Section 0
General Information

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General Information

Conversion - English/Metric

English	Multiply / Divide by	Metric
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	16,387.0	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	0.2780	
lb F	4.448	
Acceleration		
ft/s^2	0.3048	m/s^2
in/s^2	0.0254	
Torque		
lb in	0.11296	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	1055.0	J (J= one Ws)
lb ft	1.3558	
kW hour	3,600,000.0	
Light		
Foot Candle	10.764	lm/m^2
Velocity		
mph	1.6093	km/h

Conversion - English/Metric (cont'd)

English	Multiply / Divide by	Metric
Temperature		
(°F – 32)*5/9	=	°C
°F	=	(9/5 *°C + 32)
Fuel Performance		
235.215/mpg	=	100 km/L

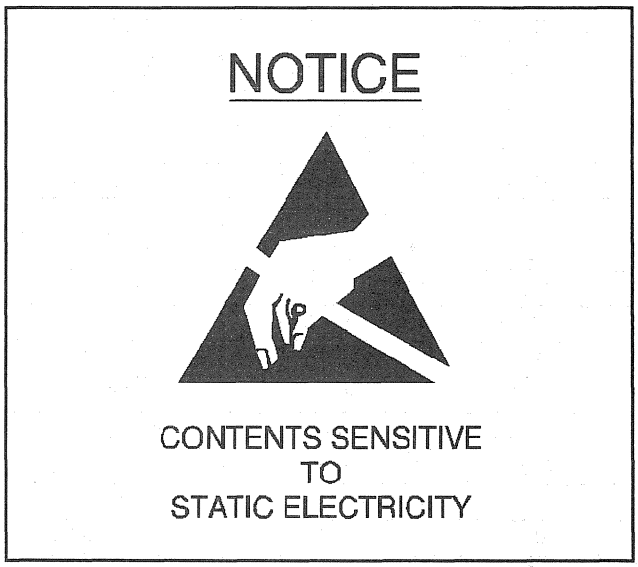
Equivalents - Decimal and Metric

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

Equivalents - Decimal and Metric (cont'd)

Fraction (in)	Decimal (in)	Metric (mm)
39/64	0.609375	15.47812
5/8	0.625	15.875
41/64	0.640625	16.27187
21/32	0.65625	16.66875
43/64	0.671875	17.06562
11/16	0.6875	17.4625
45/64	0.703125	17.85937
23/32	0.71875	18.25625
47/64	0.734375	18.65312
3/4	0.75	19.05
49/64	0.765625	19.44687
25/32	0.78125	19.84375
51/64	0.796875	20.24062
13/16	0.8125	20.6375
53/64	0.828125	21.03437
27/32	0.84375	21.43125
55/64	0.859375	21.82812
7/8	0.875	22.225
57/64	0.890625	22.62187
29/32	0.90625	23.01875
59/64	0.921875	23.41562
15/16	0.9375	23.8125
61/64	0.953125	24.20937
31/32	0.96875	24.60625
63/64	0.984375	25.00312
1	1.0	25.4

Arrows and Symbols



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Electrostatic discharge (ESD) can damage many solid state electrical components. Not all components that are susceptible to damage from ESD are labeled with the ESD symbol. Exercise caution when handling all solid state electrical components.

Avoid damaging solid state electrical components by taking the following precautions:

- Discharge personal electricity by touching a metal ground point after each of the following activities:
  - sliding across the vehicle seat
  - sitting or rising
  - walking
- Do not touch the exposed electric terminals on a component with your finger or a tool. The connector that you are checking may be tied into a circuit that is susceptible to damage by ESD.
- Do not allow a screwdriver or a similar tool to contact exposed terminals when disconnecting a connector.
- Do not remove the protective packing of the solid state component until you are ready to install the solid state component.
- Unless specified in a particular diagnostic procedure, avoid the following activities:
  - jumpering components or connectors
  - grounding components or connectors
  - using test equipment probes on components or connectors
- When a diagnosis requires the use of test equipment probes, connect the ground lead first.
- Touch the solid state component's package to a ground before opening.
- Do not lay the solid state component in any of the following locations:
  - On a metal work bench
  - On top of an electrically operating appliance or piece of equipment, like a TV, radio or oscilloscope
- Do not drop the solid state component.

Special Tools Ordering Information

The special service tools shown in this service manual that have product numbers beginning with J or BT are available for worldwide distribution from:

OE Tool and Equipment Group
Kent-Moore
28635 Mound Road
Warren, MI, U.S.A. 48092–3499
Phone: 1–800–345–2233 or 810–574–2332
Monday through Friday
8:00 a.m.–7:00 p.m. Eastern Standard Time
Fax: 1–800–578–7375 or 810–578–7321

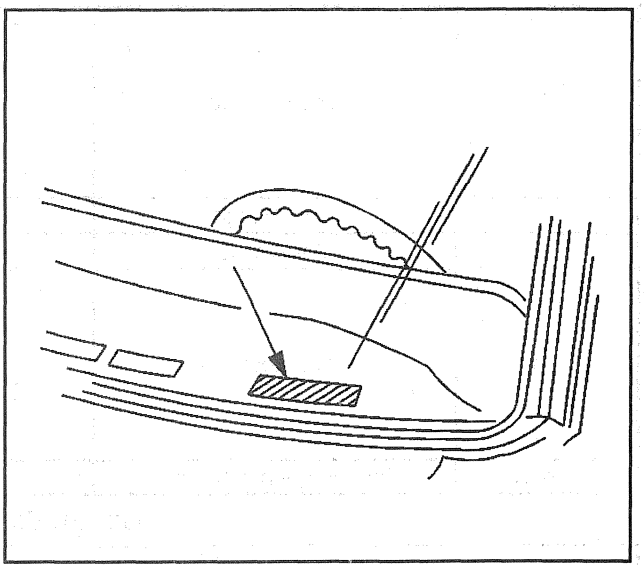
The TECH 2® scan tool and accessories can be purchased through:

Dealer Equipment and Services
5775 Enterprise Dr.
Warren, MI, U.S.A. 48092–3463
Phone: 1–800–GM-TOOLS or 810–574–2332
Monday through Friday
8:00 a.m.–6:00 p.m. EST
Fax: 1–810–578–7205

Diagnostic Work Sheets

The GM Diagnostic Worksheet has been designed to improve communications between the service customer and the technician. The diagnostic worksheet can provide the technician with more information than the conventional repair order, since it is filled out by the service customer. The GM Diagnostic Worksheets are available to you at no cost. GM Service Bulletin 58-01-01 has information on how to order this diagnostic worksheet.

Vehicle Identification



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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.

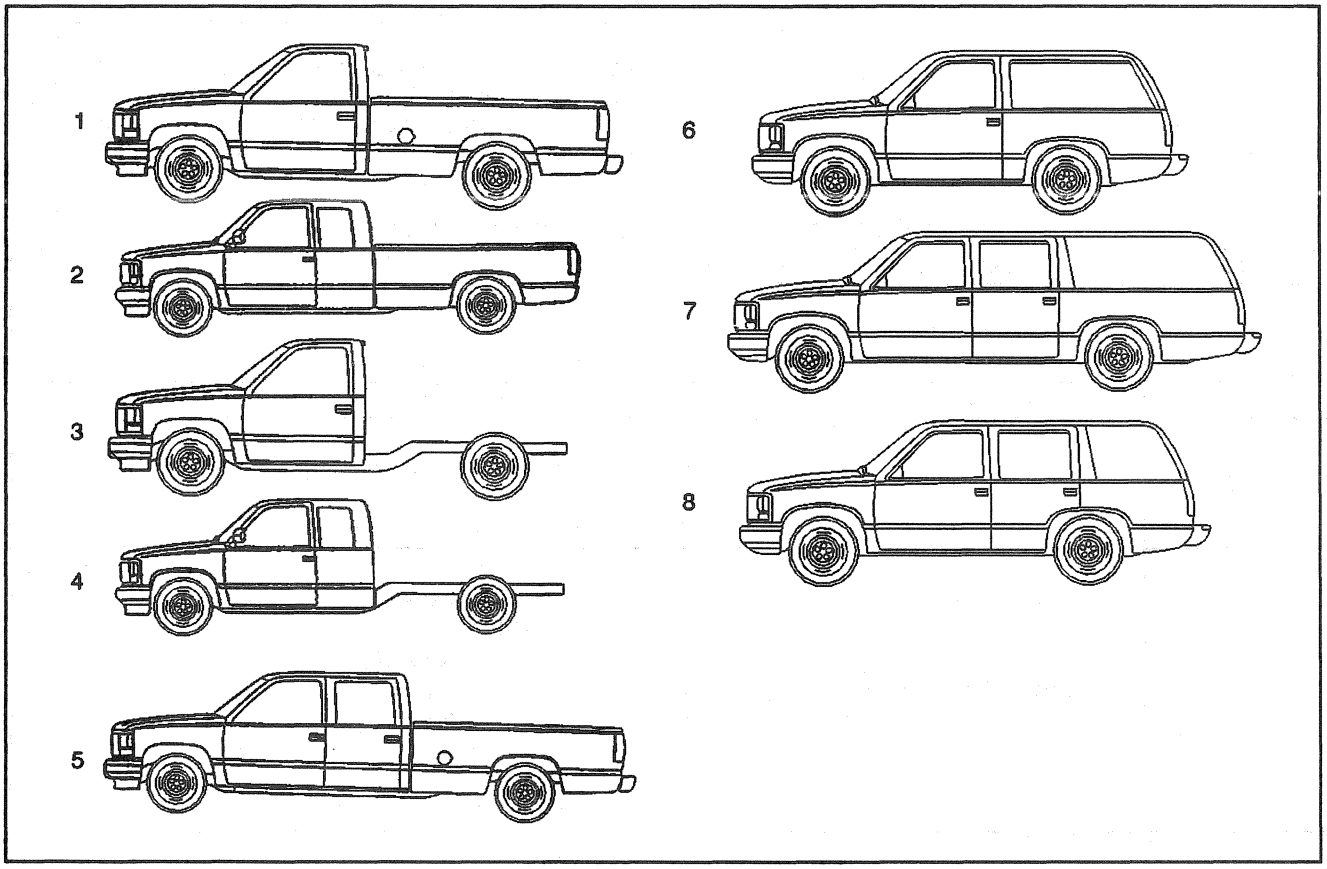
Vehicle Identification Number (VIN) System

Position	Definition	Character	Description
1	Country of Origin	1	United States
		2	Canada
		3	Mexico
2	Manufacturer	G	General Motors
3	Make	B	Chevrolet
		C	Incomplete Chevrolet Truck
		D	GMC
		T	Incomplete GMC Truck
4	GVWR/Brake System	B	3001-4000/Hydraulic
		C	4001-5000/Hydraulic
		D	5001-6000/Hydraulic
		E	6001-7000/Hydraulic
		F	7001-8000/Hydraulic
		G	8001-9000/Hydraulic
		H	9001-10000/Hydraulic
		J	10001-14000/Hydraulic
		K	14001-16000/Hydraulic
5	Truck Line/Chassis Type	C	Conventional Cab/4x2
		D	Military Truck/4x4
		K	Conventional Cab/4x4
6	Series	1	½ Ton
		2	¾ Ton
		3	1 Ton
7	Body Type	3	Crew Cab
		4	Two-Door Cab
		6	Suburban
		8	Utility
		9	Extended Cab

Vehicle Identification Number (VIN) System (cont'd)

Position	Definition	Character	Description
8	Engine Type	F	(L65) 6.5L Diesel
		M	(L30) 5.0L Gas
		R	(L31) 5.7L Gas
		J	(L29) 7.4L Gas
		S	(L56) 6.5L Diesel
		W	(L35) 4.3L Gas
9	Check Digit	—	—
10	Model Year	W	1998
11	Plant Location	1	Oshawa, Ontario
		E	Pontiac, MI
		Z	Fort Wayne, Indiana
		J	Janesville, WI
		G	Silao, Mexico
		R	Arlington, TX
12–17	Plant Sequence Number	—	—

C/K Model Identification



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Legend

(1) Regular Cab Pickup
(2) Extended Cab Pickup
(3) Regular Cab Chassis
(4) Extended Cab Chassis
(5) Crew Cab Pickup
(6) 2 Door Utility
(7) Suburban
(8) 4 Door Utility

Vehicle Identification

Model	Engine		Transmission	
	Base	Option	Base	Option
C105 (16)	5.7L V8 (L31)	—	4 Spd. Auto. (M30)	—
C107 (03)	4.3L V6 (L35)	5.0L (L30) 5.7L V8 (L31)	5 Spd. Manual (MG5)	4 Spd. Auto. (M30)
C107 (06)	5.7L V8 (L31)	–	4 Spd. Auto. (M30)	–
C107 (53)	4.3L V6 (L35)	5.0L (L30) 5.7L V8 (L31)	5 Spd. Manual (MG5)	4 Spd. Auto. (MT1) 4 Spd. Auto. (M30) 5 Spd. Manual (M50)
C109 (03)	4.3L V6 (L35)	5.0L (L30) 5.7L V8 (L31)	5 Spd. Manual (MG5)	4 Spd. Auto. (MT1) 4 Spd. Auto. (M30) 5 Spd. Manual (M50)
C109 (06)	5.7L V8 (L31)	6.5L V8 (L65)	4 Spd. Auto. (M30)	4 Spd. Auto. (MT1)
C109 (53)	5.0L (L30)	5.7L V8 (L31)	5 Spd. Manual (MG5)	4 Spd. Auto. (MT1) 4 Spd. Auto. (M30) 5 Spd. Manual (M50)
C207 (53)	5.0L (L30)	5.7L V8 (L31) 6.5L V8 (L56)	5 Spd. Manual (MG5)	4 Spd. Auto. (MT1) 4 Spd. Auto. (M30) 5 Spd. Manual (M50)
C209 (03)	5.0L (L30)	5.7L V8 (L31) 7.4L V8 (L29) 6.5L V8 (L56) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
C209 (06)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	4 Spd. Auto. (MT1)	–
C209 (53)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
C309 (03)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
C309 (43)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
C309 (53)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
C310 (03)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
C314 (03)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
C318 (03)	7.4L V8 (L29)	6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
K105 (16)	5.7L V8 (L31)	6.5L V8 (L56)	4 Spd. Auto. (M30)	4 Spd. Auto. (MT1)
K107 (03)	4.3L V6 (L35)	5.0L V8 (L30) 5.7L V8 (L31)	5 Spd. Manual (MG5)	4 Spd. Auto. (M30)
K107 (06)	5.7L V8 (L31)	–	4 Spd. Auto. (M30)	–
K107 (53)	4.3L V6 (L35)	5.0L V8 (L30) 5.7L V8 (L31) 6.5L V8 (L56)	5 Spd. Manual (MG5)	4 Spd. Auto. (MT1) 4 Spd. Auto. (M30) 5 Spd. Manual (M50)
K109 (03)	4.3L V6 (L35)	5.0L V8 (L30) 5.7L V8 (L31)	5 Spd. Manual (MG5)	4 Spd. Auto. (MT1) 4 Spd. Auto. (M30) 5 Spd. Manual (M50)
K109 (06)	5.7L V8 (L31)	6.5L V8 (L65)	4 Spd. Auto. (M30)	4 Spd. Auto. (MT1)

Vehicle Identification (cont'd)

Model	Engine		Transmission	
	Base	Option	Base	Option
K109 (53)	5.0L V8 (L30)	5.7L V8 (L31) 6.5L V8 (L56)	5 Spd. Manual (MG5)	4 Spd. Auto. (MT1) 4 Spd. Auto. (M30) 5 Spd. Manual (M50)
K207 (53)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
K209 (03)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
K209 (06)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	4 Spd. Auto. (MT1)	–
K209 (53)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
K309 (03)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
K309 (43)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
K309 (53)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
K310 (03)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)
K314 (03)	5.7L V8 (L31)	7.4L V8 (L29) 6.5L V8 (L65)	5 Spd. Manual (MW3)	4 Spd. Auto. (MT1)

Model Codes:
- C-Rear Wheel Drive
- K-Selectable or Automatic Four Wheel Drive
- 03-Two Door Cab
- 06-Suburban or Four Door Utility
- 16-Two Door Utility
- 43-Four Door Cab
- 53-Two Door Extended Cab

Model Codes: C-Rear Wheel Drive
K–Selectable Four Wheel Drive
03–Two Door Cab
06–Suburban or Four Door Utility
16–Two Door Utility
43–Four Door Cab
53–Two Door Extended Cab

VIN Derivative

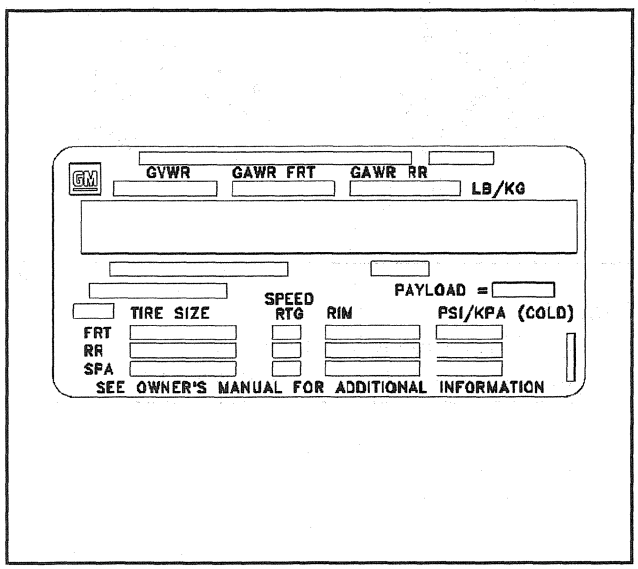
All engines and transmissions are stamped or laser etched with a partial Vehicle Identification Number (VIN), which was derived from the complete VIN. A VIN derivative contains the following nine positions:

Position	Definition	Character	Description
1	GM Division Identifier	G	General Motors
2	Model Year	W	1998
3	Assembly Plant	1	Oshawa, Ontario
		E	Pontiac, MI
		Z	Fort Wayne, IN
		J	Janesville, WI
		G	Silao, Mexico
		R	Arlington, TX
4–9	Plant Sequence Number	—	—

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

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

Label - Vehicle Certification



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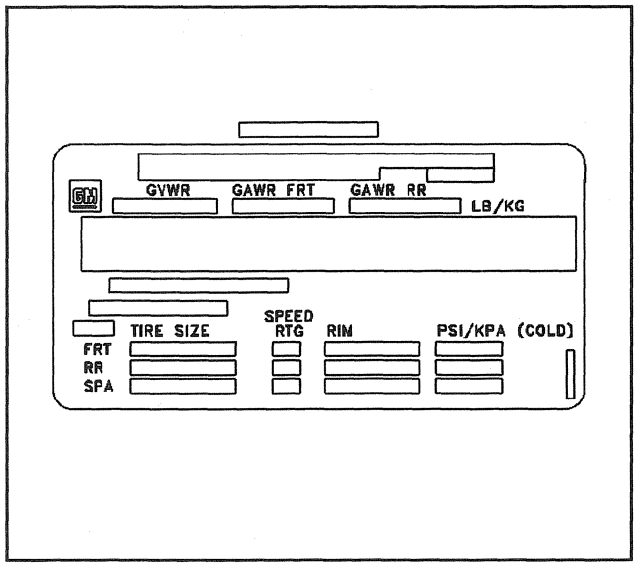

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The vehicle certification label displays the following assessments:

- The Gross Vehicle Weight Rating (GVWR)
- The Gross Axle Weight Rating (GAWR)
- 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.

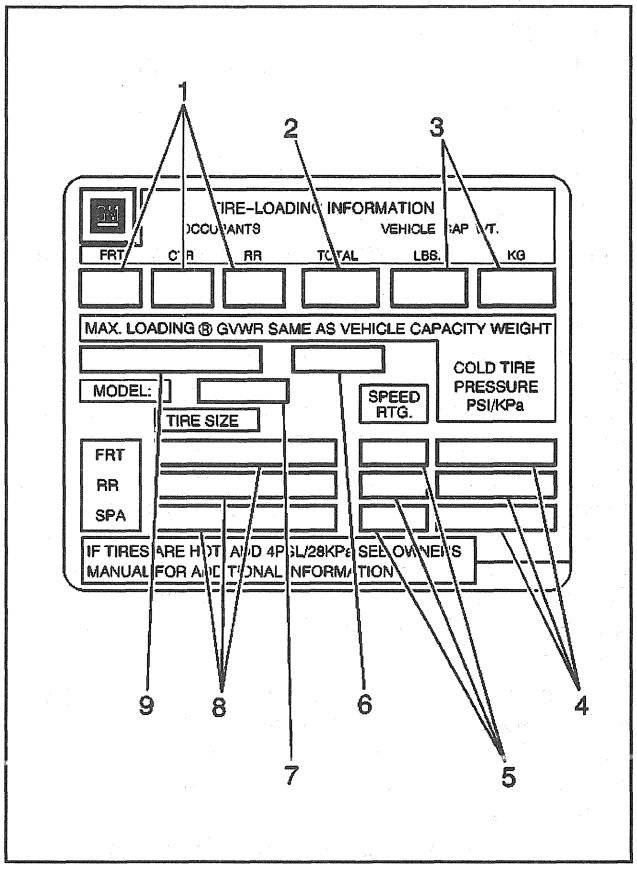
The front gross axle weight (GAW) is the weight exerted on the front axle. The rear gross axle weight (GAW) is the weight exerted on the rear axle. The front and rear gross axle weights must not exceed the front and rear gross axle weight ratings.

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. For more information on tires, refer to *Tire Inflation Pressure Specifications* in Maintenance and Lubrication.

