 lb in

### Fuel System Specifications

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

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

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

### Notice

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

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

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

## Exhaust System

### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Catalytic Converter-to-Muffler Nuts	40 N·m	30 lb ft
Exhaust Pipe-to-Manifold Nuts	53 N·m	39 lb ft
Exhaust Pipe-to-Manifold Studs	15 N·m	11 lb ft
Hanger-to-Frame Nuts	45 N·m	33 lb ft
Hanger-to-Transfer Case Bolts (A4WD)	55 N·m	41 lb ft
Hanger-to-Transmission Bolts (RWD)	45 N·m	33 lb ft
Muffler Hanger-to-Frame Bolts	25 N·m	18 lb ft

### Exhaust System Description

#### Important

Use of non-OEM parts may cause driveability concerns.

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

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

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

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

#### Resonator

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

#### Catalytic Converter

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

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

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

The catalyst in the converter is not serviceable.

#### Muffler

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

## Transmission/Transaxle Description and Operation

### Automatic Transmission – 4L60E

#### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Accumulator Cover to Case Bolt	8.0-14.0 N·m	6-10 lb ft
Case Extension to Case Bolt	42.0-48.0 N·m	31-35 lb ft
Case Extension to Case Bolt (4WD Shipping)	11.2-22.6 N·m	8.3-16.7 lb ft
Converter Cover Bolt	10 N·m	89 lb in
Converter Housing to Case Screw	65.0-75.0 N·m	48-55 lb ft
Cooler Pipe Connector	35.0-41.0 N·m	26-30 lb ft
Detent Spring to Valve Body Bolt	20.0-27.0 N·m	15-20 lb ft
Floorshift Control Bolt	10 N·m	89 lb in
Flywheel to Torque Converter Bolt	63 N·m	46 lb ft
Forward Accumulator Cover to Valve Body Bolt	8.0-14.0 N·m	6-10 lb ft
Heat Shield to Transmission Bolt	17 N·m	13 lb ft
Line Pressure Plug	8.0-14.0 N·m	6-10 lb ft
Manual Shaft to Inside Detent Lever Nut	27.0-34.0 N·m	20-25 lb ft
Negative Battery Cable Bolt	15 N·m	11 lb ft
Oil Level Indicator Bolt	47 N·m	35 lb ft
Oil Pan to Transmission Case Bolt	11 N·m	97 lb in
Oil Passage Cover to Case Bolt	8-14.0 N·m	6-10 lb ft
Park Brake Bracket to Case Bolt	27.0-34.0 N·m	20-25 lb ft
Park/Neutral Position Switch Screw	3 N·m	27 lb in
Plate to Case Bolt (Shipping)	27.0-34.0 N·m	20-25 lb ft
Plate to Converter Bolt (Shipping)	27.0-34.0 N·m	20-25 lb ft
Plug Assembly, Automatic Transmission Oil Pan (C/K)	30-40 N·m	22.1-29.5 lb ft
Plug Assembly, Automatic Transmission Oil Pan (Y)	28-32 N·m	20.7-23.6 lb ft
Pressure Control Solenoid Bracket to Valve Body Bolt	8.0-14.0 N·m	6-10 lb ft
Pump Assembly to Case Bolt	26.0-32.0 N·m	19-24 lb ft
Pump Cover to Pump Body Bolt	20.0-27.0 N·m	15-20 lb ft
Shift Cable Grommet Screw	1.7 N·m	15 lb in
Shift Control Cable Attachment	20 N·m	15 lb ft
Speed Sensor Retainer Bolt	10.5-13.5 N·m	7.7-10 lb ft
Stud, Automatic Transmission Case Extension (Y-car)	18.0-22.0 N·m	13-16 lb ft
TCC Solenoid Assembly to Case Bolt	8.0-14.0 N·m	6-10 lb ft
Trans Mount to Transmission Bolt	25 N·m	18 lb ft
Transmission Fluid Pressure Manual Valve Position Switch to Valve Body Bolt	8.0-14.0 N·m	6-10 lb ft
Transmission Oil Cooler Pipe Fitting	35.0-41.0 N·m	26-30 lb ft
Transmission Oil Pan to Case Bolt	9.5-13.8 N·m	7-10 lb ft
Transmission to Engine Bolt	47 N·m	35 lb ft
Valve Body to Case Bolt	8.0-14.0 N·m	6-10 lb ft

**Transmission General Specifications**

<b>Name</b>	<b>Hydra-matic 4L60-E</b>
<b>RPO Codes</b>	M30
<b>Production Location</b>	Toledo, Ohio Romulus, MI Ramos Arizpe, Mexico
<b>Vehicle Platform (Engine/Transmission) Usage</b>	M/L
<b>Transmission Drive</b>	Longitudinally-Mounted Rear Wheel Drive
<b>1st Gear Ratio</b>	3.059:1
<b>2nd Gear Ratio</b>	1.625:1
<b>3rd Gear Ratio</b>	1.000:1
<b>4th Gear Ratio</b>	0.696:1
<b>Reverse</b>	2.294:1
<b>Torque Converter Size (Diameter of Torque Converter Turbine)</b>	245 mm 258 mm 298 mm 300 mm
<b>Pressure Taps</b>	Line Pressure
<b>Transmission Fluid Type</b>	DEXRON® III
<b>Transmission Fluid Capacity (Approximate)</b>	245 mm Converter Dry: 8.3 l (8.8 qt) 258 mm Converter Dry: 8.8 l (9.3 qt) 298 mm Converter Dry: 11.25 l (11.9 qt) 300 mm Converter Dry: 11.50 l (12.1 qt)
<b>Transmission Type: 4</b>	Four Forward Gears
<b>Transmission Type: L</b>	Longitudinal Mount
<b>Transmission Type: 60</b>	Product Series
<b>Transmission Type: E</b>	Electronic Controls
<b>Position Quadrant</b>	P, R, N, Overdrive, D, 2, 1 P, R, N, Overdrive, 3, 2, 1
<b>Case Material</b>	Die Cast Aluminum
<b>Transmission Weight Dry (Approximate)</b>	245 mm Converter 65.4 kg (144.30 lb) 258 mm Converter 79.9 kg (176.6 lb) 298 mm Converter 70.5 kg (155.70 lb) 300 mm Converter 86.17 kg (190.5 lb)
<b>Transmission Weight Wet (Approximate)</b>	245 mm Converter 72.4 kg (159.55 lb) 258 mm Converter 89.2 kg (197.7 lb) 298 mm Converter 80.5 kg (176.16 lb) 300 mm Converter 98.4 kg (218.0 lb)
<b>Maximum Trailer Towing Capacity</b>	6 130 kg (13,500 lb)
<b>Maximum Gross Vehicle Weight (GVW)</b>	3 900 kg (8,600 lb)

## Fluid Capacity Specifications

Application	Specification	
	Metric	English
Bottom Pan Removal	4.7 liters	5 quarts
Complete Overhaul	10.6 liters	11 quarts
(measurements are approximate)		

## Transmission Component and System Description

The 4L60E transmission consists primarily of the following components:

- Torque converter assembly
- Servo assembly and 2-4 band assembly
- Reverse input clutch and housing
- Overrun clutch
- Forward clutch
- 3-4 clutch
- Forward sprag clutch assembly
- Lo and reverse roller clutch assembly
- Lo and reverse clutch assembly
- Two planetary gear sets: Input and Reaction
- Oil pump assembly
- Control valve body assembly

The electrical components of the 4L60-E are as follows:

- 1-2 and 2-3 shift solenoid valves
- 3-2 shift solenoid valve assembly
- Transmission pressure control (PC) solenoid
- Torque converter clutch (TCC) solenoid valve
- TCC pulse width modulation (PWM) solenoid valve
- Automatic transmission fluid pressure (TFP) manual valve position switch
- Automatic transmission fluid temperature (TFT) sensor
- Vehicle speed sensor assembly

## Adapt Function

### Transmission Adapt Function

The 4L60-E transmission uses a line pressure control system, which has the ability to continuously adapt the system's line pressure. This compensates for normal wear of the following parts:

- The clutch fiber plates
- The seals
- The springs

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

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

### **Automatic Transmission Shift Lock Control Description**

The automatic transmission shift lock control is a safety device that prevents an inadvertent shift out of PARK when the ignition is ON. 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. This allows current to flow through the switch to the automatic transmission shift lock control switch. The circuit continues through the normally-closed switch to the automatic transmission shift lock control solenoid. The automatic transmission shift lock control soleniod is permanently grounded. This energizes the automatic transmission shift lock control solenoid, locking the shift linkage in the PARK position. When the driver presses the brake pedal the contacts in the automatic transmission shift lock control switch open, causing the automatic transmission shift lock control solenoid to release. This allows the shift lever to move from the PARK position.





## Abbreviations and Meanings

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

BTDC	Before Top Dead Center
BTM	Battery Thermal Module
BTSI	Brake Transmission Shift Interlock
Btu	British Thermal Units
<b>C</b>	
°C	Degrees Celsius
CAC	Charge Air Cooler
CAFE	Corporate Average Fuel Economy
Cal	Calibration
Cam	Camshaft
CARB	California Air Resources Board
CC	Coast Clutch
cm <sup>3</sup>	Cubic Centimeters
CCM	Convenience Charge Module, Chassis Control Module
CCOT	Cycling Clutch Orifice Tube
CCP	Climate Control Panel
CD	Compact Disc
CE	Commutator End
CEAB	Cold Engine Air Bleed
CEMF	Counter Electromotive Force
CEX	Cabin Exchanger
cfm	Cubic Feet per Minute
cg	Center of Gravity
CID	Cubic Inch Displacement
CKP	Crankshaft Position
CKT	Circuit
C/Ltr	Cigar Lighter
CL	Closed Loop
CLS	Coolant Level Switch
CMC	Compressor Motor Controller
CMP	Camshaft Position
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
Coax	Coaxial
COMM	Communication
Conn	Connector
CPA	Connector Position Assurance
CPP	Clutch Pedal Position
CPS	Central Power Supply
CPU	Central Processing Unit
CRT	Cathode Ray Tube
CRTC	Cathode Ray Tube Controller
CS	Charging System
CSFI	Central Sequential Fuel Injection
CTP	Closed Throttle Position
cu ft	Cubic Foot/Feet
cu in	Cubic Inch/Inches
CV	Constant Velocity Joint
CVRSS	Continuously Variable Road Sensing Suspension

Cyl	Cylinder(s)
<b>D</b>	
DAB	Delayed Accessory Bus
dB	Decibels
dBA	Decibels on A-weighted Scale
DC	Direct Current, Duty Cycle
DCM	Door Control Module
DE	Drive End
DEC	Digital Electronic Controller
DERM	Diagnostic Energy Reserve Module
DI	Distributor Ignition
dia	Diameter
DIC	Driver Information Center
Diff	Differential
DIM	Dash Integration Module
DK	Dark
DLC	Data Link Connector
DMCM	Drive Motor Control Module
DMM	Digital Multimeter
DMSDS	Drive Motor Speed and Direction Sensor
DMU	Drive Motor Unit
DOHC	Dual Overhead Camshafts
DR, Drvr	Driver
DRL	Daytime Running Lamps
DTC	Diagnostic Trouble Code
<b>E</b>	
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
<b>F</b>	
°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
<b>G</b>	
g	Grams, Gravitational Acceleration
GA	Gage, Gauge
gal	Gallon
gas	Gasoline
GCW	Gross Combination Weight
Gen	Generator
GL	Gear Lubricant
GM	General Motors
GM SPO	General Motors Service Parts Operations
gnd	Ground
gpm	Gallons per Minute
GRN	Green
GRY	Gray
GVWR	Gross Vehicle Weight Rating