Tire Placard



65541

Legend

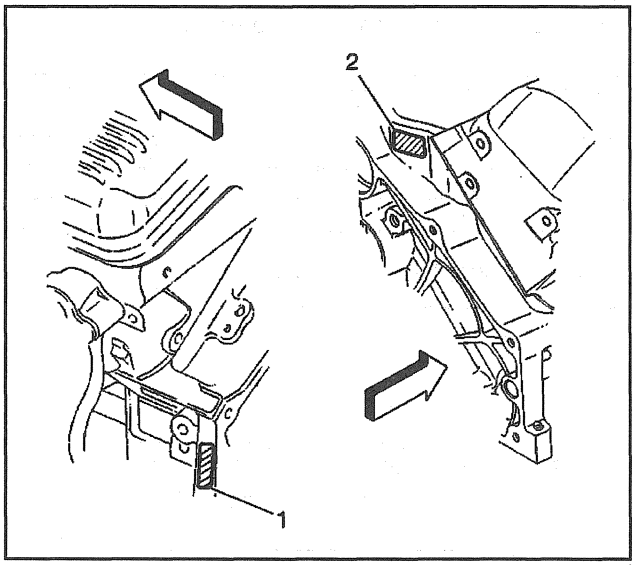
(1) Specified Occupant Seating Positions
(2) Total Occupant Seating
(3) Maximum Vehicle Capacity Weight
(4) Tire Pressures, Front, Rear, and Spare
(5) Tire Speed Rating, Front, Rear, and Spare
(6) Tire Label Code
(7) Engineering Model Minus First Character
(8) Tire Sizes, Front, Rear, and Spare
(9) Vehicle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

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

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

Engine ID and VIN Derivative Location

4.3L Engine

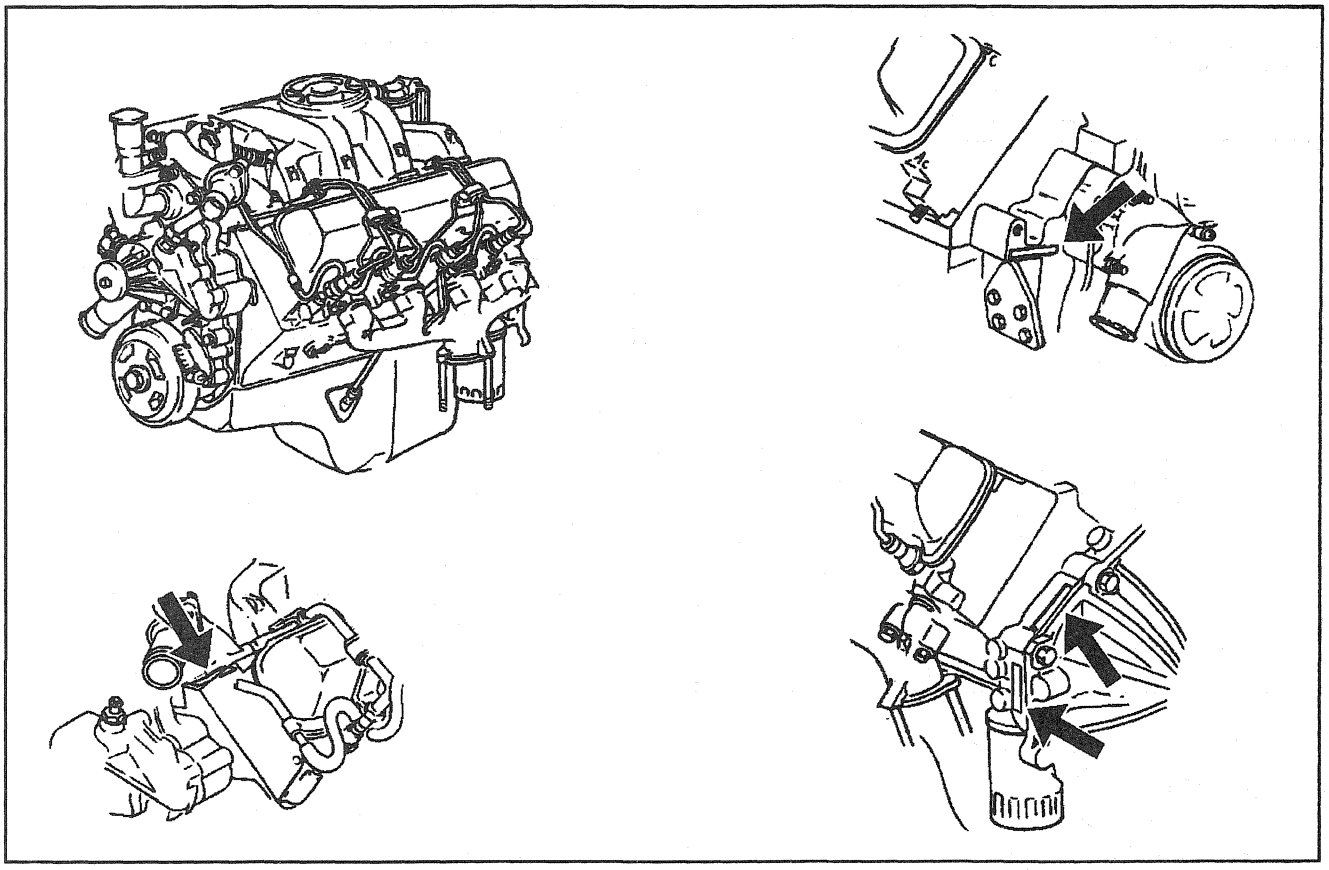


174107

Legend

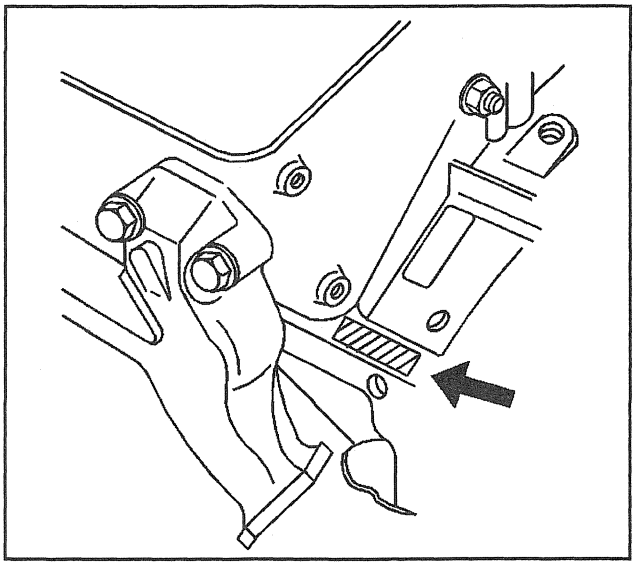
(1) Engine Identification Number
(2) Alternative Engine Identification Number

4.3L Engine



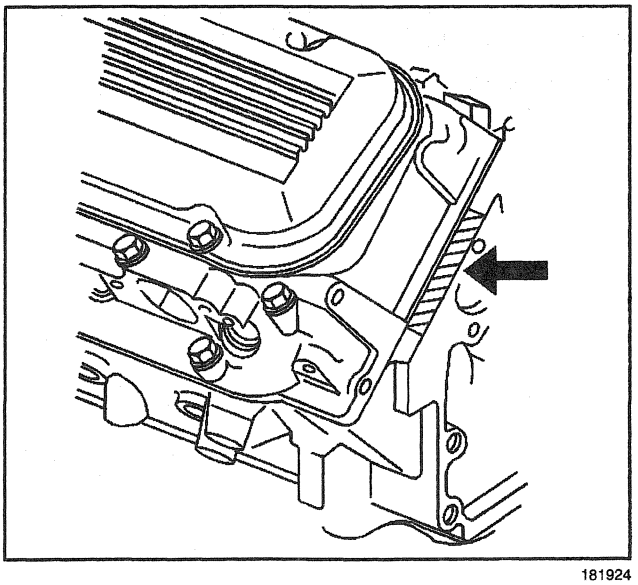
181919

6.5L Diesel Engine



181920

5.0L and 5.7L Engines

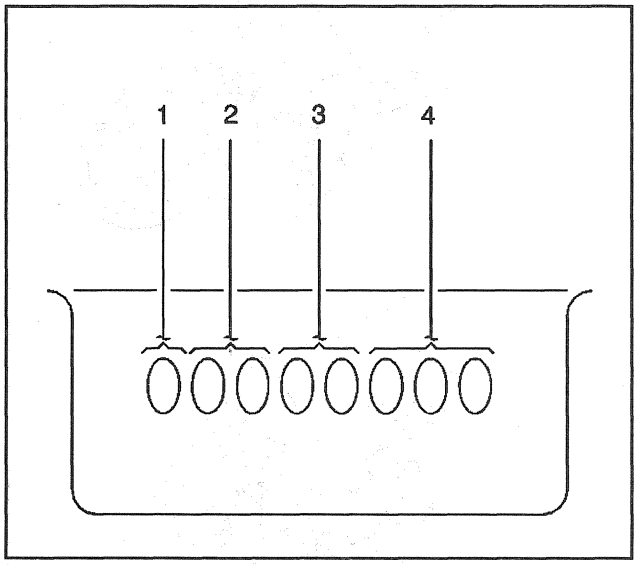


181924

7.4L Engine

Located on the VIN plate, the VIN provides detailed engine identification and code information by liter and by the engine code letter.

Engine ID



174106

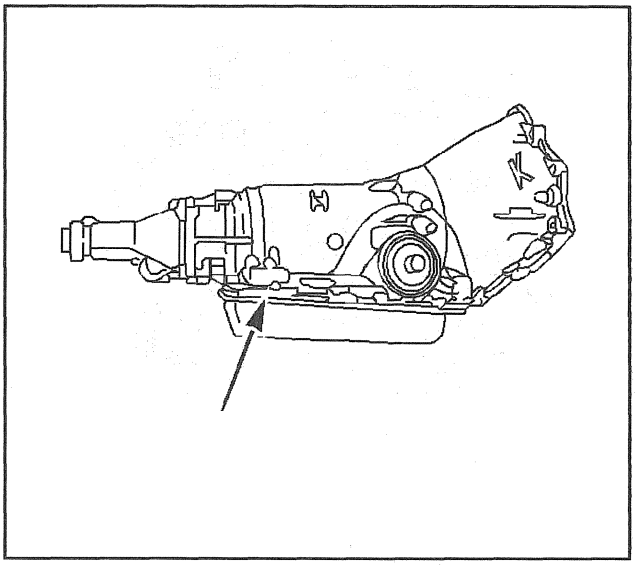
Legend

(1) Source Code
(2) Month of Build
(3) Date of Build
(4) Broadcast Code

The engine unit number or date code is either laser etched or stamped into the engine block.

All engines are stamped with an eight digit engine identification number.

Transmission ID and VIN Derivative Location (Transmission ID)



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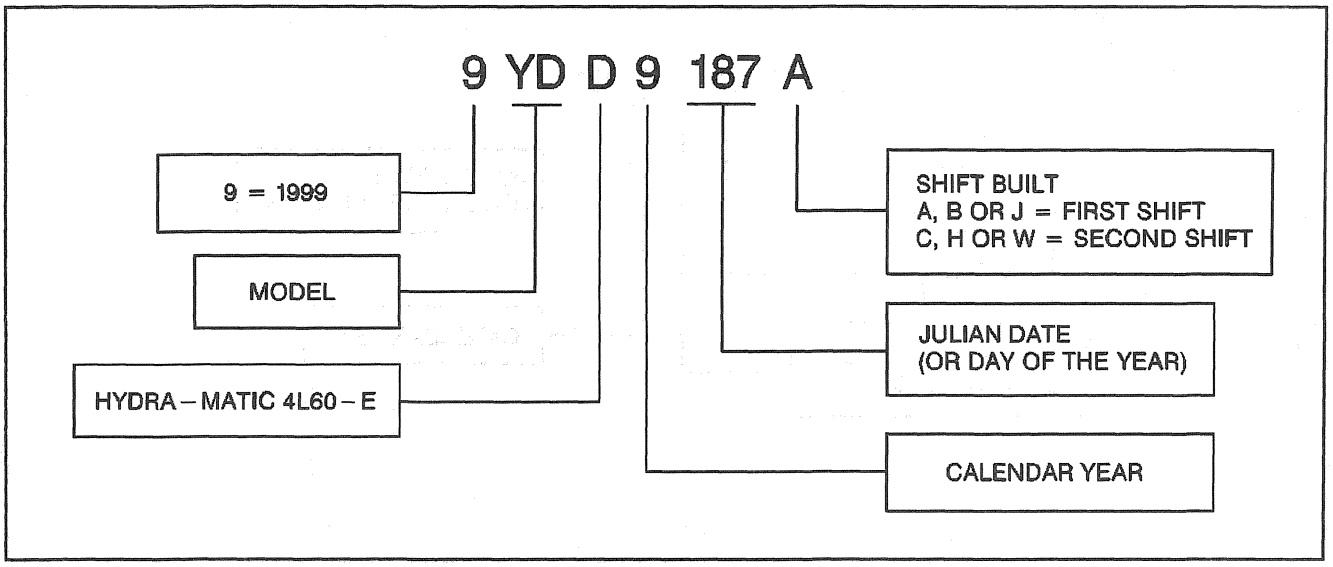
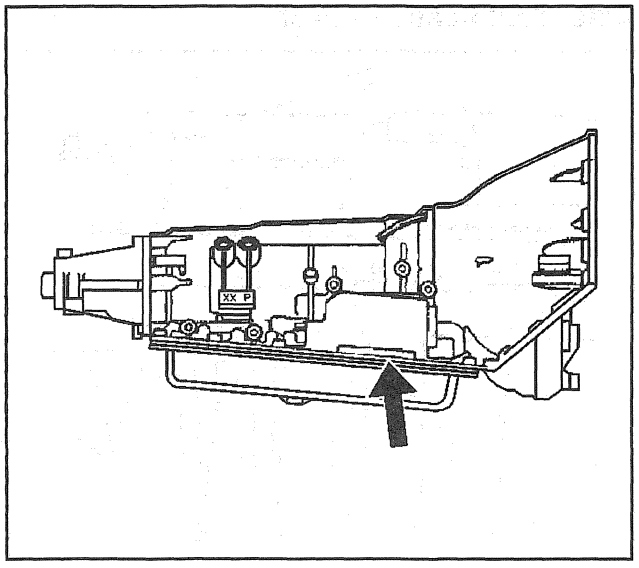
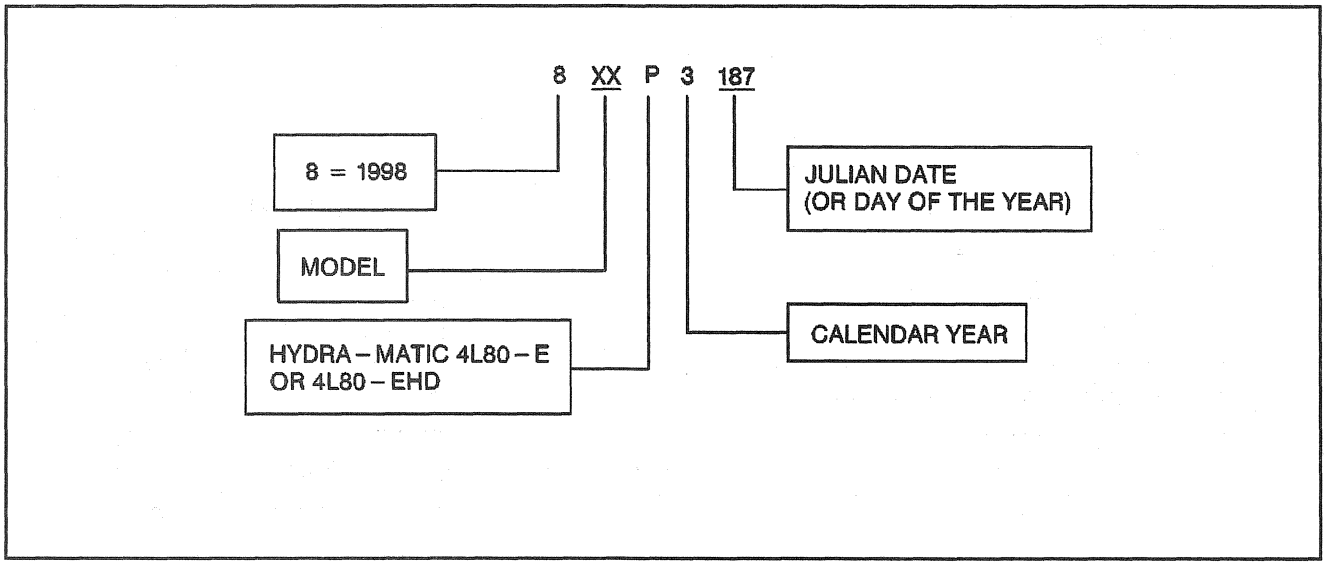


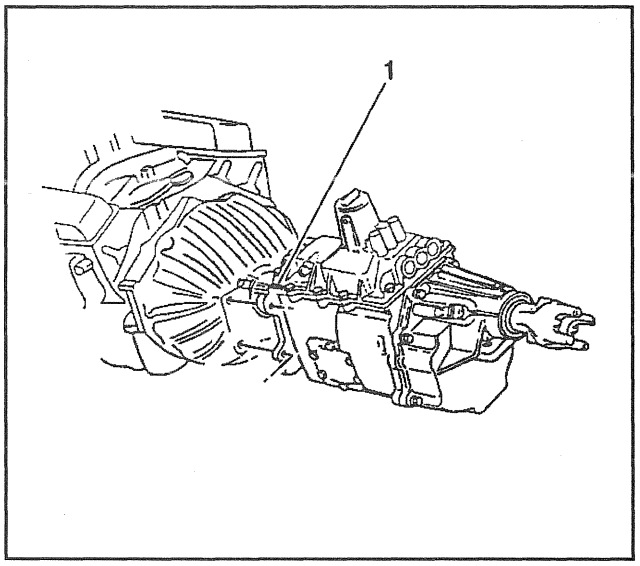
174101



181925



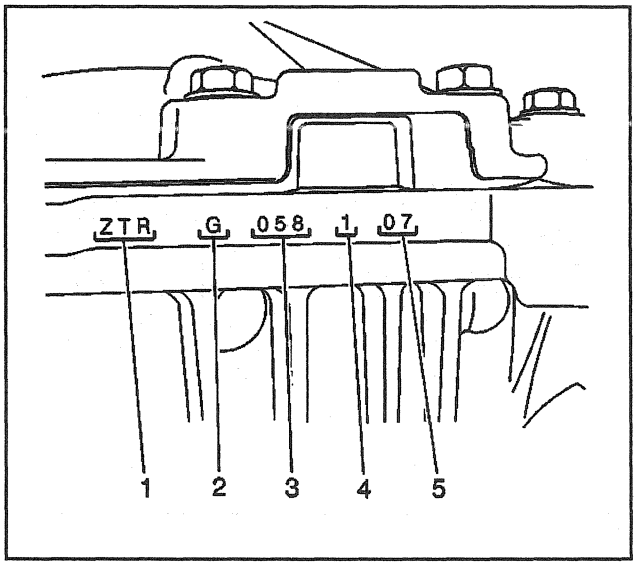
181926



186748

The transmission model identification is located on a label or tag on the transmission case. If this label is missing or unreadable, use the service parts identification label in order to identify the vehicle's transmission.

Axle Identification - Front



376492

Legend

(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

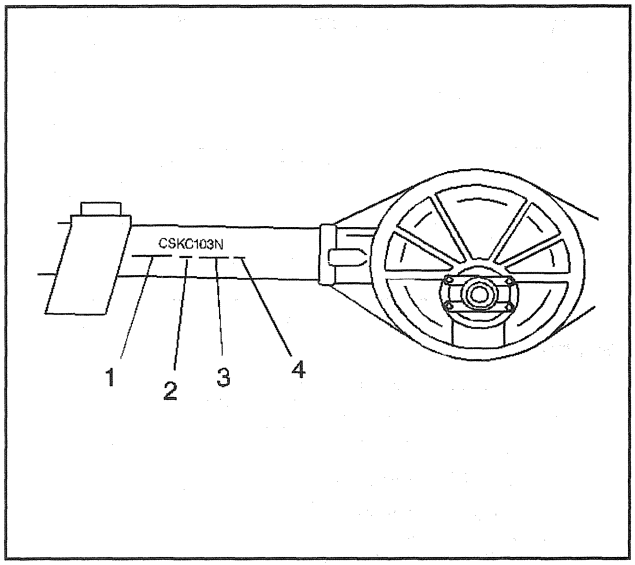
Front axle identification information is stamped on the top of the differential carrier assembly.

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



5794

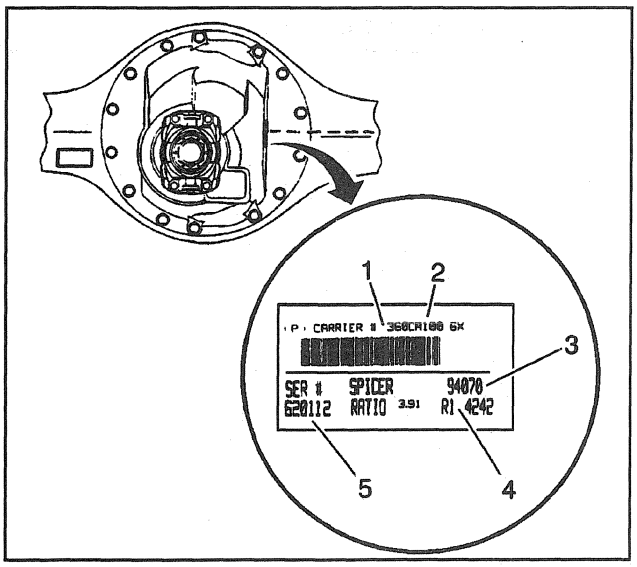
Legend

(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.

In order to verify reports made on rear axle assemblies, include full code letters and build date numbers.

Dana/Spicer® Rear Axle Differential Carrier ID



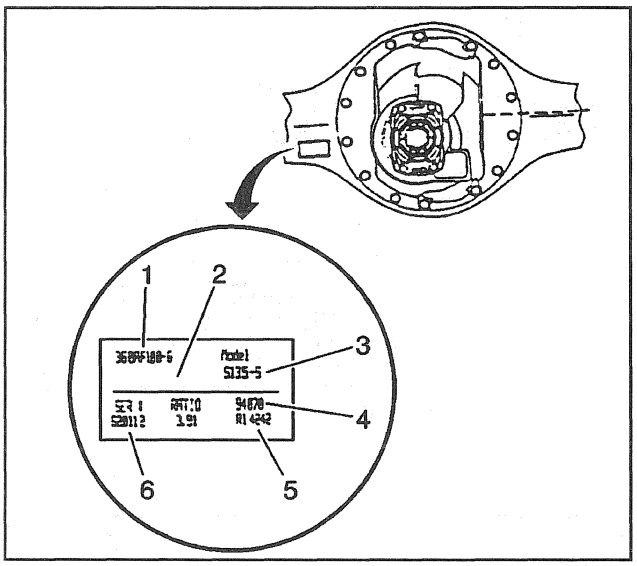
200587

Legend

(1) Dana® Part Number
(2) Customer Part Number (Optional)
(3) Julian Date Code
(4) Line Set Number (Optional)
(5) Last Six Digits of Vehicle Serial Number (Optional)

Axle Housing

Dana/Spicer® Rear Axle ID



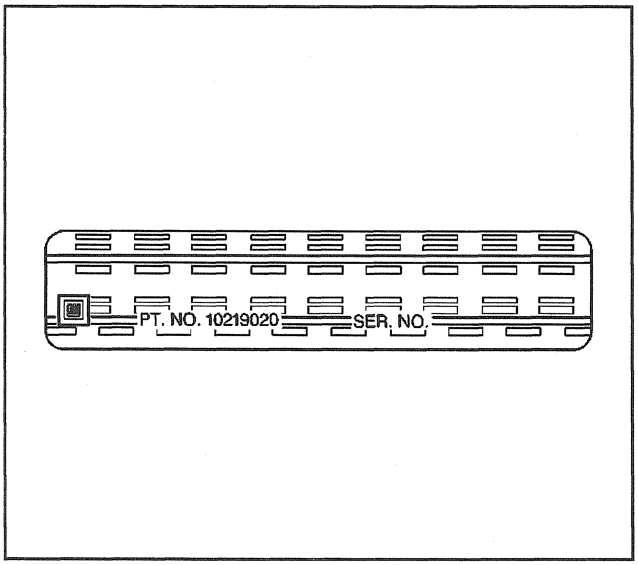
200582

Legend

(1) Dana® Part Number
(2) Customer Part Number (Optional)
(3) Model
(4) Julian Date Code
(5) Line Set Number (Optional)
(6) Last Six Digits of Vehicle Serial Number (Optional)

The housing tag is the same type of tag used for the Differential Carrier.

Labeling - Anti-Theft

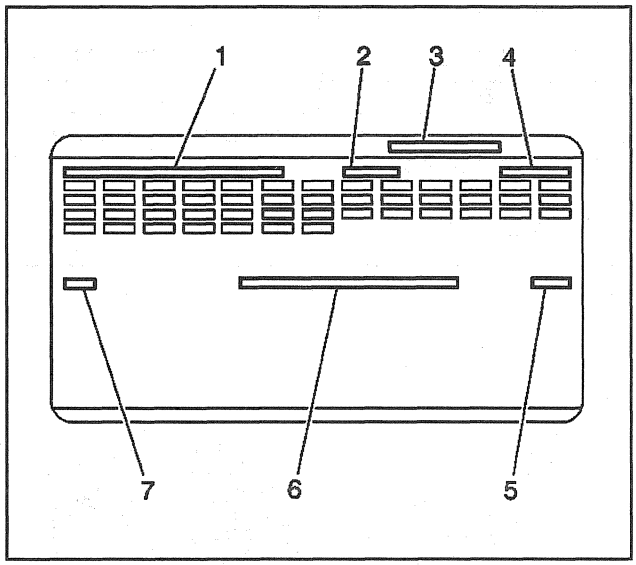


175291

Federal law requires that General Motors label certain body parts on this vehicle with the VIN. The purpose of the law is to reduce the number of motor vehicle thefts by helping in the tracing and recovering of parts from stolen vehicles.

The labels are permanently affixed to an interior surface of the part. The label on a replacement part contains the letter R, the manufacturer's logo, and the DOT symbol.

Label - Service Parts ID



6480

Legend

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

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

RPO Code List

AE7: 60/40 Front Split Bench Seat, Driver, Passenger Easy Entry
AG2: Seat Adjuster: Power, 6-way, Passenger
AG9: Seat Adjuster: Power, 6-way, Driver
AJ1: Windows: Deep Tint
AJ3: Restraint: Front Seat, Driver Inflatable
AL3: Restraint: Front Seat, Driver Inflatable, Delete
AM7: Seat, Rear Folding
APC: Provisions, Front Bucket Seating
APD: Provisions, Front Bench Seating
APR: Sales Incentive, 2500 Work Truck
AS3: Seat, Rear Suburban
ATZ: Seat, Rear Delete
AT5: Seat, Center
AU0: Lock Control: Remote Entry

AU3: Locks, Power Door
AU6: Electric End Gate Lock Release
A20: Window: Rear Quarter Swing Out
A21: Window: Non Encapsulated Glass
A28: Window: Rear, Full Width, Sliding
A31: Windows: Power
A50: Seat, Front Bucket
A52: Seat, Front Bench
A95: Seat: Front Bucket, High Back, Pass and Driver Reclining
BAG: Parts Package, Export
BG9: Floor Covering, Rubber
BNP: Molding Wheel Opening Delete
BVE: Steps, Running Board
BYP: Sales, Sport Equipment Package
BZY: Liner, Pickup Box
B30: Floor Covering, Carpet
B32: Auxiliary Floor Covering, Front Floor Mats
B33: Auxiliary Floor Covering, Rear Floor Mats
B34: Carpeted Front Floor Mats
B35: Carpeted Rear Floor Mats
B37: Floor Covering, Auxiliary Front and Rear
B39: Floor Covering, Carpeted Floor Mat
B4L: Label Price, Refer Geographic Chart
B71: Molding, Wheel Opening Colored
B85: Molding, Body Side, Exterior
B96: Molding, Wheel Opening
CMD: Plant Code, Flint, MI
C25: Wiper System, Rear Window
C3F: 7700 Lbs. GVW Rating
C36: Auxiliary Heater
C49: Rear Window Defogger
C5B: 15000 Lbs. GVW Rating
C5I: 8050 Lbs. GVW Rating
C5M: 6100 Lbs. GVW Rating
C5P: 6250 Lbs. GVW Rating
C5Q: 6300 Lbs. GVW Rating
C5S: 6600 Lbs. GVW Rating
C5U: 6800 Lbs. GVW Rating
C5Z: 7200 Lbs. GVW Rating
C6P: 8600 Lbs. GVW Rating
C6U: 9000 Lbs. GVW Rating
C6W: 9200 Lbs. GVW Rating
C6Y: 9600 Lbs. GVW Rating
C60: HVAC System, Front Air Conditioning
C69: HVAC System, Rear Air Conditioning
C7A: 10000 Lbs. GVW Rating
C7E: 11000 Lbs. GVW Rating
C7I: 6450 Lbs. GVW Rating
C7L: 12000 Lbs. GVW Rating
DD0: Mirror, Outside, LH and RH, Electric, Heated, Electrochromic
DD7: Mirror: I/S, Rearview Light Sensitive, Compass
DE2: Mirror: O/S, LH & RH, Folding, Painted
DF2: Mirror: O/S, LH & RH, Camper Style, Stainless Steel
DF5: Mirror: I/S, Rearview, Electrochromic, Compass and Outside Temperature
DG5: Mirror: O/S, LH & RH, Large Stainless Steel
DK6: Console: Roof, Interior
DR1: Mirror: O/S, LH & RH, Manual Control
D44: Mirror: Outside, Painted
D45: Mirror: Outside, Stainless Steel
D48: Mirror: Outside, Remote Control, Electric
D55: Console, Front Compartment, Floor
EF1: Bumper Provisions, Rear, Delete
EXP: Export, International Sales
E24: Door, Rear Side Hinged
E55: Body Equipment End Gate
E62: Body Equipment, Stepside Pickup Box
E63: Body Equipment, Fleetside Pickup Box
FE9: Certification: Emission, Federal
FG5: Shock Absorbers: Front & Rear, Gas, Delco/Bilstein, 46MM
FW1: Plant Code, Fort Wayne, IN, GM NATG
F44: Chassis, Heavy Duty
F48: Chassis, Manual Select Dampening
F51: Shock Absorbers, Front and Rear, Heavy Duty
F60: Spring, Front, Heavy Duty
F61: Stabilizer Shaft: Rear
GAM: Vehicle Government
GK9: Rear Axle: 4.63 Ratio
GTY: Axle Wide Track
GT4: Rear Axle: 3.73 Ratio
GT5: Rear Axle: 4.10 Ratio
GU4: Rear Axle: 3.08 Ratio
GU6: Rear Axle: 3.42 Ratio
G80: Rear Axle: Positraction
HC4: Rear Axle: 4.56 Ratio
HC7: Rear Axle: 5.13 Ratio
JAN: Plant Code, Janesville, WI, GM NATG
JB5: Brake System: Power, Front Disc, Rear Drum, 6400 Lbs.
JB6: Brake System: Power, Front Disc, Rear Drum, 7200 Lbs.
JB7: Brake System: Power, Front Disc, Rear Drum, 8400 Lbs.
JB8: Brake System: Power, Front Disc,

Rear Drum, 10000 Lbs.

JD5: Brake System: Dual Power, Front Disc, Rear Drum, 6400 Lbs.

JD6: Brake System: Hydraulic Power, Front Disc, Rear Drum, 7200 Lbs.

JD7: Brake System: Hydraulic Power, Front Disc, Rear Drum, 8400 Lbs.

JF9: Brake System: Hydraulic Power, Four Wheel Disc

KA1: Heated Seats, DR/PS, High Back Buckets w/Leather

KC4: Cooling System, Engine Oil

KG9: Generator, 140 Amp

KL5: Modification Engine, Natural Gas

KL6: Provisions, Natural Gas

KNP: Transmission, Heavy Duty Cooling System

KW2: Generator, 124 Amp

KXB: Dual Generator, 100 Amp

K02: Fan: Radiator Booster

K05: Heater: Engine Block

K34: Cruise Control: Automatic, Electronic

K47: Air Cleaner, High Capacity

K60: Generator: 100 Ampere

K68: Generator: 105 Ampere

L29: Engine: 7.4 Liter V8, MFI

L30: Engine: 5.0 Liter V8, CPI

L31: Engine: 5.7 Liter V8, CPI

L35: Engine: 4.3 Liter V6, CPI

L56: Engine Diesel: 6.5 Liter V8, Turbo

L65: Engine Diesel: 6.5 Liter V8, Turbo

MG5: Transmission: Manual 5 Speed, New Venture Gear

MSL: Plant Code, Silao, Mexico

MT1: Transmission: 4L80-E, 4-Speed Automatic, Electronic

MW3: Transmission: Manual 5 Speed, New Venture Gear

M30: Transmission: 4L60-E, 4-Speed Automatic, Electronic

M50: Transmission: Manual 5 Speed, New Venture Gear

NA1: Emission System: GVW Less than 8500 lbs

NA4: Emission System: GVW Above 8500 lbs

NA5: Emission System: Federal, Tier 0

NB2: Emission System: California, Tier 0

NB6: Emission System: California, Tier 1

NB8: Emission Override: California System

NC1: Emission System: California, LEV

NC7: Emission Override: Federal System

NF2: Emission System: Federal, Tier 1

NG1: Certification Emission, Geographically Restricted Registration

NM8: Leaded Fuel System Compatible

NN8: Emission Override Unleaded Fuel, Export

NP1: Transfer Case, Electronic Shift, Two Speed

NP5: Steering Wheel: Leather Wrapped

NQZ: Fuel Tank, Auxiliary, Rear Mounted, 18 Gallon, Delete

NRQ: Exhaust Close Coupled

NY1: Shield, Fuel Tank

NZZ: Sales Package, Skid Plate, Off Road Sport

N33: Steering Column: Tilt Type

N83: Wheel: 15 x 7, Chrome Styled

N90: Wheel: 15 x 7, Aluminum Cast, 4.75 Inch Bolt Circle

OSG: Plant Code, Oshawa, Ontario, GM of Canada

PF4: Wheel: 16 x 7, Aluminum Cast

PO6: Wheel, Trim Discs

QBN: Tire: All, LT245/75R16/C BW R/PE ST TBL OOR

QBX: Tire: All, LT245/75R16/C WOL R/PE ST TBL OOR

QFL: Tire: All, P235/75R15 BW R/PE ST TL ALS 105S

QFN: Tire: All, P235/75R15 WL R/PE ST TL ALS 105S

QGA: Tire: All, P245/75/R16 BW R/PE ST TL ALS 109S

QGB: Tire: All, P245/75/R16 WOL R/PE ST TL ALS 109S

QGC: Tire: All, P265/75/R16 BW R/PE ST TL ALS 114S

QGD: Tire: All, P265/75/R16 WOL R/PE ST TL ALS 114S

QHA: Tire: All, P235/75/R15/X BW R/PE ST TL ALS

QIW: Tire: All, P245/75/R16 BL R/PE ST TL OOR

QIZ: Tire: All, P245/75/R16 BL R/PE ST TL ALS

Q4B: GVW Rating 6200 lbs.

RHD: Right Hand Drive

RSA: Restraint: Front Seat, 208, Auto, Passive

RSB: Restraint: Front Seat, 208, Auto, Manual, Active

R04: Wheel, Single Rear

R05: Wheel, Dual Rear

TP2: Battery Auxiliary, Camper

TL1: Grille: Special

T62: Lighting, Daytime Running, Delete

T85: Headlamps: LH Rule of Road, E Mark

UC2: Speedometer: Instrument, Kilometers & Miles, Kilometer Odometer, Positive Bias

UD4: Alarm: Vehicle Speed, 120 K/H

UG1: Homelink™ 3–Channel Transmitter

UK1: Radio, Frequencies, Japanese

UL0: Radio: AM/FM Stereo, Seek/Scan, Auto Reverse Cassette, Music Search

UL2: Radio, Frequencies, European

UL5: Radio: Delete

UM6: Radio: AM/FM Stereo, Seek/Scan, Auto Reverse Cassette, Clock, ETR

UM7: Radio: AM/FM Stereo, Seek/Scan, Clock, ETR

UN0: Radio: AM/FM Stereo, Seek/Scan, Compact Disc, Auto Tone

UP0: Radio: AM/FM Stereo, Seek/Scan, Auto Reverse, Music Search, Cassette, Compact Disc Player, Auto Tone

UQ3: Speaker System, Performance Enhanced Radio

UQ5: Speaker System 4, Dual Front Door Mounted, Dual Extended Range, Quarter Mounted

UW3: Radio: AM/FM Stereo, Seek/Scan, Auto Reverse, Music Search

UY1: Wiring Provisions, Camper

U01: Roof Marker Lamp, Five

U19: Speedometer Inst, Kilo and Miles

VB1: Label Shipping, Japan

VB3: Bumper, Rear Step, Chrome, Impact Strip

VC0: Vehicle Label, Noise Control Information

VC4: Label Price/Fuel Econ, Puerto Rico

VC5: Label Shipping, Except for US, US Possessions, Or Japan

VC7: Label Price/Fuel Econ, Guam

VG3: Bumper, Front Impact Strip

VG8: Vehicle Label, Notice to Buyer

VK3: License Plate, Front Mounting Package

VK5: Seat: Temporary, For Shipping

VPH: Vehicle Preparation Overseas Delivery

VL3: Label: Mirror, O/S Warning

VR4: Trailer Hitch: Weight Distributing Platform

VR6: Hook: Tie Down

VS7: Vehicle Non-Saleable

VYU: Provisions, Snow Plow Prep

V10: Provisions: Cold Climate

V22: Grille Chrome, Radiator

V27: Guards, Front Bumper

V43: Bumper, Rear Step, Painted

V54: Luggage Carrier, Roof, Painted

V60: Vehicle Statement Gulf States Organization, Incomplete Vehicle

V73: Vehicle Statement US/Canada

V76: Tow Hook

V78: Vehicle Statement Delete

V87: Vehicle Statement Gulf States Organization

V98: Factory Delivery Processing

WD1: Identification Pilot Vehicle

W99: Equipment Misc Equip For Venez

XBN: Tire: Front, LT245/75/R16/C BL R/PE ST TBL OOR

XBX: Tire: Front, LT245/75/R16/C WOL R/PE ST TBL OOR

XFL: Tire: Front, P235/75/R15 ST TL ALS B/W

XFN: Tire: Front, P235/75/R15/N WL R/PE ST TL ALS 105S

XGA: Tire: Front, P245/75/R16 BW R/PE ST TL AT 109S

XGB: Tire: Front, P245/75/R16 WOL R/PE ST TL AT 109S

XGC: Tire: Front, P265/75/R16 BW R/PE ST TL AT 114S

XGD: Tire: Front, P265/75/R16 WOL R/PE ST TL AT 114S

XGK: Tire: Front, LT245/75/R16 BL R/PE ST OOR

XHA: Tire: Front, P235/75/R15X BL R/PE ST TL ALS

XHE: Tire: Front, LT235/75/R16C BL R/PE ST ALS

XHH: Tire: Front, LT245/75/R16E BL R/PE ST ALS

XHM: Tire: Front, P235/75/R15 WOL R/PE ST TL ALS 108S (X/LOAD)

XHP: Tire: Front, LT225/75/R16D BL R/PE ST TL ALS

XHR: Tire: Front, LT225/75/R16D BL R/PE ST TL OOR

XTN: Tire: Front, 225/70R9.5F BW R/ST ST TL HWY

XYK: Tire: Front, LT215/85/R16D BL R/PE ST TL OOR

XYK: Tire: Front, LT215/85/R16D BL R/PE ST TL HWY

X81: Sales Incentive Price Leader

X88: Conversion Name Plate — CHEVROLET

YA7: Assembly Line Emission Test, California

YA9: Axle, 3400 lbs

YBN: Tire: Rear, LT245/75R16C BL R/PE ST TBL OOR

YBX: Tire: Rear, LT245/75R16C WOL R/PE ST TBL OOR

YD3: Front Axle For Scheduling GVW Plate

YD6: Rear Spring, Base Equipment

YD7: Axle for Scheduling GVW Plate, Used with R05

YE9: Convenience Package Comfort and Decor Level #3

YFL: Tire: Rear, P235/75R15 BW R/PE ST TL ALS

YFN: Tire: Rear, P235/75R15N RWL R/PE ST

TL ALS 105S

YF2: Sales Package, Ambulance Upfitter

YF4: Vehicle Engineering, Hold Order

YF5: California Emission Certificate

YF7: Sales Package, Recreational Vehicle Upfitter

YGA: Tire: Rear, P245/75R16 BW R/PE ST TL AT 109S

YGB: Tire: Rear, P245/75R16 WOL R/PE ST TL AT 109S

YGC: Tire: Rear, P265/75R16 BW R/PE ST TL AT 114S

YGD: Tire: Rear, P265/75R16 WOL R/PE ST TL AT 114S

YGK: Tire: Rear, P245/75R16E BL R/PE ST OOR (9591214)

YG4: Optional Seats Not Desired

YHA: Tire: Rear, P235/75R15X BL R/PE ST TL ALS

YHH: Tire: Rear, P245/75R16E BL R/PE ST ALS

YHM: Tire: Rear, P235/75R15 WOL R/PE ST TL ALS 108S (X/LOAD)

YHP: Tire: Rear, LT225/75R16D BL R/PE ST TL ALS

YHR: Tire: Rear, LT225/75R16D BL R/PE ST TL OOR

YTN: Tire: Rear, LT225/70R19.5 BW R/ST ST TL HWY

YYK: Tire: Rear, LT215/85R16D BL R/PE ST TL HWY

YYL: Tire: Rear, LT215/85R16D BL R/PE ST TL OOR

Y91: Sales Package, Luxury (GMT 425)

ZA6: Package Price Leader, Canadian

ZA7: Package Value Leader, Canadian

ZBN: Tire: Spare LT245/75R16C BL R/PE ST TBLE OOR

ZBX: Tire: Spare LT245/75R16C WOL R/PE ST TBLE OOR

ZFL: Tire: Spare P235/75R15 BW R/PE ST TL ALS 105S

ZFN: Tire: Spare P235/75R15N RWL R/PE ST TL ALS 105S

ZGA: Tire: Spare P245/75R16 BW R/PE ST TL ALS 109S

ZGB: Tire: Spare P245/75R16 WOL R/PE ST TL AT 109S

ZGC: Tire: Spare P265/75R16 BW R/PE ST TL AT 114S

ZGD: Tire: Spare P265/75R16 WOL R/PE ST TL AT 114S

ZGK: Tire: Spare LT245/75R16E BL R/PE ST OOR

ZHA: Tire: Spare P235/75R15X BW R/PE ST TL ALS

ZHH: Tire: Spare LT245/75R16E BL R/PE ST ALS

ZHM: Tire: Spare P235/75R15 WOL R/PE ST TL ALS 108S (X/LOAD)

ZHP: Tire: Spare LT225/75R16D BL R/PE ST TL ALS

ZHR: Tire: Spare LT225/75R16D BL R/PE ST TL OOR

ZM9: Sales Package Comfort and Convenience (Utility/Suburban Feature Package)

ZP6: Sales Package Combination, Rear Window Wiper/Rear Window Defogger

ZTN: Tire: Spare LT225/70R19.5F BW R/ST ST TL HWY

ZW9: Body Equipment, Base Body or Chassis Cab

ZYK: Tire: Spare LT215/85R16D BL R/PE ST TL HWY

ZYL: Tire: Spare LT215/85R16D BL R/PE ST TL OOR

ZY1: Color Combination, Solid

ZY2: Color Combination, Two Tone

ZY4: Color Combination, Deluxe Two Tone

Z49: Export, Canadian Modified Mandatory Base Equipment

Z71: Chassis Package Off-Road

Z81: Camper Special

Z82: Trailer Provisions Special equipment, Heavy Duty

Z88: Conversion Name Plate, GMC TRUCK

01L: Exterior Color Secondary, Special

01U: Exterior Color Primary, Special

11L: Secondary Color Exterior, Pewter Metallic

11U: Primary Color Exterior, Pewter Metallic

12U: Primary Color Exterior, Linen White

13C: Trim Combination Cloth, Light Gray

13D: Trim Combination Cloth, Light Gray

13I: Interior Color, Light Gray

13V: Trim Combination Vinyl, Light Gray

132: Trim Combination Leather, Light Gray

19U: Primary Color Exterior, Lamp Black

23U: Primary Color Exterior, Ocean Blue

24L: Secondary Color Exterior, Opal Blue

24U: Primary Color Exterior, Opal Blue

24U: Primary Color Exterior, Medium Blue Metallic

25L: Secondary Color Exterior, Bright Blue Metallic

26C: Trim Combination Cloth, Navy

26D: Trim Combination Cloth, Navy

26I: Interior Trim, Navy

26V: Trim Combination Vinyl, Navy

262: Trim Combination Leather, Navy

27A: Stripe Color Accent, Light Indigo/Dark Indigo

29U: Primary Color Exterior, Dark Blue
31A: Stripe Color Accent, Light SIlver/Dark Indigo
35L: Secondary Color Exterior, Laguna Green
35U: Primary Color Exterior, Laguna Green
39L: Secondary Color Exterior, Indigo Blue Metallic
39U: Primary Color Exterior, Indigo Blue Metallic
41L: Secondary Color Exterior, Black
41U: Primary Color Exterior, Black
43L: Secondary Color Exterior, Emerald Green
43U: Primary Color Exterior, Emerald Green
46U: Primary Color Exterior, Dark Green
50L: Secondary Color Exterior, Olympic White
50U: Primary Color Exterior, Olympic White
51A: Stripe Color Accent, Gunmetal/Ultra Silver
51L: Secondary Color Exterior, Dark Toreador Metallic
51U: Primary Color Exterior, Dark Toreador Metallic
52C: Trim Combination Cloth, Light Neutral
52D: Trim Combination Cloth, Light Neutral
52I: Interior Trim, Light Neutral
52V: Trim Combination Vinyl, Light Neutral
522: Trim Combination Leather, Light Neutral
56A: Stripe Color Accent, Medium Beige/Black
61U: Primary Color Exterior, Tan
65L: Secondary Color Exterior, Smokey Carmel Metallic
65U: Primary Color Exterior, Smokey Carmel Metallic
69L: Secondary Color Exterior, Copper Metallic
69U: Primary Color Exterior, Copper Metallic
71U: Primary Color Exterior, Red Orange
72U: Primary Color Exterior, Standard Red
74L: Secondary Color Exterior, Victory Red
74U: Primary Color Exterior, Victory Red
79C: Trim Combination Cloth, Ruby Red
79D: Trim Combination Cloth, Ruby Red
79I: Interior Trim, Ruby Red
79V: Trim Combination Vinyl, Ruby Red
792: Trim Combination Leather, Ruby Red
80A: Stripe Color Accent, Gunmetal/Light Silver
82A: Stripe Color Accent, Light Silver/Dark Green
83A: Stripe Color Accent, Green/Ultra Silver
84A: Stripe Color Accent, Light Silver/Dark Indigo
87A: Stripe Color Accent, Light Silver/Medium Red
90U: Primary Color Exterior, Gray Metallic
91L: Secondary Color Exterior, Dark Argent

Labels - How to Obtain Replacement

Obtain replacements for the following labels through the GM Service Parts Operations:

- The vehicle emission control information (exhaust emission tune-up) label
- The spare wheel caution label
- The jacking label
- The serpentine belt routing label
- The engine fan caution label
- The spare tire storage label