H	
H	Hydrogen
H <sub>2</sub> O	Water
Harn	Harness
HC	Hydrocarbons
H/CMPR	High Compression
HD	Heavy Duty
HDC	Heavy Duty Cooling
hex	Hexagon, Hexadecimal
Hg	Mercury
Hi Alt	High Altitude
HO <sub>2</sub> S	Heated Oxygen Sensor
hp	Horsepower
HPL	High Pressure Liquid
HPS	High Performance System
HPV	High Pressure Vapor
HPVS	Heat Pump Ventilation System
Htd	Heated
HTR	Heater
HUD	Head-up Display
HVAC	Heater-Ventilation-Air Conditioning
HVACM	Heater-Vent-Air Conditioning Module
HVIL	High Voltage Interlock Loop
HVM	Heater Vent Module
Hz	Hertz
I	
IAC	Idle Air Control
IAT	Intake Air Temperature
IC	Integrated Circuit, Ignition Control
ICCS	Integrated Chassis Control System
ICM	Ignition Control Module
ID	Identification, Inside Diameter
IDI	Integrated Direct Ignition
IGBT	Insulated Gate Bi-Polar Transistor
ign	Ignition
ILC	Idle Load Compensator
in	Inch/Inches
INJ	Injection
inst	Instantaneous, Instant
IP	Instrument Panel
IPC	Instrument Panel Cluster
IPM	Instrument Panel Module
I/PEC	Instrument Panel Electrical Center
ISC	Idle Speed Control
ISO	International Standards Organization
ISS	Input Speed Shaft, Input Shaft Speed
K	
KAM	Keep Alive Memory
KDD	Keyboard Display Driver
kg	Kilogram

kHz	Kilohertz
km	Kilometer
km/h	Kilometers per Hour
km/l	Kilometers per Liter
kPa	Kilopascals
KS	Knock Sensor
kV	Kilovolts
<b>L</b>	
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
<b>M</b>	
MAF	Mass Air Flow
Man	Manual
MAP	Manifold Absolute Pressure
MAT	Manifold Absolute Temperature
max	Maximum
M/C	Mixture Control
MDP	Manifold Differential Pressure
MFI	Multiport Fuel Injection
mi	Miles
MIL	Malfunction Indicator Lamp
min	Minimum
MIN	Mobile Identification Number
mL	Milliliter
mm	Millimeter
mpg	Miles per Gallon
mph	Miles per Hour
ms	Millisecond
MST	Manifold Surface Temperature
MSVA	Magnetic Steering Variable Assist, Magnasteer®
M/T	Manual Transmission/Transaxle
MV	Megavolt

mV	Millivolt
<b>N</b>	
NAES	North American Export Sales
NC	Normally Closed
NEG	Negative
Neu	Neutral
NI	Neutral Idle
NiMH	Nickel Metal Hydride
NLGI	National Lubricating Grease Institute
N·m	Newton-meter Torque
NO	Normally Open
NOx	Oxides of Nitrogen
NPTC	National Pipe Thread Coarse
NPTF	National Pipe Thread Fine
NOVRAM	Non-Volatile Random Access Memory
<b>O</b>	
O <sub>2</sub>	Oxygen
O <sub>2</sub> S	Oxygen Sensor
OBD	On-Board Diagnostics
OBD II	On-Board Diagnostics Second Generation
OC	Oxidation Converter Catalytic
OCS	Opportunity Charge Station
OD	Outside Diameter
ODM	Output Drive Module
ODO	Odometer
OE	Original Equipment
OEM	Original Equipment Manufacturer
OHC	Overhead Camshaft
ohms	Ohm
OL	Open Loop, Out of Limits
ORC	Oxidation Reduction Converter Catalytic
ORN	Orange
ORVR	On-Board Refueling Vapor Recovery
OSS	Output Shaft Speed
oz	Ounce(s)
<b>P</b>	
PAG	Polyalkylene Glycol
PAIR	Pulsed Secondary Air Injection
PASS, PSGR	Passenger
PASS-Key®	Personalized Automotive Security System
P/B	Power Brakes
PC	Pressure Control
PCB	Printed Circuit Board
PCM	Powertrain Control Module
PCS	Pressure Control Solenoid
PCV	Positive Crankcase Ventilation
PEB	Power Electronics Bay
PID	Parameter Identification
PIM	Power Inverter Module
PM	Permanent Magnet Generator