The following labels are not available as service parts:

- The vehicle certification label
- The tire pressure placard
- The service parts identification label

Exterior and Interior Colors

Exterior Colors

GM Code	WA No.	Color
24	305D	Opal Blue Metallic
25	303D	Bright Blue Metallic
27	146B	Lt. Stellar Blue Metallic
35	304D	Laguna Green
39	9792	Indigo Metallic
41	8555	Black
43	177B	Emerald Green Metallic
50	8624	White
51	334D	Dk. Toreador Metallic
55	228A	Lt. Autumnwood Metallic
59	225C	Red Maple Metallic
65	333D	Smokey Caramel
74	9260	Victory Red
77	9800	Dk. Cherry Metallic
84	9927	Dk. Hunt Club Red
96	8867	Ultra Silver Metallic

Interior Colors

GM Code	WA No.	Color
13I	9779	Medium Gray
26I	173B	Navy Blue
52I	195A	Neutral
79I	9933	Ruby Red

Fasteners

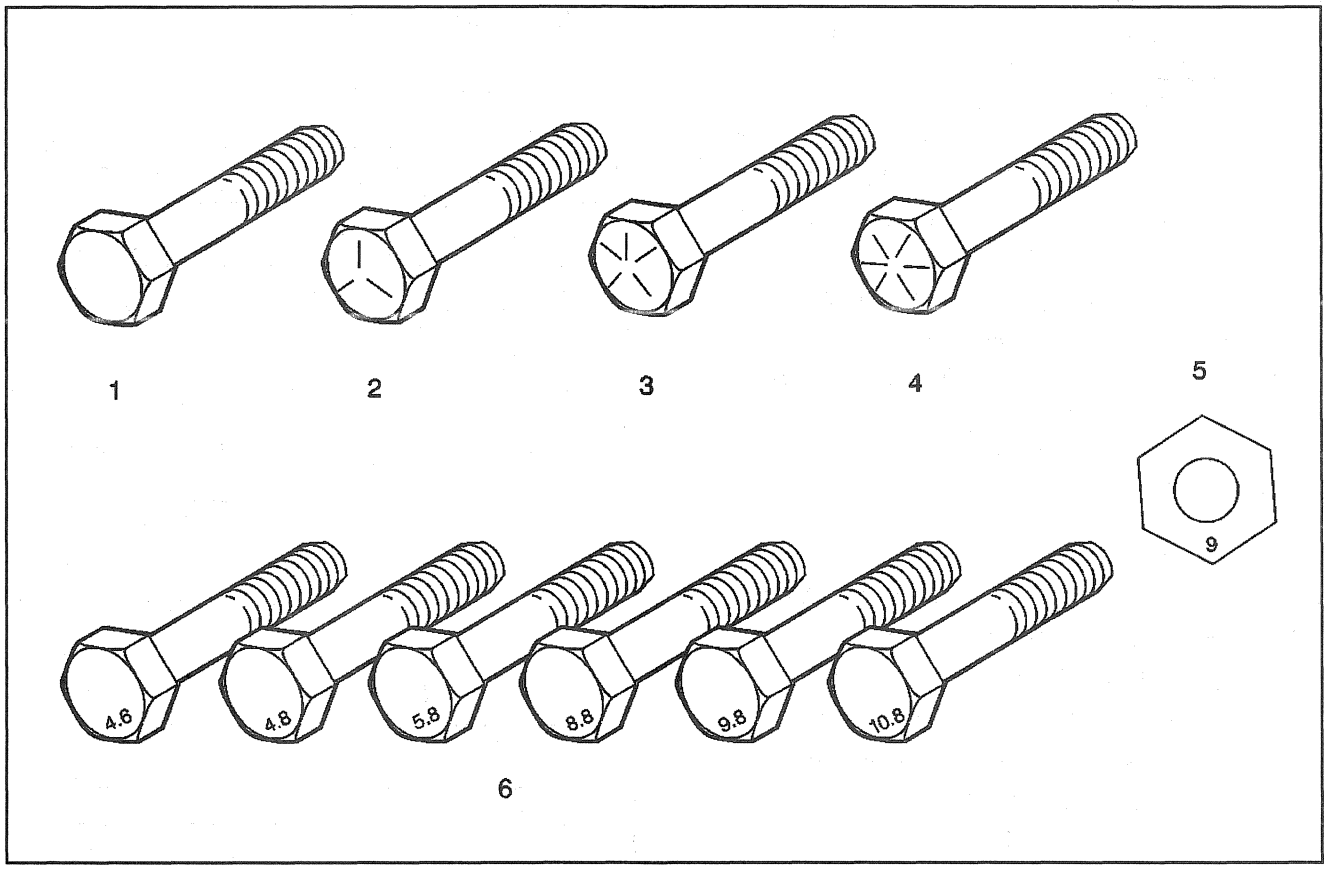
Metric Fasteners

This vehicle is dimensioned in the metric system. Most metric fasteners are very close in diameter to well known fasteners in the English (inch) system. Replace fasteners with those 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



171891

Legend

(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.

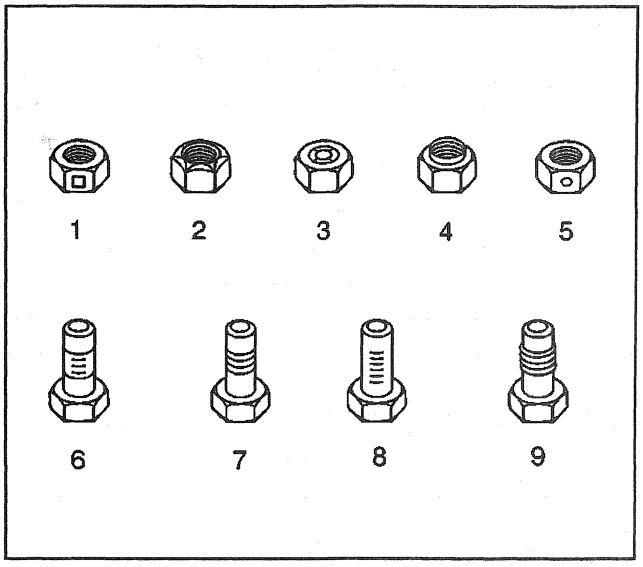
The correct fasteners are available through GM SPO. Many metric fasteners available in the aftermarket parts channels are designed to metric standards of countries other than the United States, and may exhibit the following defects:

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

The metric fasteners on GM products are designed to new, international standards. 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

Prevailing Torque Fasteners



171892

Legend

(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 nut is designed in order to develop an interface between the nut and bolt threads. Distortion of the top of a metal nut or using a nylon patch on the threads in the middle of the hex flat causes that interface.

A prevailing torque bolt/nut that is clean and free of rust may be reused. If there is any doubt, replace the fastener:

1. Clean away all dirt or foreign material.
2. Inspect the fastener for signs of overtightening.
3. Handstart the fastener at the original location.
4. Inspect the fastener for torque development, referring to the table below.
5. Tighten the fastener within specifications.

Prevailing Torque Specifications (Metric-Size Fasteners)

Application	Specification	
	Metric	English
Nuts and All Metal Bolts/Screws		
6 mm	0.4 N·m	4 lb in
6.3 mm	0.4 N·m	4 lb in
8 mm	0.6 N·m	7 lb in
10 mm	1.4 N·m	12 lb in
12 mm	2.2 N·m	18 lb in
14 mm	3.0 N·m	27 lb in
16 mm	4.2 N·m	37 lb in
20 mm	7.0 N·m	62 lb in
Adhesive or Nylon Coated Bolts/Screws		
6 mm	0.4 N·m	4 lb in
6.3 mm	0.4 N·m	4 lb in
8 mm	0.6 N·m	7 lb in
10 mm	1.2 N·m	11 lb in
12 mm	1.6 N·m	14 lb in
14 mm	2.4 N·m	21 lb in
16 mm	3.4 N·m	30 lb in
20 mm	5.6 N·m	50 lb in

Prevailing Torque Specifications (English-Size Fasteners)

Application	Specification	
	Metric	English
Nuts and All Metal Bolts/Screws		
0.250 in	0.4 N·m	4 lb in
0.312 in	0.6 N·m	5 lb in
0.375 in	1.4 N·m	12 lb in
0.437 in	1.6 N·m	16 lb in
0.500 in	2.4 N·m	21 lb in
0.562 in	3.2 N·m	28 lb in
0.625 in	4.2 N·m	37 lb in
0.750 in	7.0 N·m	62 lb in
Adhesive or Nylon Coated Bolts/Screws		
0.250 in	0.4 N·m	4 lb in
0.312 in	0.6 N·m	5 lb in
0.375 in	1.0 N·m	9 lb in
0.437 in	1.4 N·m	12 lb in
0.500 in	1.8 N·m	16 lb in
0.562 in	2.6 N·m	23 lb in
0.625 in	3.4 N·m	30 lb in
0.750 in	5.2 N·m	49 lb in

Thread Inserts

Repair Procedure

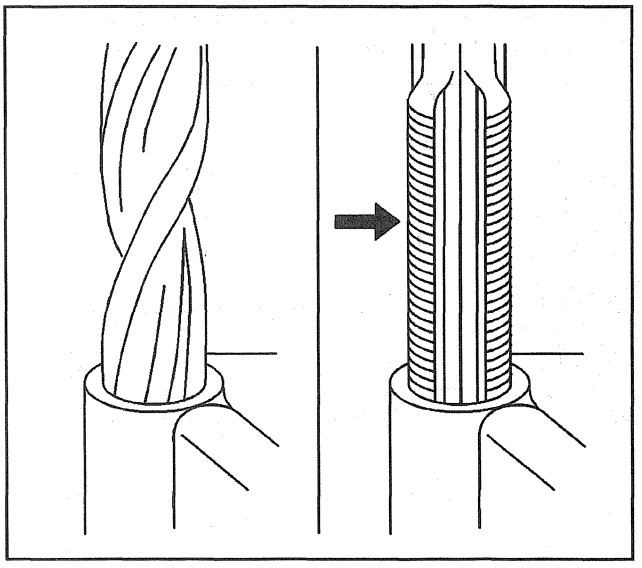
Tools Required

General purpose thread repair kits. These kits are available commercially.

Caution: Wear safety glasses in order to avoid eye damage.

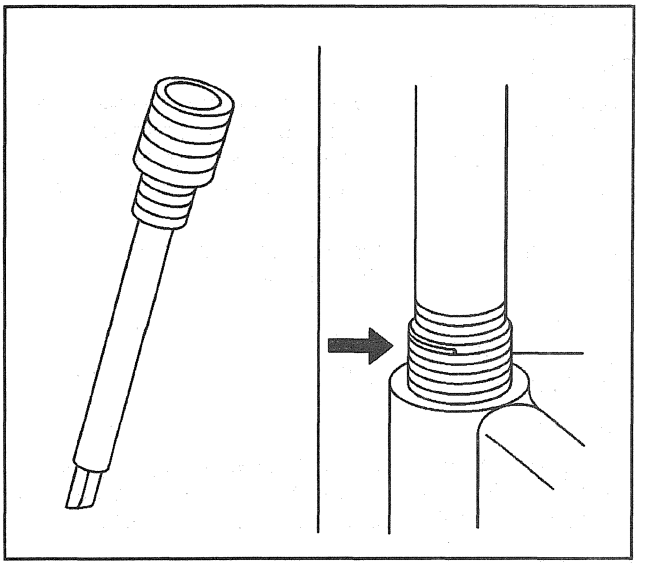
Important: Refer to the thread repair kit manufacturer's instructions regarding the size of the drill and tap to use.

Avoid any buildup of chips. Back out the tap every few turns and remove the chips.



4962

1. Determine the size, the pitch, and the depth of the damaged thread. If necessary, adjust the stop collars on the cutting tool and tap to the required depth.
2. Drill out the damaged threads. Clean out any chips.
3. Lubricate the tap with light engine oil. Tap the hole. Clean the threads.



4963

4. Thread the thread insert onto the mandrel of the installer. Engage the tang of the insert onto the end of the mandrel.

Important: The insert should be flush to one turn below the surface.

5. Lubricate the insert with light engine oil (except when installing in aluminum) and install the insert.
6. If the tang of the insert does not break off when backing out the installer, break the tang off with a drift.

Torque Wrenches

Torque Defined

Torque is defined as the measurement of resistance to turning or rotating. Torque, often called torsional or twisting movement, tends to twist a body about an axis of rotation. A typical application is the tightening of a screw.

Torque applied in tightening a common bolt, nut, or screw is expended in three areas:

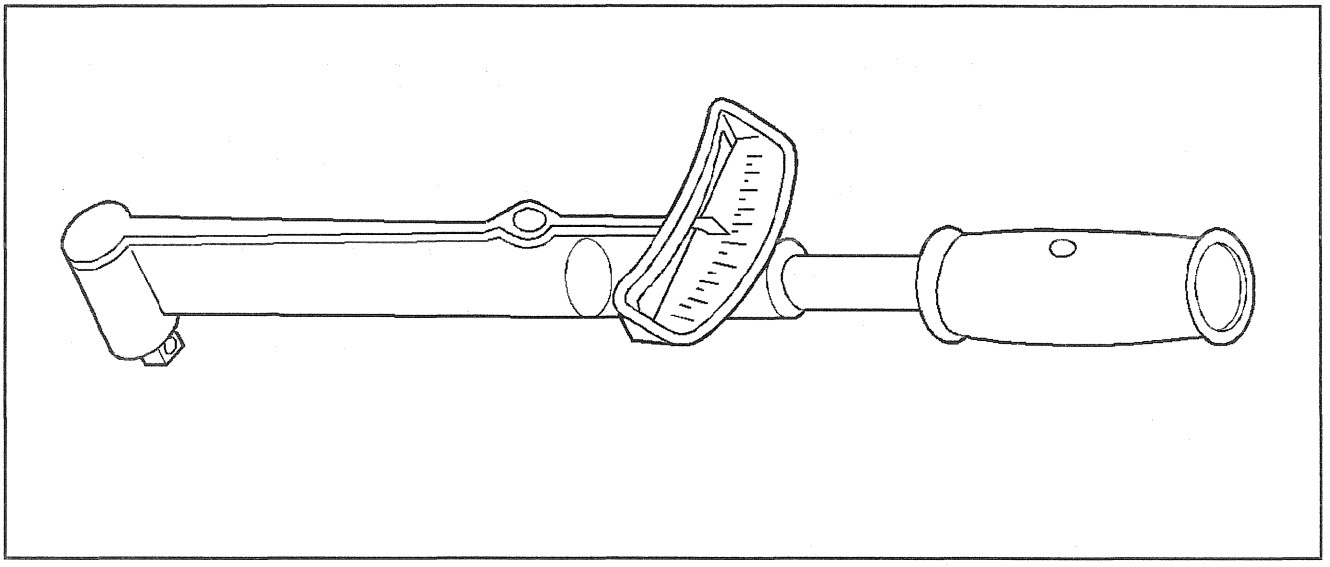
- the head
- bearing surface
- clamp load

Clamp Load

About 50% of applied torque is used in overcoming bearing friction. This is the friction between the bearing surface of the bolt head, screw head or nut face, and the base material or washer (the surface the fastener is rotating on). Approximately 40% of the applied torque is used in overcoming thread friction. this leaves only about 10% of the applied torque to develop useful clamp load. Clamp load is the force that holds a joint together. Friction can account for as much as 90% of the applied torque on a fastener.

Torque Wrenches and Techniques

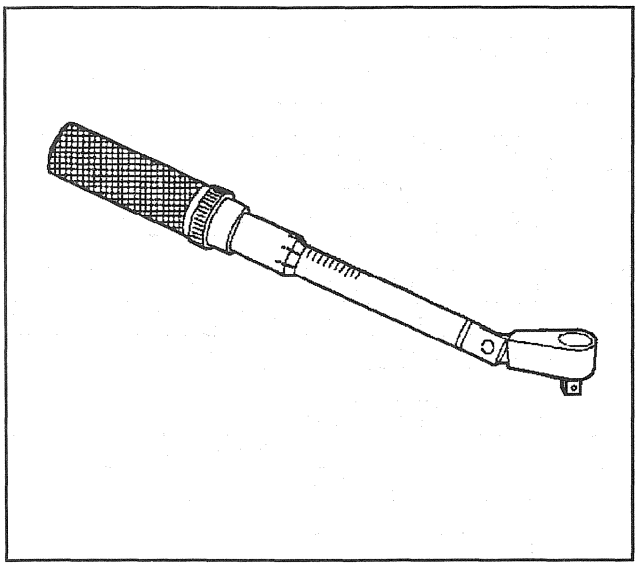
The term "torque wrench" is commonly used to describe a type of measuring tool. The tool is set or calibrated in such a way as to make possible the measurements of the resistance to turning (torque). The torque wrench measures this resistance to turning and, therefore, is the method used to obtain objective tightening data used in the assembly of fasteners. A torque wrench is a gage tool that can be compared with micrometers, dial indicators, vernier calipers, levels, and other measuring devices.



6487

Tapered Beam Model Torque Wrench

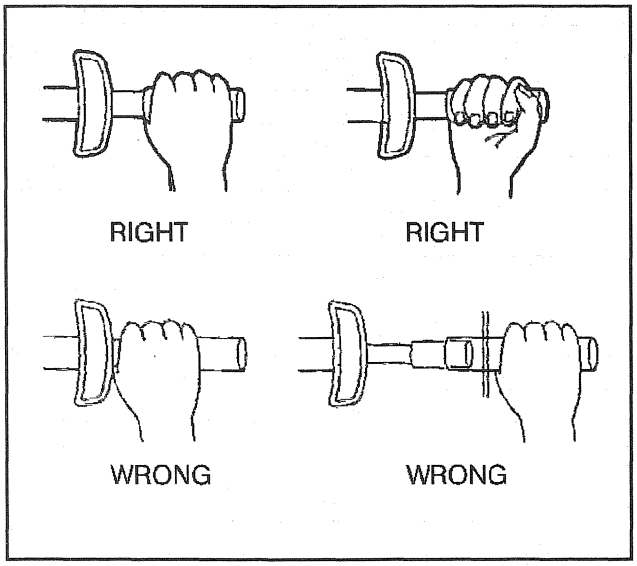
Of the many different types of torque wrenches available, the most popular in the service field is the tapered beam model. This model uses a pointer attached to the head that runs the length of the flexible beam (shaft) to a scale located near the handle. As the wrench is pulled, the beam bends and the pointer indicates the torque on the scale.



6484

Click-type Torque Wrench

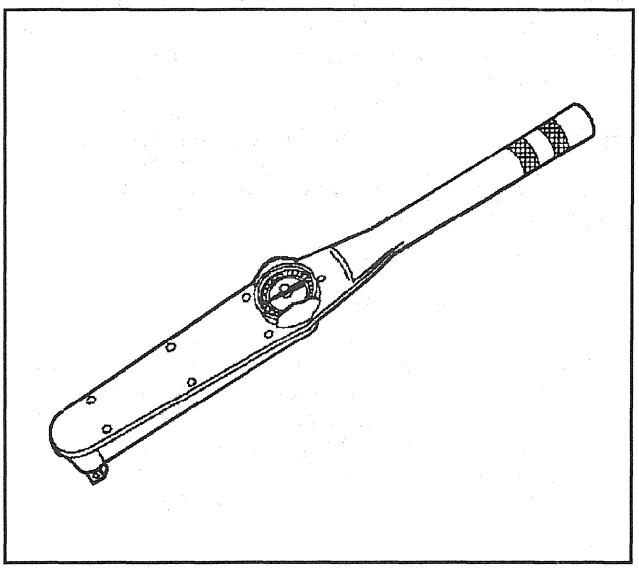
Another type of torque wrench is the "Click" type which is adjusted to a predetermined torque. Once the designated torque has been reached, the wrench has a reflex signalling feature that causes a momentary breakaway of the body of the torque wrench. This feature has the effect of sending a strong impulse to the technician's hand. Although once quite popular, these wrenches are not the preferred method for torque applications.



6485

Pivoted Handle Torque Wrench

Some types of torque wrenches are equipped with a pivoted handle. If used properly, this handle permits the accurate and correct use of the torque wrench. In order to hold a pivoted type handle, it should be floated on the pivot point. This concentrates your pulling force. If the pivoting handle comes in contact with the yoke extension during the process of pulling, there is a very good chance the torque readings will be inaccurate because this could alter the wrench loading point. The design of the handle, however, makes it inconvenient to deliberately use the floating principle improperly.



6486

Direct Reading Torque Wrench

Some of the newer model wrenches, such as the Snap-on® Direct Reading Torqometer wrench (Model TES or equivalent) can be held at any position on the wrench without affecting accuracy. these wrenches are preferred over the flexible beam types because of their greater degree of accuracy, compact design, and scales that are easily readable.

Torque Wrench Accuracy

Selecting the proper size and range of a torque wrench is important in obtaining accurate results. The best quality torque wrenches (the Snap-on® Direct Reading Torqometer models or equivalent) are accurate within 2% of the indicated reading from 20% of full scale to full scale. For example, a 200 N·m (148 lb ft) full scale torque wrench is guaranteed to be accurate from 40 N·m to 200 N·m (30–148 lb ft) (20–100% of full scale). Using this wrench below 40 N·m (30 lb ft) (its guaranteed operating range) could result in inaccurate torque readings and possible joint failure due to either an overtorque or undertorque condition.

Torque Wrench Selection

Since it is not possible to purchase one wrench to fit the widest range of torque specifications in the service environment, the following guidelines should be used for torque wrench selection:

- 0–20 N·m Full Scale (177 lb in). Accurate from 4–20 N·m (35–177 lb in).
- 0–75 N·m Full Scale (55 lb ft). Accurate from 15–75 N·m (11–55 lb ft).
- 0–250 N·m Full Scale (185 lb ft). Accurate from 50–250 N·m (37–185 lb ft).

Torque Wrench Calibration

This is a general guideline and is published to facilitate the selection of a range or torque wrenches that would cover most applications and would remain in the guaranteed accuracy ranges of the wrenches. Once a wrench is put into service, nothing guarantees that the wrench will remain calibrated within its accuracy range. It is recommended, therefore, that torque wrenches be calibrated a minimum of twice annually. Once again, the torque wrench is a precision measuring device. The torque wrench is exposed to a rugged working conditions. Precautions must be taken in order to protect against inaccurate measurements.

Continuous Pull Method

Once a torque wrench is selected, you will use a technique called the "continuous pull method" in order to increase accuracy during torquing. Pull the torque wrench in one continuous, smooth action until the specified torque is reached. There is no jerking or wratcheting during this final tightening effort. The continuous pull method is an excellent way to develop consistency.