P/N	Part Number
PNK	Pink
PNP	Park/Neutral Position
PRNDL	Park, Reverse, Neutral, Drive, Low
POA	Pilot Operated Absolute Valve
POS	Positive, Position
POT	Potentiometer Variable Resistor
PPL	Purple
ppm	Parts per Million
PROM	Programmable Read Only Memory
P/S, PS	Power Steering
PSCM	Power Steering Control Module, Passenger Seat Control Module
PSD	Power Sliding Door
PSP	Power Steering Pressure
psi	Pounds per Square Inch
psia	Pounds per Square Inch Absolute
psig	Pounds per Square Inch Gauge
pt	Pint
PTC	Positive Temperature Coefficient
PWM	Pulse Width Modulated
<b>Q</b>	
QDM	Quad Driver Module
qt	Quart(s)
<b>R</b>	
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
<b>S</b>	
s	Second(s)
SAE	Society of Automotive Engineers
SC	Supercharger
SCB	Supercharger Bypass
SCM	Seat Control Module
SDM	Sensing and Diagnostic Module
SEO	Special Equipment Option
SFI	Sequential Multiport Fuel Injection
SI	System International Modern Version of Metric System
SIAB	Side Impact Air Bag
SIR	Supplemental Inflatable Restraint
SLA	Short/Long Arm Suspension
sol	Solenoid
SO <sub>2</sub>	Sulfur Dioxide
SP	Splice Pack
S/P	Series/Parallel
SPO	Service Parts Operations
SPS	Service Programming System, Speed Signal
sq ft, ft <sup>2</sup>	Square Foot/Feet
sq in, in <sup>2</sup>	Square Inch/Inches
SRC	Service Ride Control
SRI	Service Reminder Indicator
SRS	Supplemental Restraint System
SS	Shift Solenoid
ST	Scan Tool
STID	Station Identification Station ID
S4WD	Selectable Four-Wheel Drive
Sw	Switch
SWPS	Steering Wheel Position Sensor
syn	Synchronizer
<b>T</b>	
TAC	Throttle Actuator Control
Tach	Tachometer
TAP	Transmission Adaptive Pressure, Throttle Adaptive Pressure
TBI	Throttle Body Fuel Injection
TC	Turbocharger, Transmission Control
TCC	Torque Converter Clutch
TCS	Traction Control System
TDC	Top Dead Center
TEMP	Temperature
Term	Terminal
TFP	Transmission Fluid Pressure
TFT	Transmission Fluid Temperature
THM	Turbo Hydro-Matic
TIM	Tire Inflation Monitoring, Tire Inflation Module
TOC	Transmission Oil Cooler

TP	Throttle Position
TPA	Terminal Positive Assurance
TPM	Tire Pressure Monitoring, Tire Pressure Monitor
TR	Transmission Range
TRANS	Transmission/Transaxle
TT	Tell Tail Warning Lamp
TV	Throttle Valve
TVRS	Television and Radio Suppression
TVV	Thermal Vacuum Valve
TWC	Three Way Converter Catalytic
TWC+OC	Three Way + Oxidation Converter Catalytic
TXV	Thermal Expansion Valve
<b>U</b>	
UART	Universal Asynchronous Receiver Transmitter
U/H	Underhood
U/HEC	Underhood Electrical Center
U-joint	Universal Joint
UTD	Universal Theft Deterrent
UV	Ultraviolet
<b>V</b>	
V	Volt(s), Voltage
V6	Six-Cylinder Engine, V-Type
V8	Eight-Cylinder Engine, V-Type
Vac	Vacuum
VAC	Vehicle Access Code
VATS	Vehicle Anti-Theft System
VCIM	Vehicle Communication Interface Mode
VCM	Vehicle Control Module
V dif	Voltage Difference
VDOT	Variable Displacement Orifice Tube
VDV	Vacuum Delay Valve
vel	Velocity
VES	Variable Effort Steering
VF	Vacuum Fluorescent
VIO	Violet
VIN	Vehicle Identification Number
VLR	Voltage Loop Reserve
VMV	Vacuum Modulator Valve
VR	Voltage Regulator
V ref	Voltage Reference
VSES	Vehicle Stability Enhancement System
VSS	Vehicle Speed Sensor
<b>W</b>	
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
<b>X</b>	
X-valve	Expansion Valve
<b>Y</b>	
yd	Yard(s)
YEL	Yellow