Abbreviations and Their Meanings

Abbreviation	Meaning
A	
A	Ampere(s)
ABS	Antilock Brake System
A/C	Air Conditioning
AC	Alternating Current
ACC	Accessory, Automatic Climate Control
ACL	Air Cleaner
ACR4	Air Conditioning Refrigerant, Recovery, Recycling, Recharging
A/D	Analog to Digital
Adj	Adjust
ADL	Automatic Door Lock
A/F	Air/Fuel (Ratio)
AIR	Secondary Air Injection
ALC	Automatic Level Control
Alt	Altitude
AM/FM	Amplitude Modulation/Frequency Modulation
Ant	Antenna
AP	Accelerator Pedal
API	American Petroleum Institute
APP	Accelerator Pedal Position
APT	Adjustable Park Throttle
ARS	Automatic Restraint System
ASR	Acceleration Slip Regulation
A/T	Automatic Transmission/Transaxle
ATC	Automatic Temperature Control
ATC	Automatic Transfer Case
ATDC	After Top Dead Center
Auto	Automatic
avg	average
AWD	All Wheel Drive
AWG	American Wire Gage
A4WD	Automatic Four Wheel Drive
B	
B+	Battery Positive Voltage
B-	Battery Negative Voltage
BARO	Barometric (pressure)
batt	battery
BBV	Brake Booster Vacuum
BCM	Body Control Module
BHP	Brake Horsepower
BLK	Black
BLU	Blue
BP	Back Pressure
BPM	Brake Pressure Modulator
BPP	Brake Pedal Position
BRN	Brown
BTDC	Before Top Dead Center
BTSI	Brake Transmission Shift Interlock
Btu	British thermal units
C	
°C	Degrees Celsius
CAC	Charge Air Cooler
CAFE	Corporate Average Fuel Economy
Cal	Calibration
Cam	Camshaft
CARB	California Air Resources Board
cc	cubic centimeters
CCM	Central 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
cfm	cubic feet per minute
cg	center of gravity
CID	Cubic Inch Displacement
CKP	Crankshaft Position
CKT	Circuit
CL	Closed Loop
C/Ltr	Cigar Lighter
cm3	cubic centimeters
CMP	Camshaft Position
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO2	Carbon Dioxide
Coax	Coaxial
COMM	Communication
Conn	Connector

Abbreviation	Meaning
Conv	Converter
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
CTP	Closed Throttle Position
cu ft	cubic foot/feet
cu in	cubic inch/inches
CV	Contant Velocity (joint)
CVRSS	Continuously Variable Road Sensing Suspension
Cyl	Cylinder(s)
D	
DAB	Delayed Accessory Bus
dB	decibels
dBA	decibels on A-weighted scale
DC	Direct Current
DCM	Door Control Module
DE	Drive End
DEC	Digital Electronic Controller
DERM	Diagnostic Energy Reserve Module
DFI	Direct Fuel Injection
DI	Distributor Ignition
dia	diameter
DIC	Driver Information Center
Diff	Differential
DK	Dark
DLC	Data Link Connector
DMM	Digital Multimeter
DOHC	Dual Overhead Camshafts
DR	Driver
DRL	Daytime Running Lamps
DTC	Diagnostic Trouble Code
DVM	Digital Voltmeter
DVOM	Digital Voltmeter/Ohmmeter
E	
EBCM	Electronic Brake Control Module
EBTCM	Electronic Brake and Traction Control Module
EC	Electrical Center
ECC	Electronic Climate Control
ECI	Extended Compressor at Idle
ECL	Engine Coolant Level
ECM	Engine Control Module
ECS	Emission Control System
ECT	Engine Coolant Temperature
EEPROM	Electronically Erasable Programmable Read Only Memory
EEVIR	Evaporator Equalized Values in Receiver

Abbreviation	Meaning
EFE	Early Fuel Evaporation
EGR	Exhaust Gas Recirculation
EGR TW	Exhaust Gas Recirculation Thermal Vacuum Valve
EI	Electronic Ignition
ELAP	Elapsed
ELC	Electronic Level Control
E/M	English / Metric
EMF	Electromotive Force
Eng	Engine
EOP	Engine Oil Pressure
EOT	Engine Oil Temperature
EPA	Environmental Protection Agency
EPR	Exhaust Pressure Regulator
EPROM	Erasable Programmable Read Only Memory
ESC	Electronic Suspension Control
ESD	Electrostatic Discharge
ETC	Electronic Throttle Control, Electronic Temperature Control
ETCC	Electronic Touch Climate Control
ETR	Electronically Tuned Receiver
EVAP	Evaporative Emission
EVO	Electronic Variable Orifice
Exh	Exhaust
F	
°F	Degrees Fahrenheit
FC	Fan Control
FDC	Fuel Data Center
FED	Federal (all United States except California)
FEDS	Fuel Enable Data Stream
FF	Flexible Fuel
FI	Fuel Injection
FMVSS	Federal Motor Vehicle Safety Standards
F/P	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
G	
g	grams, gravitational accelaration
GA	Gage
gal	gallon
gas	gasoline
GCW	Gross Combination Weight
Gen	Generator
GL	Gear Lubricant
GM	General Motors

Abbreviation	Meaning
GM SPO	General Motors Service Parts Operations
gnd	ground
gpm	gallons per minute
GRN	Green
GRY	Gray
GVWR	Gross Vehicle Weight Rating
H	
H	Hydrogen
H2O	Water
Harn	Harness
HC	Hydrocarbons
H/CMPR	High Compression
HD	Heavy Duty
HDC	Heavy Duty Cooling
hex	hexagon
Hg	Mercury
Hi Alt	High Altitude
HO2S	Heated Oxygen Sensor
hp	horsepower
HPL	High Pressure Liquid
HPS	High Performance System
HPV	High Pressure Vapor
Htd	Heated
HTR	Heater
HUD	Head-up Display
HVAC	Heater-Vent-Air Conditioning
HVACM	Heater-Vent-Air Conditioning Module
HVM	Heater Vent Module
Hz	Hertz
I	
IAC	Idle Air Control
IAT	Intake Air Temperature
IC	Integrated Circuit, Ignition Control
ICM	Ignition Control Module
ID	Identification, Inside Diameter
IDI	Integrated Direct Ignition
ign	ignition
ILC	Idle Load Compensator
in	inch/inches
INJ	Injection
inst	instantaneous
int	intake
I/P	Instrument Panel
IPC	Instrument Panel Cluster
I/PEC	Instrument Panel Electrical Center
ISC	Idle Speed Control
ISO	International Standards Organization
ISS	Input Speed Shaft
K	
KAM	Keep Alive Memory
KDD	Keyboard Display Driver

Abbreviation	Meaning
kg	kilogram
kHz	kilohertz
km	kilometer
km/h	kilometers per hour
km/l	kilometers per liter
kPa	kilopascals
KS	Knock Sensor
kV	kilovolts
L	
L	Liter
L4	Four Cylinder Engine, In-line
L6	Six Cylinder Engine, In-Line
lb	pound
lb ft	pound feet (torque)
lb in	pound inch (torque)
LCD	Liquid Crystal Display
LDCL	Left Door Closed Locking
LDCM	Left Door Control Module
LED	Light Emitting Diode
LF	Left Front
LH	Left Hand
lm	lumens
LR	Left Rear
lt	left
LT	Light
LTPWS	Low Tire Pressure Warning System
M	
MAF	Mass Air Flow
Man	Manual
MAP	Manifold Absolute Pressure
MAT	Manifold Absolute Temperature
max	maximum
M/C	Mixture Control
MDP	Manifold Differential Pressure
MFI	Multiport Fuel Injection
mi	miles
MIL	Malfunction Indicator Lamp
min	minimum
ml	milliliter
mm	millimeter
mpg	miles per gallon
mph	miles per hour
ms	millisecond
MST	Manifold Surface Temperature
M/T	Manual Transmission/Transaxle
MV	Megavolt
mV	millivolt
N	
NAES	North American Export Sales
NC	Normally Closed
NEG	Negative
Neu	Neutral

Abbreviation	Meaning
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
NVRAM	Non Volatile Random Access Memory
O	
O2	Oxygen
O2S	Oxygen Sensor
ODB	On-Board Diagnostics
OBD II	On-Board Diagnostics II
OC	Oxidation Converter (Catalytic)
OD	Outside Diameter
ODO	Odometer
OE	Original Equipment
OEM	Original Equipment Manufacturer
OHC	Overhead Camshaft
OL	Open Loop
ORC	Oxidation Reduction Converter (Catalytic)
ORN	Orange
OSS	Output Shaft Speed
oz	ounce(s)
P	
PAG	Polyalkylene Glycol
PAIR	Pulsed Secondary Air Injection
PASS	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
PID	Parameter Identification
PM	Permanent Magnet (Generator)
P/N	Part Number
PNK	Pink
PNP	Park/Neutral Position
PNRDL	Park, Neutral, Reverse, Drive, Low
POA	Pilot Operated Absolute (Valve)
POS	Positive
POT	Potentiometer (Variable Resistor)
PPL	Purple
ppm	parts per million
PROM	Programmable Read Only Memory
P/S	Power Steering
PSD	Power Sliding Door
PSP	Power Steering Pressure
psi	pounds per square inch

Abbreviation	Meaning
psia	pounds per square inch absolute
psig	pounds per square inch gage
pt	pint
PWM	Pulse Width Modulated
Q	
qt	quart(s)
R	
R-12	Refrigerant-12
R-134a	Refrigerant-134a
RAM	Random Access Memory (non permanent memory devise, 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
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 devise, memory contents are retained when power is removed)
RPM	Engine Speed (Revolutions Per Minute)
RPO	Regular Production Option
RR	Right Rear
rt	right
RTD	Real Time Damping
RTV	Room Temperature Vulcanizing (sealer)
RWAL	Rear Wheel Antilock
RWD	Rear Wheel Drive
S	
s	second(s)
SAE	Society of Automotive Engineers
SC	Supercharger
SCB	Supercharger Bypass
SCM	Seat Control Module
SCPI	Sequential Central Port Injection
SDM	Sensing and Diagnostic Module
SEO	Special Equipment Option
SFI	Sequential Multiport Fuel Injection
SI	System International (modern version of metric system)
SIR	Supplemental Inflatable Restraint
SLA	Short/Long Arm (suspension)
sol	solenoid
SO2	Sulfur Dioxide

Abbreviation	Meaning
SP	Splice Pack
SPO	Service Parts Operations
sq ft	square foot/feet
sq in	square inch/inches
SRC	Service Ride Control
SRI	Service Reminder Indicator
SS	Shift Solenoid
ST	Scan Tool
Stat	Status
S4WD	Selectable Four Wheel Drive
Sw	Switch
syn	synchronizer
T	
TAC	Throttle Actuator Control
Tach	Tachometer
TAP	Transmission Adaptive Pressure
TBI	Throttle Body Fuel Injection
TC	Turbocharger
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 Hydra-Matic
TP	Throttle Position
TPA	Terminal Positive Assurance
TPM	Tire Pressure Monitoring
TR	Transmission Range
TRANS	Transmission/Transaxle
TV	Throttle Valve
TVRS	Television and Radio Suppression
TVV	Thermal Vacuum Valve
TWC	Three Way Converter (Catalytic)
TWC+OC	Three Way + Oxidation Converter (Catalytic)
TXV	Thermal Expansion Valve
U	
UART	Universal Asynchronous Receive and Transmit
U/H	Underhood
U/HEC	Underhood Electrical Center
U-joint	Universal Joint
UTD	Universal Theft Deterrent
UV	Ultraviolet
V	
V	Volt(s), Voltage
V6	Six Cylinder Engine, V-Type
V8	Eight Cylinder Engine, V-Type
Vac	Vacuum
VAC	Vehicle Access Code

Abbreviation	Meaning
VATS	Vehicle Anti-Theft System
VCM	Vehicle Control Module
VDOT	Variable Displacement Orifice Tube
VDV	Vacuum Delay Valve
vel	velocity
VES	Variable Effort Steering
VF	Vacuum Fluorescent
VIO	Violet
VIN	Vehicle Identification Number
VMV	Vacuum Modulator Valve
VR	Voltage Regulator Vacuum Regulator
V ref	Voltage Reference
VSS	Vehicle Speed Sensor
W	
w/	with
W/B	Wheel Base
WHL	Wheel
WHT	White
w/o	without
WOT	Wide Open Throttle
W/P	Water Pump
W/S	Windshield
WSS	Wheel Speed Sensor
WU-OC	Warm Up Oxidation Converter (Catalytic)
WU-TWC	Warm Up Three Way Converter (Catalytic)
X	
X-valve	Expansion valve
Y	
yd	yard(s)
YEL	Yellow

Key and Lock Cylinder Coding

Key Identification and Usage

The lock cylinder keyway is designed so that other model keys will not enter a current model lock cylinder. A single key is used for all locks on the vehicle.

The key identification is obtained from the four-character key code stamped on the knockout portion of the key head. Knock the plugs out of the key head after code numbers have been recorded. The code list, available to owners of key cutting equipment from equipment suppliers, determines the lock combinations from the code numbers.

Cutting Keys

After the code has been determined from the code list or the key code diagram, perform the following steps:

1. Cut a blank key to the proper level of each of the tumbler positions.
2. Inspect the key operation in the lock cylinder.

Replacement Lock Cylinders

New lock cylinders (except ignition lock cylinders) are available from the service parts warehouse with new lock cylinder locking bars. The tumblers are also available and must be assembled into the cylinder as recommended. For additional information, refer to the following.

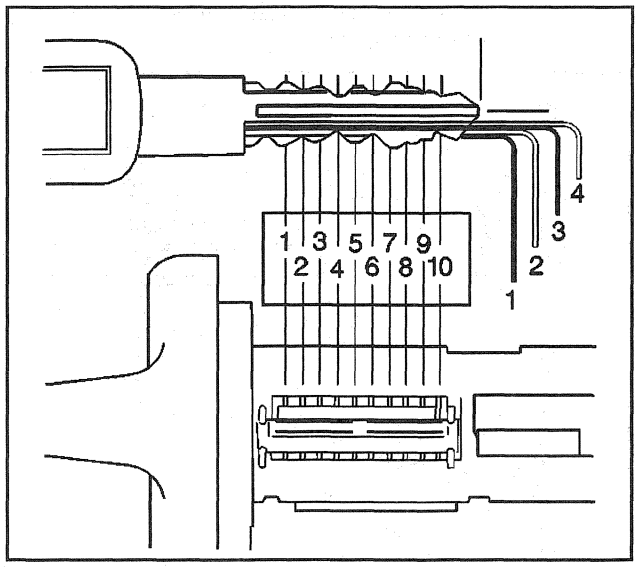
Lock Cylinder Tumbler Operation

All lock tumblers are shaped alike with the exception of the notched position on one side. As the key is inserted into the lock cylinder, the tumblers are lowered to the correct height so that notches on each tumbler are at the same level. When the notches on all six tumblers line up, two small springs push the side bar into the notches, allowing the cylinder to turn in the cylinder bore. Five types of tumblers are used in making the lock combinations, and each is coded and stamped with a number between 1 and 5.

Assembling and Coding Ignition Lock Cylinders

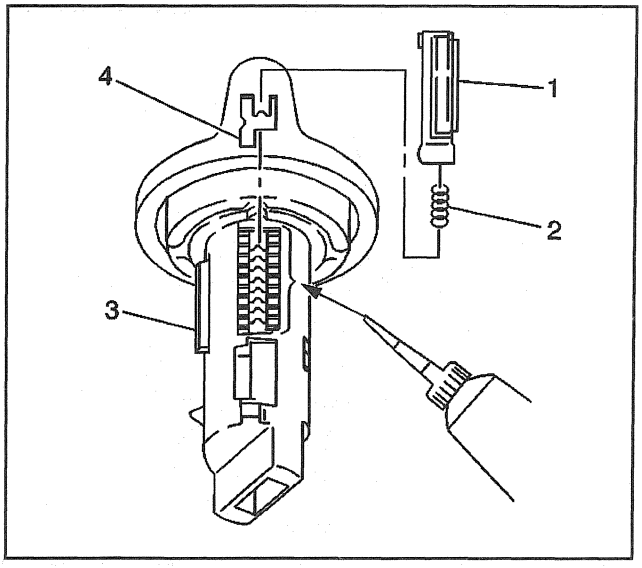
Tools Required

J 41340 Lock Cylinder Staking and Holding Fixture



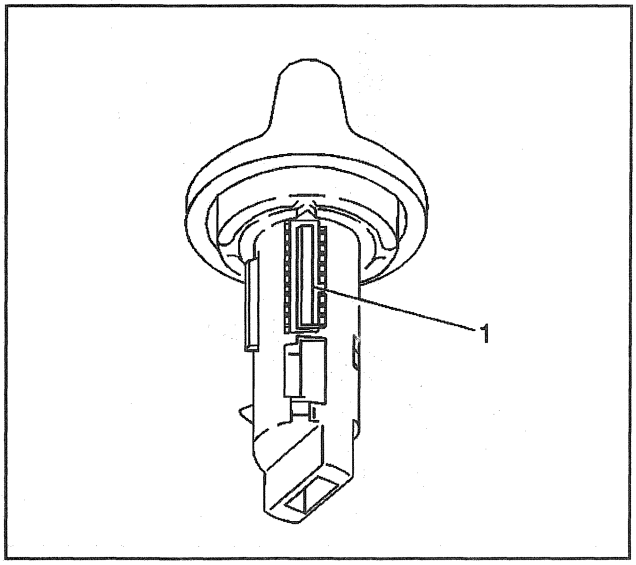
65496

1. Determine the tumbler numbers/arrangement:
   - 1.1. Place the tip of the key directly over the tip of the illustrated key.
   - 1.2. Inspect that the diagram outlines the key.
   - 1.3. Starting with position 1 (open end of cylinder), find and record the lowest level (tumbler number) that is visible.
   - 1.4. Repeat the previous step for positions 2–10.



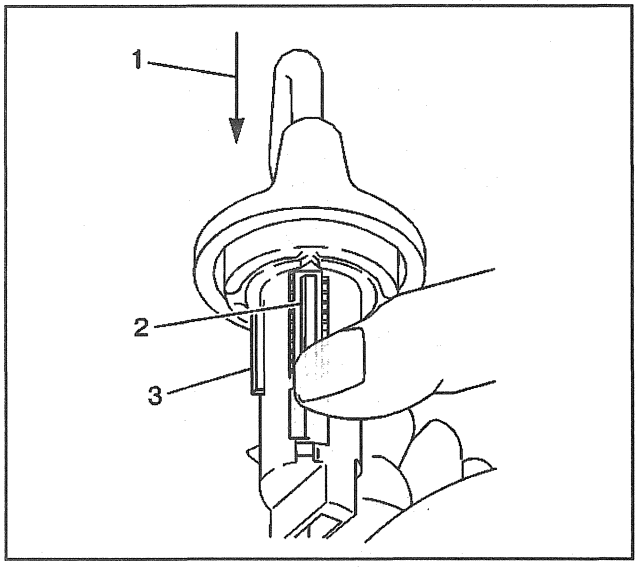
65498

2. Starting with position 1, insert the tumblers (4) into their corresponding slots in the coded order.
3. Using your fingers, pull out the side bar (3) until the tumblers fall completely into place.
4. Insert one tumbler spring (2) above each tumbler (4).
5. Lubricate the tumblers using Superlube® GM P/N 12346241 or equivalent.
6. Insert the spring retainer (1) prongs into the slots at the end of each cylinder.



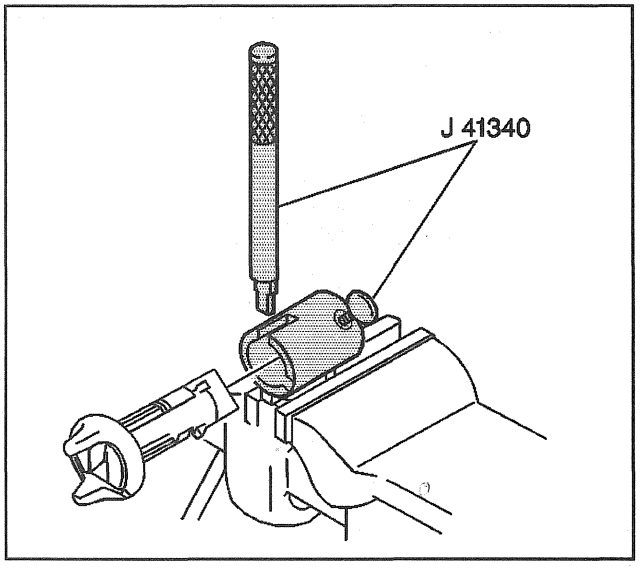
65499

7. Press down the retainer (1) until fully seated in the depression.



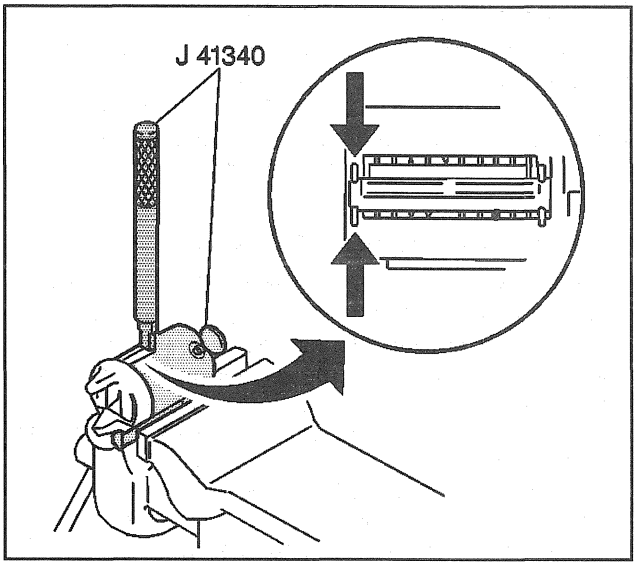
65501

8. Inspect for proper tumbler installation:
   - 8.1. Hold the spring retainer (2) in position.
   - 8.2. Insert the key (1) into the cylinder.
   - 8.3. The side bar (3) should drop down flush with the cylinder diameter if properly installed.
   - 8.4. Disassemble and assemble properly as needed.
9. Remove the key.



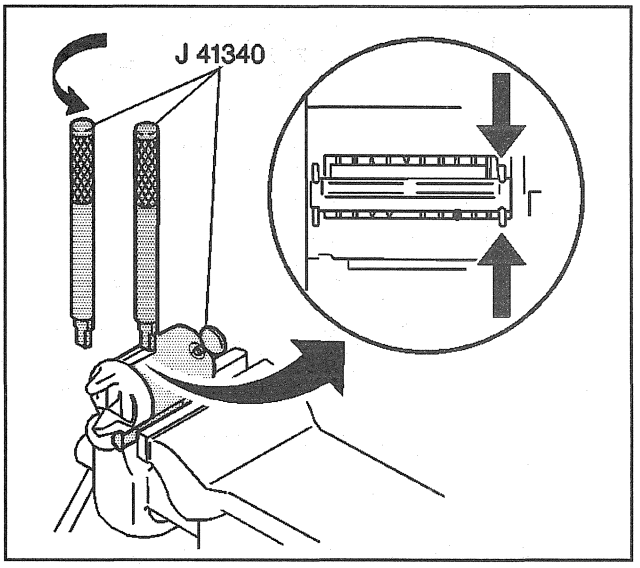
65502

10. Secure the cylinder in the *J 41340*.
    - 10.1. Inspect that the spring retainer is facing up and positioned directly under the punch slots.
    - 10.2. Push the cylinder into the *J 41340* until butted with the cylinder bezel.
    - 10.3. Tighten the holding screw.



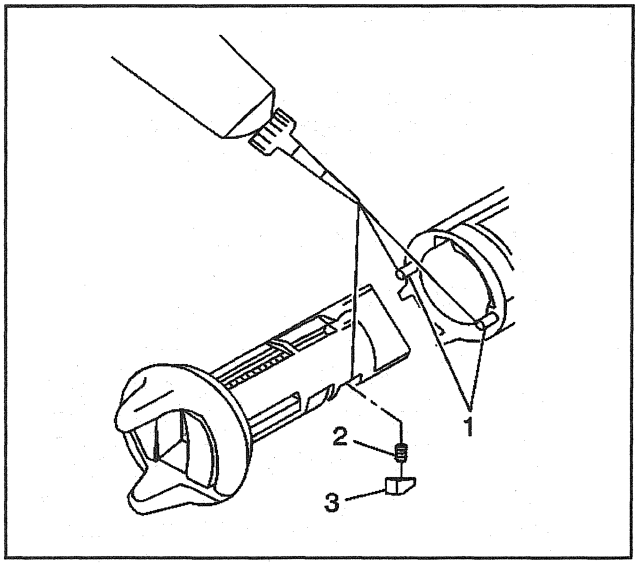
65503

11. Stake the bezel end of the retainer in place:
    - 11.1. Hold the flat side of the punch, part of *J 41340*, squarely against the face of the cylinder bezel.
    - 11.2. Stake the lock cylinder metal over the retainer corners.



65504

12. Stake the other end of the retainer:
    - 12.1. Remove the punch, part of *J 41340*.
    - 12.2. Rotate the punch, part of *J 41340*, 180 degrees.
    - 12.3. Hold the punch, part of *J 41340*, squarely against the end of the punch slot on *J 41340*.
    - 12.4. Stake the metal over the other end of the retainer.



65505

13. Loosen the holding screw.
14. Remove the cylinder from the *J 41340*.
15. Inspect that the retainer is properly staked. Restake as needed.
16. Lubricate the cylinder retainer slot.
17. Insert the following parts into the cylinder retainer slot:
    - The retainer spring (2)
    - The retainer (3)

Important: Use a paste type grease, not a spray, for the following step.

18. Lubricate the following parts with GM P/N 12345996 or equivalent as needed:
    - The detent pins (1)
    - The cylinder retainer (3)

Side Door Lock Cylinder Coding

The side door lock cylinder has five snap-in tumblers. The number 1–5 positions (beginning closest to the cylinder head) is a brass retainer tumbler. The 6–10 positions are standard tumbler positions. Therefore, only the 6–10 positions are required.

Lifting and Jacking the Vehicle

Caution: To help avoid personal injury, always use jack stands when you are working on or under any vehicle that is supported only by a jack.

Caution: To help avoid personal injury, when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which you are removing components. The additional support will reduce the possibility of the vehicle falling off the hoist. When you are removing major components from the vehicle while the vehicle is on a hoist, chain the vehicle frame to the hoist pads at the same end from which you are removing the major components to prevent tip-off. If you fail to follow these precautionary measures, vehicle damage, serious personal injury, or death may result.

Notice: When you are jacking or lifting a vehicle at the frame side rails or other prescribed lift points, be certain that the lift pads do not contact the catalytic converter, the brake pipes or the fuel lines. If such contact occurs, vehicle damage or unsatisfactory vehicle performance may result.

For lifting the vehicle, various lift points are recommended. Before you begin any lifting procedure, be sure the vehicle is on a clean, hard, level surface. Be sure all the lifting equipment meets weight standards and is in good working order. Be sure all the vehicle loads are equally distributed and secure. If you are only supporting the vehicle at the frame side rails, make sure the lifting equipment does not put too much stress on or weaken the frame side rails.

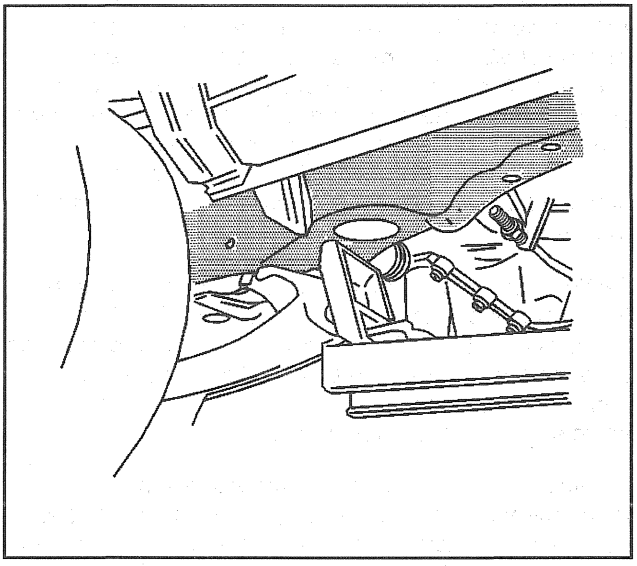
If you use any other hoisting methods than those called out, take special care not to damage the fuel tanks, the exhaust system or the underbody.

Frame Contact Hoist

Front Hoist Pads

Position the (frame contact) front hoist pads under the front frame between the lower control arm and the frame pad or the front frame pad when using a tip-up hoist pad.

Important: The front hoist pads must not contact the rocker panels, the front fenders, or the floor pan.

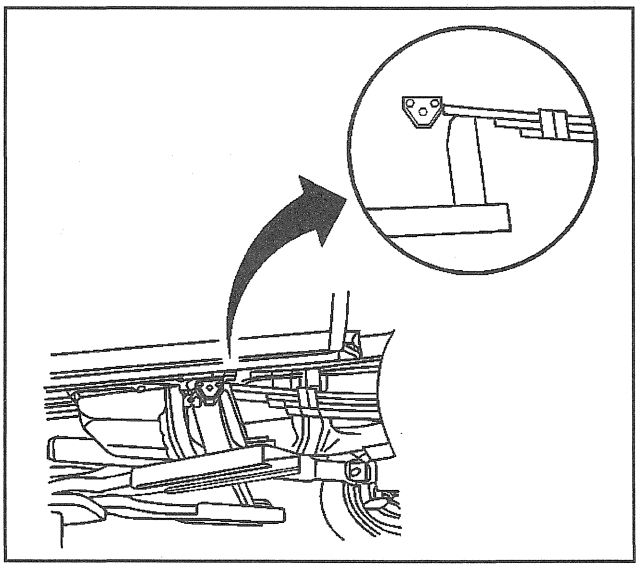


174078

Rear Hoist Pads

Position the (body/frame contact) rear hoist pads under the rear spring, just behind the hanger, for the tip-up pad only.

Important: The rear hoist pads must not contact the body rocker panels or the floor pan.

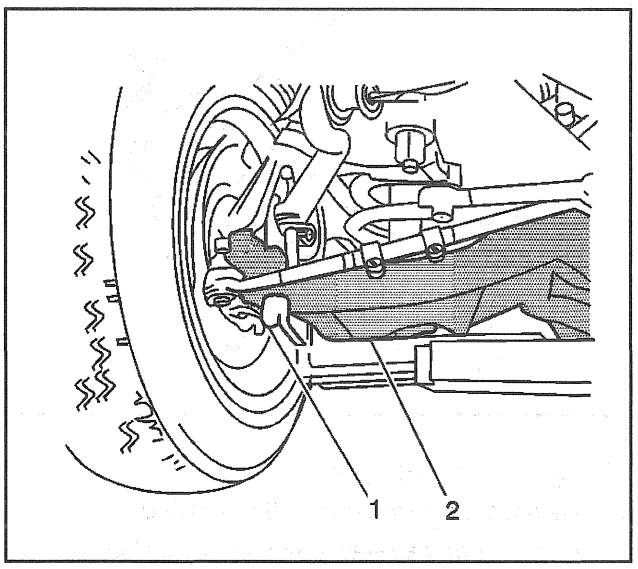


174087

Suspension Contact Hoist

Front Lift

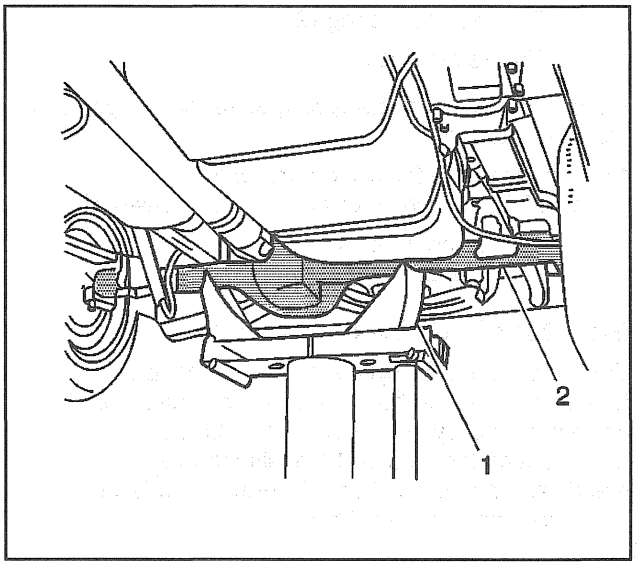
Position the (suspension contact) front lift under the outer edge of the front suspension lower control arms.



175244

Rear Lift

Position the (suspension contact) rear lift under the axle housing tubes on each side of the differential.



175245

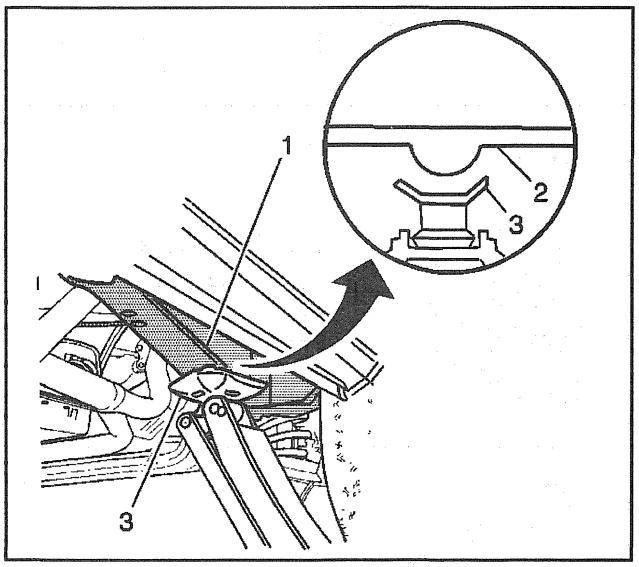
Jacking

When you are lifting a vehicle with a vehicle jack or a floor jack, block the wheels at the opposite end from which you are lifting. Use jack stands to provide additional support.

Under the Frame Rails

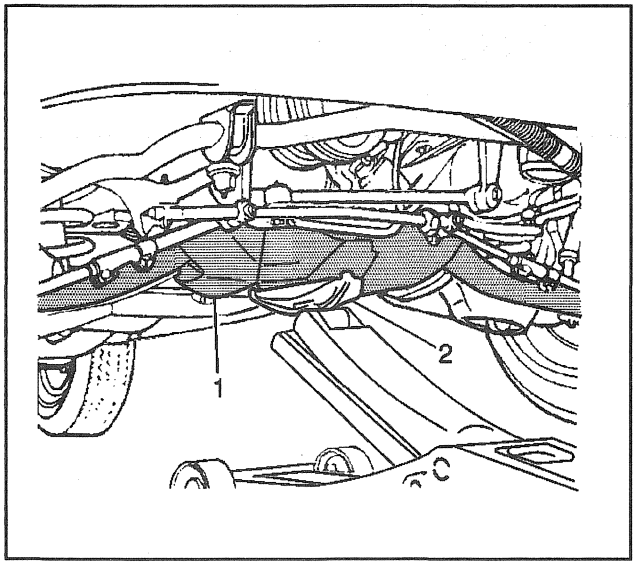
Important: The floor jack pad must not contact rocker panel or the floor pan.

Position the floor jack pad under the frame rail pad.



175238

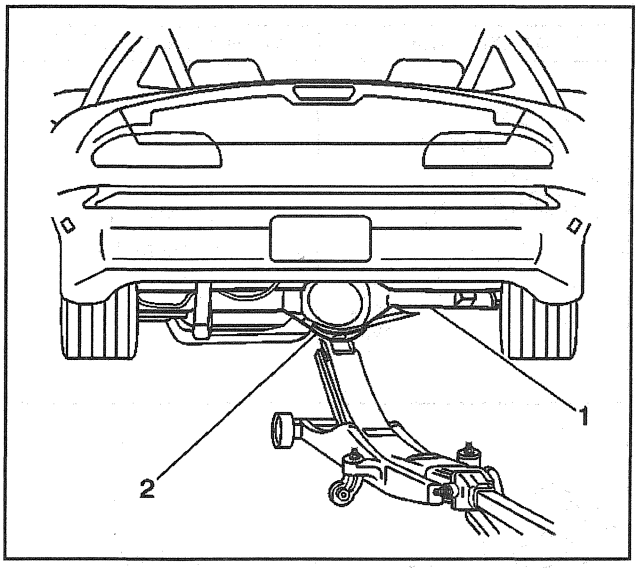
Under the Front Suspension Crossmember



175243

Position the floor jack pad under the center of the front suspension crossmember.

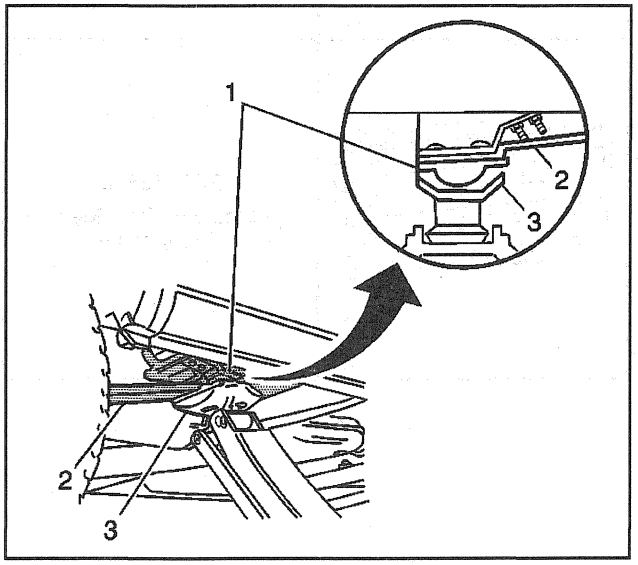
Under the Rear Differential



175241

Position the floor jack pad under the center of the rear axle differential.

Under the Rear Spring Hanger



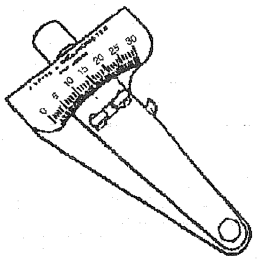
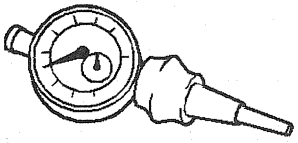
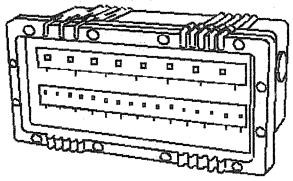
175237

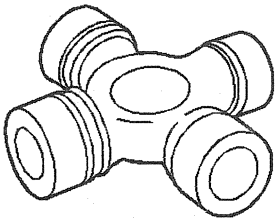
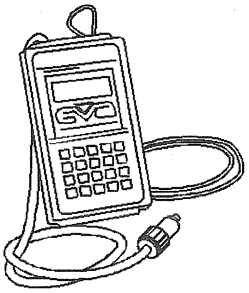
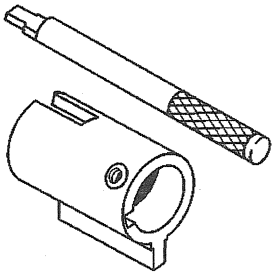
Position the jack under the rear spring hanger.

Jack Stands

Important: When supporting the vehicle with jack stands, the jack stands should be placed under the frame, the front suspension crossmember, or the rear axle.

Special Tools and Equipment

Tool Illustration	Tool No. and Description
 8224	J 23498-A Inclinometer
 5714	J 29763 Dial Indicator
 6825	P/N 313510 Biddle Frahm Reed Tachometer

Tool Illustration	Tool No. and Description
 1512	J 35819 Companion Flange Runout Gage
 6826	J 38792 Electronic Vibration Analyzer (EVA)
 65540	J 41340 Ignition Lock Holding Fixture

Maintenance and Lubrication

Specifications

Drive Belt Tension Specifications

Serpentine Belt

Belt tension is maintained by a spring tensioned idler pulley.

No adjustment of the serpentine belt is necessary.

Approximate Fluid Capacities

Application	Metric	English
Engine Cooling System	Liters	Quarts
4.3L (VIN W) With Air Conditioning	12.3	13.0
4.3L (VIN W) Without Air Conditioning	12.3	13.0
5.0L (VIN M) With Air Conditioning	17.0	18.0
5.0L (VIN M) Without Air Conditioning	16.6	17.5
5.7L (VIN R) With Air Conditioning	19.0	20.0
5.7L (VIN R) Without Air Conditioning	16.6	17.5
5.7L (VIN R) With Air Conditioning - C 3500 HD	25.5	27.0
5.7L (VIN R) Without Air Conditioning - C 3500 HD	25.0	26.5
6.5L (VIN F and S)With Air Conditioning	26.0	27.5
6.5L (VIN F and S) Without Air Conditioning	26.0	27.5
7.4L (VIN J) With Air Conditioning	26.0	27.5
7.4L (VIN J) Without Air Conditioning	23.5	25.0
7.4L (VIN J) With Air Conditioning - C 3500 HD	27.0	28.5
7.4L (VIN J) Without Air Conditioning - C 3500 HD	25.0	26.5
Engine Crankcase	Liters	Quarts
4.3L (VIN W) With Filter	4.3	4.5
5.0L (VIN M) With Filter	4.8	5.0
5.7L (VIN R) With Filter	4.8	5.0
6.5L (VIN F and S) Roth Filter	7.6	8.0
7.4L (VIN J) Roth Filter	6.5	7.0
Transmission	Liters	Quarts
4L60-E	4.7	5.0
4L60-E After Complete Overhaul	10.6	11.0
4L80-E	7.3	7.7
4L80-E After Complete Overhaul	12.8	13.5
New Venture Gear 3500 Manual Transmission	2.0	2.2
New Venture Gear 4500 Manual Transmission	3.78	4.0
Transfer Case	Liters	Quarts
New Venture 241	2.13	2.25
New Venture 243	2.13	2.25
Borg Warner 4401	3.1	3.28
Borg Warner 4470	3.1	3.28
Fuel Tank	Liters	Gallons
Short Bed Models	98.0	26.0
Long Bed Models	128.0	34.0
Crew Cab Models	128.0	34.0
Chassis-Cab (Standard Side Tank)	87.0	23.0

Approximate Fluid Capacities (cont'd)

Application	Metric	English
Chassis-Cab (Optional Rear Tank)	68.0	18.0
C3500HD (Standard Side Tank)	87.0	23.0
C3500HD (Optional Rear Tank)	68.0	18.0
Two-Door Utility	113.0	30.0
Four-Door Utility	113.0	30.0
Suburban (Gas Engine)	166.6	44.0
Suburban (Diesel Engine)	159.0	42.0

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. To determine the preferred viscosity for your vehicle's engine, refer to the Owner's Manual
Engine Coolant	50/50 mixture of clean water (preferably distilled) and use only GM Goodwrench® DEX-COOL® or Havoline® DEX-COOL® coolant.
Hydraulic Brake System	Delco Supreme 11® Brake Fluid (GM P/N 12377967 or equivalent DOT-3 brake fluid).
Park Brake Cable Guides	Chassis lubricant (GM P/N 12377985 or equivalent) meeting requirements of NLGI Grade 2, Category GC or GC-LB
Power Steering System	GM Hydraulic Power Steering Fluid (GM P/N 1052884 - 1 pint, 1050017 - 1 quart, or equivalent).
Automatic Transmission	DEXRON®-III Automatic Transmission Fluid
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 GC or GC-LB.
Front Wheel Bearings-RWD	Wheel bearing lubricant (GM P/N 1051344) or equivalent) or lubricant meeting requirements of NLGI Grade 2, Category GC or GC-LB
Differential, Standard, Front and Rear Axle	Axle Lubricant (GM P/N 1052271) or SAE 80W-90 GL-5 Gear Lubricant.
Differential, Locking	Axle Lubricant (GM P/N 1052271) or SAE 80W-90 GL-5 Gear Lubricant.
Transfer Case	DEXRON®-III Automatic Transmission Fluid
Windshield Washer Solvent	GM Optikleen® Washer Solvent (GM P/N 1051515) or equivalent
Hood Latch Assembly • Pivots and Spring Anchor • Release Pawl	Lubriplate lubricant aerosol (GM Part No. 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).
Weatherstrip Conditioning	Dielectric Silicone Grease (GM P/N 12345579 or equivalent).

Tire Inflation Pressure Specifications

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

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

Check the tire pressure when the following apply:

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

Check the tires monthly or before any extended trip. Adjust the tire pressure to the specifications on the tire placard. Refer to *Tire Placard* in General Information. Install the valve caps or extensions on the valves. These keep out dust and water.

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

Inflation Pressure Conversion Chart (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

Maintenance Items

Usage	Type
Air Cleaner	
4.3L (VIN W)	AC Type A1300C
5.0L (VIN M)	AC Type A1300C
5.7L (VIN R)	AC Type A1300C
6.5L (VIN F and S)	AC Type A1300C/A1306C
7.4L (VIN J)	AC Type A1300C
Engine Oil Filter	
4.3L (VIN W) RWD AND S4WD	AC Type PF-52
5.0L (VIN M) RWD	AC Type PF-1218
5.0L (VIN M) S4WD	AC Type PF-52
5.7L (VIN R) RWD	AC Type PF-1218
5.7L (VIN R) S4WD	AC Type PF-52
6.5L (VIN F and S) RWD AND S4WD	AC Type PF-1218
7.4L (VIN J) RWD AND S4WD	AC Type PF-1218
PCV Valve	
4.3L (VIN W)	AC Type CV746C
5.0L (VIN M)	AC Type CV796C
5.7L (VIN R)	AC Type CV796C
7.4L (VIN J)	AC Type CV774C

Maintenance Items (cont'd)

Usage	Type
Spark Plugs and Gaps	
4.3L (VIN W)	AC Type 41-932 (GAP 1.52 mm, 0.060 in)
5.0L (VIN M)	AC Type 41-932 (GAP 1.52 mm, 0.060 in)
5.7L (VIN R)	AC Type 41-932 (GAP 1.52 mm, 0.060 in)
7.4L (VIN J)	AC Type 41-932 (GAP 1.52 mm, 0.060 in)
Fuel Filter	
4.3L (VIN W)	AC Type GF-626
5.0L (VIN M)	AC Type GF-626
5.7L (VIN R)	AC Type TP-1006
7.4L (VIN J)	AC Type GF-626
Radiator Cap	
4.3L (VIN W)	AC Type RC-36
5.0L (VIN M)	AC Type RC-36
5.7L (VIN R)	AC Type RC-36
6.5L (VIN F and S)	AC Type RC-33
7.4L (VIN J)	AC Type RC-36

Maintenance

Maintenance Schedule (Gasoline)

Using The Maintenance Schedule

Because of the different ways GM vehicles are used, maintenance needs vary. More frequent maintenance intervals than found in this manual may by needed. When reading this section, keep in mind the conditions under which the vehicle is operated, and adjust the maintenance intervals accordingly.