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**Conversion - English/Metric**

English	Multiply/ Divide by	Metric
In order to calculate English measurement, divide by the number in the center column.		
In order to calculate metric measurement, multiply by the number in the center column.		
Length		
in	25.4	mm
ft	0.3048	m
yd	0.9144	
mi	1.609	km
Area		
sq in	645.2	sq mm
	6.45	sq cm
sq ft	0.0929	sq m
sq yd	0.8361	
Volume		
cu in	16,387.00	cu mm
	16.387	cu cm
	0.0164	L
qt	0.9464	
gal	3.7854	
cu yd	0.764	cu m
Mass		
lb	0.4536	kg
ton	907.18	
	0.907	tonne (t)
Force		
Kg F	9.807	newtons (N)
oz F	0.278	
lb F	4.448	
Acceleration		
ft/s <sup>2</sup>	0.3048	m/s <sup>2</sup>
ln/s <sup>2</sup>	0.0254	
Torque		
Lb in	0.11298	N·m
lb ft	1.3558	
Power		
hp	0.745	kW
Pressure (Stress)		
inches of H2O	0.2488	kPa
lb/sq in	6.895	
Energy (Work)		
Btu	1055	J (J= one Ws)
lb ft	1.3558	
kW hour	3,600,000.00	
Light		
Foot Candle	10.764	lm/m <sup>2</sup>

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

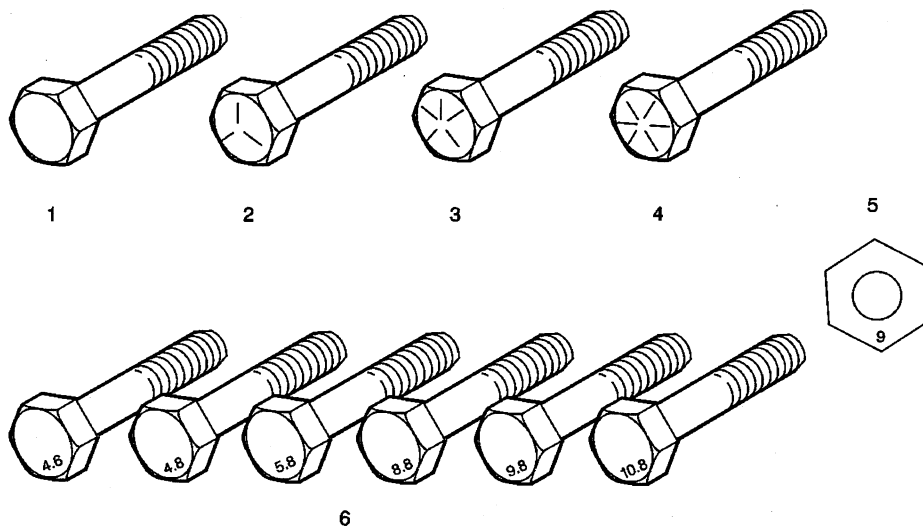
### Metric Fasteners

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

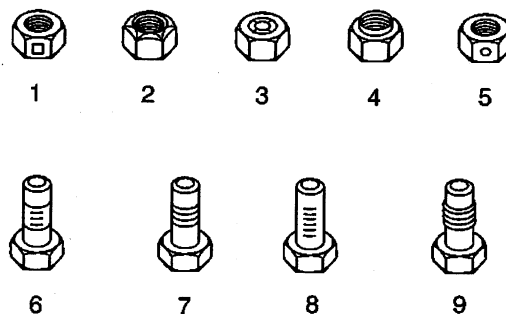
These fasteners accomplish the thread interface by a designed distortion or deformation in the fastener.

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

**English Prevailing Torque Fastener Minimum Torque Development**

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