The proper fluids and lubricants to use are listed in Fluid and Lubricant Recommendations. Use the proper fluids and lubricants whenever servicing this vehicle.

The maintenance schedules found in this manual are for vehicles that:

- Carry passengers and cargo within recommended limits.
- Are driven on reasonable road surfaces within legal driving limits.
- Are driven off-road in the recommended manner. Refer to the Owner's Manual.
- Use recommended fuel.

Selecting The Right Schedule

First you will need to decide which of the two schedules is right for your vehicle. Diesel engine vehicles have different maintenance requirements than gasoline engines. If your vehicle has a diesel engine, follow a schedule designated for diesel engine vehicles only.

Short Trip/City Definition - Gasoline Engines

Follow the Short Trip/City maintenance schedule if any one of these are true:

- Most trips are less than 8 to 16 km (5 to 10 miles). This is particularly important when outside temperatures are below 0°C (32°F).
- Most trips include extensive idling (such as frequent driving in stop and go traffic).
- The vehicle is operated in dusty areas, or off-road frequently.
- Trailer towing or using a carrier on top of the vehicle frequently.
- The vehicle is used for delivery service, police, taxi, or other commercial application. These conditions cause engine oil to break down sooner.

Short Trip/City Summary - Gasoline Engines

The following intervals only summarize maintenance schedules. Be sure to follow the complete scheduled maintenance.

Every 5 000 Kilometers (3, 000 Miles)

- Engine Oil and Filter Change (or 3 months, whichever comes first)
- Chassis Lubrication (or 3 months, whichever comes first)
- Drive Axle Service (or 3 months, whichever comes first) (See footnote**.)

Every 10 000 Kilometers (6, 000 Miles)

Tire Rotation

Every 25 000 Kilometers (15, 000 Miles)

- Shields and Underhood Insulation Inspection (GVWR above 4 530 kg (10, 000 lbs) only)
- Front Wheel Bearing Repack (RWD only) (or at every brake relining, whichever occurs first)

Every 50 000 Kilometers (30, 000 Miles)

Fuel Filter Replacement

Every 83 000 Kilometers (50, 000 Miles)

Automatic Transmission Service (vehicle over 3 895 kg (8, 600 lbs) GVWR or driven under severe conditions only)

Every 100 000 Kilometers (60, 000 Miles)

- Engine Accessory Drive Belt Inspection
- Fuel tank, Cap and Lines Inspection
- Exhaust Gas Recirculation System Inspection
- Evaporative Control System Inspection

Every 166 000 Kilometers (100, 000 Miles)

- Spark Plug Wire Inspection
- Spark Plug Replacement
- Automatic Transmission Service (normal conditions)
- Positive Crankcase Ventilation (PCV) Valve Inspection

Every 240 000 Kilometers (150, 000 Miles)

Cooling System Service (or every 60 months, whichever occurs first)

Long Trip/Highway Definition - Gasoline Engines

Follow this scheduled maintenance only if none of the conditions from the Short Trip/City Scheduled Maintenance is true. Do not use this schedule if one of the following conditions apply:

- The vehicle is used for towing trailers.
- The vehicle is driven in a dusty area.
- The vehicle is used off of paved roads.

Driving a vehicle with a fully warmed engine under highway conditions causes the engine oil to break down slower.

Long Trip/Highway Summary - Gasoline Engines

Follow the Long Trip/Highway maintenance schedule ONLY if none of the conditions from the Short Trip/City maintenance schedule is true.

These service intervals summarize the Long Trip/Highway Maintenance Schedule.

Every 12 500 Kilometers (7, 500 Miles)

- Engine Oil and Filter Change (or 12 months, whichever comes first)
- Chassis Lubrication (or 12 months, whichever comes first)
- Drive Axle Service (See footnote**.)
- Tire Rotation

Every 25 000 Kilometers (15, 000 Miles)

Shields and Underhood Insulation Inspection (GVWR above 4 530 kg (10, 000 lbs) only)

Every 50 000 Kilometers (30, 000 Miles)

- Fuel Filter Replacement
- Front Wheel Bearing Repack (2WD only) (or at every brake relining, whichever occurs first)

Every 83 000 Kilometers (50, 000 Miles)

Automatic Transmission Service (vehicle over 3 900 kg (8, 600 lbs) GVWR or driven under severe conditions only)

Every 100 000 Kilometers (60, 000 Miles)

- Engine Accessory Drive Belt Inspection
- Fuel Tank, Cap and Lines Inspection
- Exhaust Gas Recirculation System Inspection
- Evaporative Control System Inspection

Every 166 000 Kilometers (100, 000 Miles)

- Spark Plug Wire Inspection
- Spark Plug Replacement
- Automatic Transmission Service (normal conditions)
- Positive Crankcase Ventilation (PCV) Valve Inspection

Every 240 000 Kilometers (150, 000 Miles)

Cooling System Service (or every 60 months, whichever occurs first)

Maintenance Schedule (Diesel)

Using The Maintenance Schedule

Because of the different ways GM vehicles are used, maintenance needs vary. More frequent maintenance intervals than found in this manual may by needed. When reading this section, keep in mind the conditions under which the vehicle is operated, and adjust the maintenance intervals accordingly.

Use the proper fluids and lubricants whenever servicing this vehicle.

The maintenance schedules found in this manual are for vehicles that:

- Carry passengers and cargo within recommended limits. Refer to *Label - Vehicle Certification* in General Information
- Are driven on reasonable road surfaces within legal driving limits.
- Are driven off-road in the recommended manner.
- Use recommended unleaded fuel.

Selecting The Right Schedule

First you will need to decide which of the two schedules is right for your vehicle. Diesel engine vehicles have different maintenance requirements than gasoline engines. If your vehicle has a diesel engine, follow the schedule designated for diesel engines only.

Short Trip/City Definition - Diesel Engines

Follow the Short Trip/City Scheduled Maintenance only if any one of the following conditions is true for your vehicle:

- Most trips are less than 8 – 16 km (5 – 10 miles).

  This is particularly important when the outside temperature is below 0°C (32°F).
- Most trips include extensive idling (such as frequent driving in stop-and-go traffic).
- The vehicle is operated in dusty areas or off-road frequently.
- Trailer towing or using a carrier on top of the vehicle frequently.
- The vehicle is used for delivery service, police, taxi, or other commercial application.

These conditions cause engine oil to break down sooner.

Short Trip/City Summary - Diesel Engines

The following intervals only summarize maintenance schedules. Be sure to follow the complete scheduled maintenance. Refer to *Maintenance Schedule - Short Trip/City (Diesel).*

Every 4 000 Kilometers (2, 500 Miles)

- Engine Oil and Filter Change (or 3 months, whichever comes first)
- Chassis Lubrication (or 3 months, whichever comes first)
- Drive Axle Service (or 3 months, whichever comes first)

Every 12 000 Kilometers (7, 500 Miles)

Tire Rotation

Every 16 000 Kilometers (10, 000 Miles)

- Shields And Underhood Insulation Inspection.
- Thermostatically Controlled Engine Cooling Fan Check (or every 12 months, whichever occurs first)
- Air Intake System Inspection

Every 12 000 Kilometers (7, 500 Miles)

Tire Rotation

Every 24 000 Kilometers (15, 000 Miles)

Front Wheel Bearing Repack (RWD only) (or at each brake relining)

Every 40 000 Kilometers (25, 000 Miles)

Fuel Cap Replacement (If driving in dusty conditions)

Every 48 000 Kilometers (30, 000 Miles)

Fuel Filter Replacement

Every 80 000 Kilometers (50, 000 Miles)

Automatic Transmission Service

Every 96 000 Kilometers (60, 000 Miles)

- Crankcase Depression Regulator Valve (CDRV) System Check
- Engine Accessory Drive Belt Inspection
- Exhaust Gas Recirculation (EGR) System Inspection (if equipped)

Every 240 000 Kilometers (150, 000 Miles)

Cooling System Service (or every 60 months, whichever occurs first)

Long Trip/Highway Definition - Diesel Engines

Follow this scheduled maintenance only if none of the conditions from the Short Trip/City Scheduled Maintenance is true. Do not use this schedule if one of the following conditions apply:

- The vehicle is used for towing trailers.
- The vehicle is driven in a dusty area.
- The vehicle is used off of paved roads.

Driving a vehicle with a fully warmed engine under highway conditions cause engine oil to break down slower.

Long Trip/Highway Summary - Diesel Engines

Follow the Long Trip/Highway maintenance schedule ONLY if none of the conditions from the Short Trip/City maintenance schedule is true.

The following intervals only summarize the Long Trip/Highway Maintenance Schedule.

Every 8 000 Kilometers (5, 000 Miles)

- Engine Oil and Filter Change (or 12 every months, whichever comes first)
- Chassis Lubrication (or every 12 months, whichever comes first)
- Drive Axle Service

Every 8 000 Kilometers (5, 000 Miles) - Then Every 16 000 Kilometers (10, 000 Miles)

Tire Rotation

Every 16 000 Kilometers (10, 000 Miles)

- Shields And Underhood Insulation Inspection.
- Thermostatically Controlled Engine Cooling Fan Check (or every 12 months, whichever occurs first)
- Air Intake System Inspection

Every 48 000 Kilometers (30, 000 Miles)

- Front Wheel Bearing Repack (RWD only) (or at each brake relining)
- Fuel Filter Replacement

Every 80 000 Kilometers (50, 000 Miles)

Automatic Transmission Service

Every 96 000 Kilometers (60, 000 Miles)

- Crankcase Depression Regulator Valve (CDRV) System Check
- Engine Accessory Drive Belt Inspection
- Exhaust Gas Recirculation (EGR) System Inspection (if equipped)

Every 240 000 Kilometers (150, 000 Miles)

Cooling System Service (or every 60 months, whichever occurs first)

Maintenance Schedule - Short Trip/City (Gasoline)

Perform the services shown in this schedule up to 166 000 km (100,000 miles) and after 166 000 km (100,000 miles) at the same intervals.

5 000 km (3,000 miles)

- Change the engine oil and the filter every 5 000 km (3,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

10 000 km (6,000 miles)

- Change the engine oil and the filter every 10 000 km (6,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

15 000 km (9,000 miles)

- Change the engine oil and the filter every 15 000 km (9,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

20 000 km (12,000 miles)

- Change the engine oil and the filter every 20 000 km (12,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

25 000 km (15,000 miles)

- Change the engine oil and the filter every 25 000 km (15,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Inspect the air cleaner filter.
- Clean the front wheel bearings (or each brake relining, whichever occurs first).
- Repack the front wheel bearings (or each brake relining, whichever occurs first).
- For vehicles with GVWR above 3 855 kg (8,500 lbs), inspect the following vehicle components for looseness:
  - The shields
  - The underhood insulation
- Adjust or replace these components as specified.

30 000 km (18,000 miles)

- Change the engine oil and the filter every 30 000 km (18,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.

- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

35 000 km (21,000 miles)

- Change the engine oil and the filter every 35 000 km (21,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

40 000 km (24,000 miles)

- Change the engine oil and the filter every 40 000 km (24,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

45 000 km (27,000 miles)

- Change the engine oil and the filter every 40 000 km (27,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

50 000 km (30,000 miles)

- Change the engine oil and the filter every 50 000 km (30,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Clean the front wheel bearings (or each brake relining, whichever occurs first).
- Repack the front wheel bearing (or each brake relining, whichever occurs first).
- Replace the air filter.
- Replace the fuel filter. An Emission Control Service.
- For vehicles with GVWR above 3 855 kg (8,500 lbs), inspect the following vehicle components for looseness:
  - The shields
  - The underhood insulation
- Adjust or replace shields and the underhood insulation components as specified.
- Inspect the hoses and the ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valve operates properly.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.
- Inspect the shields and the underhood insulation.

55 000 km (33,000 miles)

- Change the engine oil and the filter every 55 000 km (33,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

60 000 km (36,000 miles)

- Change the engine oil and the filter every 60 000 km (36,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

65 000 km (39,000 miles)

- Change the engine oil and the filter every 65 000 km (39,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

70 000 km (42,000 miles)

- Change the engine oil and the filter every 70 000 km (42,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

75 000 km (45,000 miles)

- Change the engine oil and the filter every 75 000 km (45,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Regularly inspect the air filter when driving in dusty conditions. Replace the air filter if necessary. An Emission Control Service *
- Clean the front wheel bearings (or each brake relining, whichever occurs first).
- Repack the front wheel bearing (or each brake relining, whichever occurs first).
- For vehicles with GVWR above 3 855 kg (8,500 lbs), inspect the following vehicle components for looseness:
  - The shields
  - The underhood insulation
- Adjust or replace shields and the underhood insulation components as specified.
- Inspect the hoses and the ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valve operates properly.

80 000 km (48,000 miles)

- Change the engine oil and the filter every 80 000 km (48,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

83 000 km (50,000 miles)

- Change the automatic transmission fluid and the filter if the vehicle's GVWR exceeds 3 855 kg (8,600 lbs).
- Change the automatic transmission fluid and the filter.

85 000 km (51,000 miles)

- Change the engine oil and the filter every 85 000 km (51,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

90 000 km (54,000 miles)

- Change the engine oil and the filter at 90 000 km (54,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

95 000 km (57,000 miles)

- Change the engine oil and the filter at 95 000 km (57,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

100 000 km (60,000 miles)

- Change the engine oil and the filter every 100 000 km (60,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Inspect the engine accessory drive belt. An Emission Control Service *
- Replace the air filter.
- Replace the fuel filter. An Emission Control Service *
- Inspect the following fuel tank components for leaks or damages:
  - The fuel tank
  - The cap and lines
  - The fuel cap gasket
- Replace the necessary damaged fuel tank components. An Emission Control Service *
- Clean the front wheel bearings (or each brake relining, whichever occurs first).
- Repack the front wheel bearing (or each brake relining, whichever occurs first).
- For vehicles with GVWR above 3 855 kg (8,500 lbs), inspect the following vehicle components for looseness:
  - Shields
  - Underhood insulation
- Adjust or replace shields and the underhood insulation components as specified.
- Inspect the hoses and the ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valve operates properly.
- Inspect the Evaporative Control System.
- Verify the following components for proper routing and condition maintenance:
  - Fuel and vapor lines
  - Hoses
- Verify that the purge valve operates properly if equipped. Replace as necessary.
- Inspect the Control Exhaust Gas Recirculation (EGR) system.
- Inspect the shields and the underhood insulation.

105 000 km (60,000 miles)

- Change the engine oil and the filter every 105 000 km (63,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

110 000 km (66,000 miles)

- Change the engine oil and the filter at 110 000 km (66,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

115 000 km (69,000 miles)

- Change the engine oil and the filter every 115 000 km (69,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

120 000 km (72,000 miles)

- Change the engine oil and the filter at 120 000 km (72,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

125 000 km (75,000 miles)

- Change the engine oil and the filter every 125 000 km (75,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Clean the front wheel bearings (or each brake relining, whichever occurs first).
- Repack the front wheel bearings (or each brake relining, whichever occurs first).
- For vehicles with GVWR above 3 855 kg (8,500 lbs), inspect the following vehicle components for looseness:
  - The shields
  - The underhood insulation
- Adjust or replace shields and the underhood insulation components as specified.
- Inspect the hoses and the ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valve operates properly.

130 000 km (78,000 miles)

- Change the engine oil and the filter every 130 000 km (78,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

135 000 km (81,000 miles)

- Change the engine oil and the filter every 135 000 km (81,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

140 000 km (84,000 miles)

- Change the engine oil and the filter every 140 000 km (84,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

145 000 km (87,000 miles)

- Change the engine oil and the filter every 145 000 km (87,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

150 000 km (90,000 miles)

- Change the engine oil and the filter every 150 000 km (90,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Clean the front wheel bearings (or each brake relining, whichever occurs first).
- Repack the front wheel bearing (or each brake relining, whichever occurs first).
- For vehicles with GVWR above 3 855 kg (8,500 lbs), inspect the following vehicle components for looseness:
  - The shields
  - The underhood insulation
- Adjust or replace shields and the underhood insulation components as specified.
- Inspect the hoses and the ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valve operates properly.
- Replace the air filter.
- Replace the fuel filter. An Emission Control Service.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

155 000 km (93,000 miles)

- Change the engine oil and the filter every 155 000 km (93,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

160 000 km (96,000 miles)

- Change the engine oil and the filter every 160 000 km (96,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

165 000 km (99,000 miles)

- Change the engine oil and the filter every 165 000 km (99,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
- Verify the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

166 000 km (100,000 miles)

- Inspect the engine timing.
- Replace the spark plugs. An Emission Control Service *
- Replace the spark plug wires. An Emission Control Service *
- Change the automatic transmission fluid and the filter if the vehicle's GVWR exceeds 3 900 kg (8,600 lbs).
- Change the automatic transmission fluid and the filter if the vehicle's GVWR exceeds 3 900 kg (8,600 lbs).
- Change the automatic transmission fluid and the filter.
- Inspect the Positive Crankcase Ventilation (PCV) Valve.

240 000 km (150,000 miles)

- Drain, flush and refill the cooling system every 240 000 km (150,000 miles) or every 60 months, whichever occurs first.
- Refer to *Fluid and Lubricant Recommendations.*
- Inspect the hoses.
- Clean the radiator, condenser, pressure cap and the neck. An Emission Control Service *
- Change the automatic transmission fluid and filter.

Maintenance Schedule - Short Trip/City (Diesel)

Perform the services shown in this schedule up to 240 000 km (150,000 miles) and after 240 000 km (150,000 miles) at the same intervals.

4 000 km (2,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  If three months pass before 4,000 km (2,500 miles), then change the oil after three months.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks.

8 000 km (5,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks.

12 000 km (7,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

16 000 km (10,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.

- Inspect the axle seals for leaks.
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed and that the following components remain tight:
  - The hose connections
  - The fasteners
  - Other components
- Inspect the air cleaner housing in order to ensure the following conditions:
  - The air cleaner housing seats properly.
  - The cover fits tightly.
  - The wing nuts are tight.
- Tighten the connections and the fasteners or replace damaged components if necessary.

20 000 km (12,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks.

24 000 km (15,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the air cleaner filter.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks.
- Clean and repack the front wheel bearings (or at each brake relining, whichever occurs first)
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

28 000 km (17,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks.

32 000 km (20,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed and that the following components remain tight:
  - The hose connections
  - The fasteners
  - Other components

- Inspect the air cleaner housing in order to ensure the following conditions:
  - The air cleaner housing seats properly.
  - The cover fits tightly.
  - The wing nuts are tight.
- Tighten the connections and the fasteners or replace damaged components if necessary.

36 000 km (22,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

40 000 km (25,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Replace the fuel cap.

44 000 km (27,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

48 000 km (30,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Replace the air filter. An Emission Control Service *
- Replace the fuel filter.
- Inspect the shields and the underhood insulation for looseness.

  Adjust or replace the shields and the underhood insulation if necessary.
- Clean and repack the front wheel bearings (or at each brake relining, whichever occurs first).
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed and that the following components remain tight:
  - The hose connections
  - The fasteners
  - Other components

- Inspect the air cleaner housing in order to ensure the following conditions:
  - The air cleaner housing seats properly.
  - The cover fits tightly.
  - The wing nuts are tight.
- Tighten the connections and the fasteners or replace damaged components if necessary.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

52 000 km (32,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

56 000 km (35,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is–12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

60 000 km (37,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

64 000 km (40,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed and that the following components remain tight:
  - The hose connections
  - The fasteners
  - Other components
- Inspect the air cleaner housing in order to ensure the following conditions:
  - The air cleaner housing seats properly.
  - The cover fits tightly.
  - The wing nuts are tight.

- Tighten the connections and the fasteners or replace damaged components if necessary.
- If the engine has a thermostatically controlled cooling fan, inspect the following components for proper hook-up:
  - All of the hoses
  - All of the ducts

  If twelve months pass before the vehicle drives 40,000 miles, perform the above inspection procedure every twelve months.

68 000 km (42,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

72 000 km (45,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Inspect the air cleaner filter if the vehicle has been driven in dusty conditions.

  Replace the filter if necessary. An Emission Control Service *
- Clean and repack the front wheel bearings (or at each brake relining, whichever occurs first)
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

76 000 km (47,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

80 000 km (50,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

- Change the automatic transmission fluid and the filter if the vehicle's GVWR exceeds 3 900 kg (8,600 lbs) or if the vehicle is mainly driven under one or more of the following conditions:
  - In heavy traffic where the outside temperature regularly reaches 32°C (90°F) or higher.
  - In hilly or mountainous terrain.
  - When performing frequent trailer towing.
  - Uses such as found in the following services:
    - Taxi
    - Police
    - Delivery
- Inspect the shields and the underhood insulation for looseness.

  Adjust or replace the shields and the underhood insulation as necessary.
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed and that the following components remain tight:
  - Hose connections
  - Fasteners
  - Other components
- Inspect the air cleaner housing in order to ensure the following conditions:
  - The air cleaner housing seats properly.
  - The cover fits tightly.
  - The wing nuts are tight.
- Tighten the connections and the fasteners or replace damaged components if necessary.

84 000 km (52,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

88 000 km (55,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

92 000 km (57,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

96 000 km (60,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:

  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Replace the air filter. An Emission Control Service *
- Clean and repack the front wheel bearings (or at each brake relining, whichever occurs first).
- Inspect the crankcase depression regulator valve system for hoses exhibiting the following conditions:
  - Wear
  - Blockage
  - Collapse

  An Emission Control Service *
- Replace the fuel filter.
- Inspect the crankcase depression regulator valve. An Emission Control Service *
- Inspect the accessory drive (serpentine) belt for the following conditions:
  - Cracking
  - Fraying
  - Wear
  - Improper tension

  Adjust or replace the belt as necessary.
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed and that the following components remain tight:
  - The hose connections
  - The fasteners
  - Other components
- Inspect the air cleaner housing in order to ensure the following conditions:
  - The air cleaner housing seats properly.
  - The cover fits tightly.
  - The wing nuts are tight.
- Tighten the connections and the fasteners or replace damaged components if necessary.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

100 000 km (62,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:

  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

104 000 km (65,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:

  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is -12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

108 000 km (67,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

112 000 km (70,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed and that the following components remain tight:
  - The hose connections
  - The fasteners
  - Other components
- Inspect the air cleaner housing in order to ensure the following conditions:
  - The air cleaner housing seats properly.
  - The cover fits tightly.
  - The wing nuts are tight.
- Tighten the connections and the fasteners or replace damaged components if necessary.
- If the engine has a thermostatically controlled cooling fan, inspect the following components for proper hook-up:
  - All of the hoses
  - All of the ducts

  If twelve months pass before the vehicle drives 64 000 km (40,000 miles) perform the above inspection procedure every twelve months.
- Verify proper operation of the thermostatically controlled cooling fan valve.

116 000 km (72,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

120 000 km (75,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Inspect the air cleaner filter if the vehicle has been driven in dusty conditions.

  Replace the filter if necessary. An Emission Control Service *

- If the vehicle is a 2 wheel drive vehicle, then clean and repack the front wheel bearings (or at each brake relining, whichever occurs first.)
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

124 000 km (77,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is −12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

128 000 km (80,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is −12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed and that the following components remain tight:
  - The hose connections
  - The fasteners
  - Other components
- Inspect the air cleaner housing in order to ensure the following conditions:
  - The air cleaner housing seats properly.
  - The cover fits tightly.
  - The wing nuts are tight.
- Tighten the connections and the fasteners or replace damaged components if necessary.
- If the engine has a thermostatically controlled cooling fan, inspect the following components for proper hook-up:
  - All of the hoses
  - All of the ducts

  If twelve months pass before the vehicle drives 64 000 km (40,000 miles), perform the above inspection procedure every twelve months.
- Verify proper operation of the thermostatically controlled cooling fan valve.

132 000 km (82,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is −12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

136 000 km (85,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is −12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

140 000 km (87,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

144 000 km (90,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Replace the air filter. An Emission Control Service *
- Clean and repack the front wheel bearings (or at each brake relining, whichever occurs first).
- Replace the fuel filter.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

148 000 km (92,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

152 000 km (95,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks

156 000 km (97,500 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:
  - Three months pass since the last oil change.
  - The vehicle drive 4 000 km (2,500 miles) since the last oil change.
- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.
- Inspect the rear fluid level.

  Add fluid if necessary.
- Inspect the axle seals for leaks
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

160 000 km (100,000 miles)

- Change the engine oil and the filter. An Emission Control Service *

  Change the engine oil and the filter as soon as one of the following conditions occurs:

  - Three months pass since the last oil change.
  - The vehicle drives 4 000 km (2,500 miles) since the last oil change.

- Lubricate the following components:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
  - The ball joints

  Only lubricate the ball joints if the temperature of the ball joint is –12°C (10°F) or higher.

- Inspect the rear fluid level.

  Add fluid if necessary.

- Inspect the axle seals for leaks
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed and that the following components remain tight:
  - The hose connections
  - The fasteners
  - Other components
- Inspect the air cleaner housing in order to ensure the following conditions:
  - The air cleaner housing seats properly.
  - The cover fits tightly.
  - The wing nuts are tight.
- Tighten the connections and the fasteners or replace damaged components if necessary.
- Inspect the hoses and replace the hoses if the hoses exhibit the following conditions:
  - Cracking
  - Swelling
  - Deterioration
- Tighten all of the hose clamps (except the constant tension clamps).
- Remove debris and clean the outside of the radiator and air conditioning condenser.

  Wash the radiator neck.

- Pressure test the radiator and the cap in order to ensure proper operation.
- Change the automatic transmission fluid and the filter.
- If the engine has a thermostatically controlled cooling fan, inspect the following components for proper hook-up:
  - All of the hoses
  - All of the ducts

  If twelve months pass before the vehicle drives 64 000 km (40,000 miles), perform the above inspection procedure every twelve months.

- Verify proper operation of the thermostatically controlled cooling fan valve.

240 000 km (150,000 miles)

- Drain, flush and refill the cooling system as soon as one of the following conditions occurs:
  - The vehicle reaches 240 000 km (150,000 miles).
  - Sixty months pass since the previous service

  Refer to Recommended Fluid and Lubricants.

- Inspect the hoses.
- Clean the following components:
  - The radiator
  - The condenser
  - The pressure cap
  - The neck

  An Emission Control Service *

Footnotes

The California Air Resources Board has determined that the failure to perform this maintenance item will not nullify the emission warranty. The California Air Resources Board has also determined that the failure to perform this maintenance item will not limit the recall liability prior to the completion of the vehicle useful life. GM, however, urges that all recommended maintenance be recorded.

Drive Axle Service:

- The Locking Differential

  Drain the fluid and refill the fluid at the first engine oil change. At subsequent oil changes, inspect the fluid level and add fluid as necessary. Drain the fluid and refill the fluid every 25 000 km (15,000 miles) if the vehicle is performing either of the following actions:

  - Driving in dusty areas
  - Towing a trailer

- The Standard Differential

  Inspect the fluid level and add fluid as necessary at every oil change. Drain the fluid and refill the fluid every 25 000 km (15,000 miles) if the vehicle is performing either of the following actions:

  - Driving in dusty areas
  - Towing a trailer

- Heavy-duty or off-road use may require more frequent lubrication.

Maintenance Schedule - Long Trip/Highway (Diesel)

Perform the services shown in this schedule up to 240 000 km (150,000 miles) in this schedule and after 244 000 km (150,000 miles) at the same intervals.

8 000 km (5,000 miles)

- Change the engine oil and the filter every 8 000 km (5,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless their temperature is -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

16 000 km (10,000 miles)

- Change engine oil and filter every 16 000 km (10,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate the ball joints unless their temperature is -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed.
- Inspect the air intake system installation in order to ensure that hose connections, fasteners and other components are tightly fitted.
- Inspect the air cleaning housing in order to ensure that the air cleaning housing is properly seated, the cover and wing nuts are tightly fitted.
- Inspect the air cleaning housing in order to ensure that the air cleaning housing cover and wing nuts are tightly fitted.
- Tighten the connections and fasteners. Replace the necessary damaged components.
- Inspect the hoses and ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valves operate properly.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

24 000 km (15,000 miles)

- Change engine oil and filter at 24 000 km (15,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds –12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tire. Refer to *Tire Rotation* in Suspension.

32 000 km (20,000 miles)

- Change engine oil and filter every 32 000 km (20,000 miles) or every three months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds –12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed.
- Inspect the air intake system installation in order to ensure that hose connections, fasteners and other components are tightly fitted.
- Inspect the air cleaning housing in order to ensure that the air cleaning housing is properly seated, the cover and wing nuts are tightly fitted.
- Inspect the air cleaning housing in order to ensure that the air cleaning housing cover and wing nuts are tightly fitted.
- Tighten the connections and fasteners. Replace the necessary damaged components.
- Inspect the hoses and ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valves operate properly.
- Rotate the tire. Refer to *Tire Rotation* in Suspension.

40 000 km (25,000 miles)

- Change engine oil and filter every 40 000 km (25,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds –12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

48 000 km (30,000 miles)

- Change engine oil and filter every 48 000 km (30,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds –12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Replace the air filters. An Emission Control Service *
- Clean the front wheel bearings or each brake relining, whichever occurs first.
- Repack the front wheel bearings or each brake relining, whichever occurs first.
- Replace the oil filter.
- Inspect the shields and underhood insulation for looseness. Adjust or replace the shields and underhood insulation as required.
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed.
- Inspect the air intake system installation in order to ensure that hose connections, fasteners and other components are tightly fitted.
- Inspect the air cleaning housing in order to ensure that the air cleaning housing is properly seated, the cover and wing nuts are tightly fitted.
- Tighten the connections and fasteners. Replace the necessary damaged components.
- Inspect the hoses and ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valves operate properly.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

56 000 km (35,000 miles)

- Change engine oil and filter every 56 000 km (35,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tire. Refer to *Tire Rotation* in Suspension.

64 000 km (40,000 miles)

- Change engine oil and filter every 64 000 km (40,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Inspect the air intake system installation in order to ensure that hose connections, fasteners and other components tightly fitted.
- Inspect the air cleaning housing in order to ensure that the air cleaning housing is properly seated, the cover and wing nuts are tightly fitted.
- Tighten the connections and fasteners. Replace the necessary damaged components.
- Rotate the tire. Refer to *Tire Rotation* in Suspension.

72 000 km (45,000 miles)

- Change engine oil and filter every 72 000 km (45,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.

- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

80 000 km (50,000 miles)

- Change engine oil and filter every 80 000 km (50,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F).
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Change the automatic transmission fluid and filter. 3 900 kg (8,600 lbs).
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed.
- Inspect the air intake system installation in order to ensure that hose connections, fasteners and other components tightly fitted.
- Inspect the air cleaning housing in order to ensure that the air cleaning housing is properly seated, the cover and wing nuts are tightly fitted.
- Tighten the connections and fasteners. Replace the necessary damaged components.
- Inspect the hoses and ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valves operate properly.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

88 000 km (55,000 miles)

- Change engine oil and filter every 88 000 km (55,000 miles) or every three months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.

96 000 km (60,000 miles)

- Change engine oil and filter every 96 000 km (60,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Replace the air filter. An Emission Control Service. *
- Clean the front wheel bearings or each brake relining, or whichever occurs first.
- Repack the front wheel bearing or each brake relining, or whichever occurs first.
- Inspect the crankcase depression regulator valve system for the following faulty conditions. This is also an Emission Control Service. *
  - Worn hoses
  - Plugged hoses
  - Collapsed hoses
- Replace the fuel filter.
- Inspect the equipped EGR System except for Code F engine. An Emission Control Service.
- Inspect the shields and the underhood insulation for looseness. Adjust or replace the shields and the underhood insulation if damaged or loosed.
- Change the automatic transmission fluid and filter if the vehicle's GVWR exceeds 3 900 kg (8,600 lbs).
- Change the automatic transmission fluid and filter if the vehicle is mainly driven under one or more of the following conditions.
  - In heavy traffic with outdoor temperatures exceeding 32°C (90°F) or higher.
  - In hilly and mountainous terrain
  - For frequent trailer towing
  - Uses found in the following services
    - Taxi
    - Police
    - Delivery
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed.
- Inspect the air intake system installation in order to ensure that hose connections, fasteners and other components tightly fitted.
- Inspect the air cleaning housing in order to ensure that the air cleaning housing is properly seated, the cover and wing nuts are tightly fitted.

- Tighten the connections and fasteners. Replace the necessary damaged components.
- Inspect the hoses and ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valves operate properly.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed.
- Inspect the air intake system installation in order to ensure that hose connections, fasteners and other components tightly fitted.
- Inspect the air cleaning housing in order to ensure that the air cleaning housing is properly seated, the cover and wing nuts are tightly fitted.
- Tighten the connections and fasteners. Replace the necessary damaged components.
- Inspect the hoses and ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valves operate properly.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

104 000 km (65,000 miles)

- Change engine oil and filter every 104 000 km (65,000 miles) or every three months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

112 000 km (70,000 miles)

- Change engine oil and filter every 112 000 km (70,000 miles) or every three months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed.
- Inspect the air intake system installation in order to ensure that hose connections, fasteners and other components tightly fitted.
- Inspect the hoses and ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valve operate properly.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

120 000 km (75,000 miles)

- Change engine oil and filter every 120 000 km (75,000 miles) or every three months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tire. Refer to *Tire Rotation* in Suspension.

128 000 km (80,000 miles)

- Change engine oil and filter every 128 000 km (80,000 miles) or every three months, or whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tire. Refer to *Tire Rotation* in Suspension.
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed.
- Inspect the air intake system installation in order to ensure that hose connections, fasteners and other components tightly fitted.
- Inspect the hoses and ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valves operate properly.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

136 000 km (85,000 miles)

- Change engine oil and filter every 136 000 km (85,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F).
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tire. Refer to *Tire Rotation* in Suspension.

144 000 km (90,000 miles)

- Change engine oil and filter every 144,000 km (90,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Replace the air filter. An Emission Control Service.
- Clean the front wheel bearings or each brake relining, or whichever occurs first.
- Repack the front wheel bearing or each brake relining, or whichever occurs first.
- Replace the fuel filter.
- Inspect the shields and underhood insulation for looseness. Adjust the shields and underhood insulation as required.
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed.
- Inspect the air intake system installation in order to ensure that hose connections, fasteners and other components tightly fitted.
- Inspect the hoses and ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Verify that the valves operate properly.
- Rotate the tire. Refer to *Tire Rotation* in Suspension.

152 000 km (95,000 miles)

- Change engine oil and filter every 152 000 km (95,000 miles) or every three months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Rotate the tire. Refer to *Tire Rotation* in Suspension.

160 000 km (100,000 miles)

- Change engine oil and filter every 160 000 km (100,000 miles) or every 60 months, whichever occurs first. An Emission Control Service *
- Lubricate the following vehicle components when performing a maintenance schedule:
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Do not lubricate ball joints unless the ball joint temperature exceeds -12°C (10°F) or higher.
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the axle seals for leaks.
- Drain, flush and refill the cooling system with coolant.
- Inspect the hoses if the hoses are cracked, swollen, or deteriorated. Replace the hoses if damaged. Tighten the hose clamps except for the constant tension clamps. Remove and clean the debris out the radiator and the air conditioning condenser. Clean the radiator neck thoroughly in order to ensure proper operation. Pressure test the radiator and the cap.
- Change the automatic transmission fluid and filter.
- Inspect the shields and underhood insulation for looseness. Adjust the shields and underhood insulation as required.
- Inspect the air intake system installation in order to ensure that the gaskets are properly sealed.
- Inspect the air intake system installation in order to ensure that hose connections, fasteners and other components tightly fitted.
- Inspect hoses and ducts for the proper maintenance if the engine has a thermostatically controlled cooling fan. Ensure that the valve operates properly.
- Rotate the tire. Refer to *Tire Rotation* in Suspension.

240 000 km (150,000 miles)

- Drain, flush and refill the cooling system every 240 000 km (150,000 miles) or every 60 months, whatever exceeds first. Refer to Recommended Fluid and Lubricants. Inspect the hoses. Clean the radiator, condenser, pressure cap and neck. An Emission Control Service *
- Change the automatic transmission fluid and filter.

Maintenance Schedule - Long Trip/Highway (Gasoline)

Perform the services shown in this schedule up to 166 000 km (100,000 miles) and after 166 000 km (100,000 miles) at the same intervals.

12 500 km (7,500 miles)

- Change the engine oil and the filter every 12 500 km (7,500 miles) or every 12 months, whichever occurs first. An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Verify the rear fluid level. Add fluid as needed.
- Verify the constant velocity joints and the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension

25 000 km (15,000 miles)

- Change the engine oil and the filter every 25 000 km (15,000 miles) or every 12 months, whichever occurs first. An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and the axle seals for leaks.
- Inspect the shields and the underhood insulation (GVWR above 3 855 kg (8,500 lbs)).

37 500 km (22,500 miles)

- Change the engine oil and the filter every 37 500 km (22,500 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

50 000 km (30,000 miles)

- Change the engine oil and the filter every 50 000 km (30,000 miles) or every 12 months, whichever occurs first. An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and the axle seals for leaks.
- Clean and repack the front wheel bearings (or at each brake relining, whichever occurs first).
- Replace the air filter.
- Replace the fuel filter. An Emission Control Service *
- Inspect the shields and the underhood insulation.

62 500 km (37,500 miles)

- Change the engine oil and the filter every 62 500 km (37,500 miles) or every 12 months, whichever occurs first. An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and the axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

75 000 km (45,000 miles)

- Change the engine oil and the filter every 75 000 km (45,000 miles) or every 12 months, whichever occurs first. An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and the axle seals for leaks.

83 000 km (50,000 miles)

- Change the automatic transmission fluid and the filter if the vehicle's GVWR is over 3 900 kg (8,600 lbs), or if the vehicle is mainly driven under one or more of these conditions:
  - In heavy traffic where the outside temperature regularly reaches 32°C (90°F) or higher.
  - In hilly or mountainous terrain
  - When doing frequent trailer towing
  - Vehicles performing taxi, police or delivery services
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs

87 500 km (52,500 miles)

- Change the engine oil and filter every 87 500 km (52,500 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

100 000 km (60,000 miles)

- Change the engine oil and filter every 100 000 km (60,000 miles) or every 3 months, whichever occurs first. An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and axle seals for leaks.
- Clean and repack the front wheel bearings (or at each brake relining, which ever occurs first).
- Inspect the engine accessory drive belt. An Emission Control Service *
- Replace the air filter.
- Replace the fuel filter. An Emission Control Service *
- Inspect the following components for damage or leaks. Replace the parts as needed. An Emission Control Service *
  - Fuel tank
  - Fuel cap
  - Fuel lines
  - Fuel cap gasket
- If the engine has a thermostatically controlled cooling fan, inspect all of the hoses and all of the ducts for proper hook-up. Ensure that the valve works properly.
- Conduct an Exhaust Gas Recirculation (EGR) system inspection.
- Preform the following steps in order to conduct an evaporative control system inspection:
  1. Inspect all the fuel and vapor lines and hoses for proper hook-up, routing and condition.
  2. Ensure that the purge valve works properly (if equipped).
  3. Replace the vapor lines, hoses, and the purge valve as needed.

112 500 km (67,500 miles)

- Change the engine oil and the filter (or every 3 months, whichever occurs first). An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs

- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

125 000 km (75,000 miles)

- Change the engine oil and filter (or every 3 months, whichever occurs first). An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and axle seals for leaks.

137 500 km (82,500 miles)

- Change the engine oil and filter (or every 3 months, whichever occurs first). An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

150 000 km (90,000 miles)

- Change the engine oil and filter (or every 3 months, whichever occurs first). An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and axle seals for leaks.
- Clean and repack the front wheel bearings (or at each brake relining, whichever occurs first).
- Replace the air filter.
- Replace the fuel filter. An Emission Control Service *

162 500 km (97,500 miles)

- Change the engine oil and filter (or every 3 months, whichever occurs first). An Emission Control Service *
- Lubricate the following components. Do not lubricate the ball joints unless the ball joint temperature is -12°C (10°F) or higher.
  - The front suspension
  - The steering linkage
  - The transmission shift linkage
  - The park brake cable guides
  - The brake pedal springs
- Inspect the rear fluid level. Add fluid as needed.
- Inspect the constant velocity joints and axle seals for leaks.
- Rotate the tires. Refer to *Tire Rotation* in Suspension.

166 000 km (100,000 miles)

- Inspect the spark plug wires.
- Replace the spark plug wires. An Emission Control Service *
- Change the automatic transmission fluid and the filter.
- Inspect the positive crankcase ventilation (PCV) valve.

240 000 km (150,000 miles)

- Drain, flush and refill the cooling system (or every 60 months since the last service, whichever comes first). Refer to Recommended Fluid and Lubricants in this section.
- Inspect the hoses.
- Clean the following components. An Emission Control Service *
  - The radiator
  - The condenser
  - The pressure cap
  - The neck

Owner Checks and Services

The following information covers the inspections and services required to retain the safety, dependability, and emission control performance of the vehicle.

Make sure any necessary repairs are completed at once. Whenever any fluids or lubricants are added to the vehicle, make sure that they are the proper ones.

At The First 160, 1,600 and 10,000 Km (100, 1,000, and 6,000 Miles)

For vehicles with dual wheels, inspect the dual wheel nut torque.

At Each Fuel Fill

It is important to perform these underhood inspections at each fuel fill.

Engine Oil Level

Inspect the engine oil level and add the proper oil if necessary.

Engine Coolant Level

Inspect the engine coolant levels and add DEX-COOL® for the proper coolant mixture, if necessary.

Windshield Washer Fluid Level

Inspect the windshield washer fluid level in the windshield washer reservoir and add the proper fluid, if necessary.

At Least Once a Month

Tire Inflation

Inspect tire inflation. Make sure the tires are inflated to the pressures specified on the Certification/Tire label located on the driver's door lock pillar.

Cassette Deck Service

Clean cassette decks. Cleaning should be done every 50 hours of tape play.

At Least Twice A Year

Restraint System Check

Make sure the safety belt reminder light and all of the belts, buckles, latch plates, retractors, and anchorages are working properly. Look for any other loose or damaged safety belt system parts. If you see anything that might keep a safety belt system from doing its job, have it repaired. Have any torn or frayed safety belts replaced.

Also look for any opened or broken air bag coverings, and have them repaired or replaced. (The SIR system does not need regular maintenance).

Wiper Blade Check

Inspect wiper blades for wear or cracking. Replace the blade inserts that appear worn or damaged or that streak or miss areas of the windshield.

Air Cleaner Filter Restriction Indicator Check

This vehicle has an indicator on the engine that lets you know when the air cleaner filter is dirty and needs to be changed. Inspect indicator at least twice a year or when your oil is changed, whichever occurs first. Inspect the air cleaner filter restriction indicator more often if the vehicle is used in dusty areas or under off road conditions.

Weatherstrip Lubrication

Silicone grease on weatherstrips will make them last longer, seal better, and not stick or squeak. Apply silicone grease with a clean cloth. During very cold, damp weather more frequent application may be required. Refer to *Fluid and Lubricant Recommendations*.

Manual Transmission Check (Pickup Models Only)

Inspect the transmission fluid level; add if needed. A fluid loss may indicate a problem. Inspect the system and repair as needed. Refer to *Fluid and Lubricant Recommendations*.

Automatic Transmission Check

Inspect the automatic transmission fluid level; add if needed. A fluid loss may indicate a problem. Inspect the system and repair as needed. Refer to *Fluid and Lubricant Recommendations*.

Hydraulic Clutch System Check (Pickup Models Only)

Inspect the fluid level in the clutch reservoir. A loss of fluid may indicate a problem. Have the system inspected and repaired at once. Refer to *Fluid and Lubricant Recommendations*.

At Least Once a Year

Key Lock Cylinders Service

Lubricate the lock cylinders with the recommended lubricant.

Body Lubrication Service

Lubricate all of the following areas:

- All body hood hinge pins
- All body door hinge pins
- All body door hinge pins
- The hood latch assembly
- The secondary hood latch
- The pivots
- The spring anchor
- The release pawl
- The rear compartment hinges
- The outer tailgate handle pivot points
- The latches
- The tailgate hinge
- The tailgate linkage
- The fuel door hinge
- The locks
- The folding seat hardware

More frequent lubrication may be required when exposed to a corrosive environment. In order to locate the proper lubricant, refer to *Fluid and Lubricant Recommendations*.

Starter Switch Check

1. Before you start, make sure you have enough room around the vehicle.

Important: Do not use the accelerator pedal, and be ready to turn off the engine immediately if it starts.

2. Firmly apply both the park brake and the regular brake.
3. On automatic transmission vehicles, try to start the engine in each gear. The starter should work only in PARK (P) or NEUTRAL (N). If the starter works in any other position, your vehicle needs service.
4. On manual transmission vehicles, put the shift lever in NEUTRAL (N), push the clutch down halfway and try to start the engine. The starter should work only when the clutch is pushed down all the way to the floor. If the starter works when the clutch is not pushed all the way down, your vehicle needs service.

Automatic Transmission Shift Lock Control Check

Caution: When performing this check, the vehicle could move suddenly. Personal injury or property damage may result. Make sure there is enough room around the vehicle, in case the vehicle does move. Do not use the accelerator pedal, and be ready to turn OFF the engine immediately if it starts.

1. With the engine OFF, turn the ignition to RUN, but do not start the engine.
2. Without applying the regular brakes, try to move the transmission shift lever out of PARK with normal effort.
3. If the shift lever moves out of PARK, the automatic transmission shift lock control needs service.

Ignition Transmission Lock Check

1. Ensure that the vehicle is parked.
2. Ensure that the vehicle park brake is set.
3. Attempt to turn the ignition key to the LOCK position.
   - With an automatic transmission, the key should turn to LOCK only when the shift lever is in the PARK (P) position.
   - With a manual transmission, the key should turn to LOCK only when the shift lever is in the REVERSE (R) position.
4. On vehicles equipped with a key release button, try to turn the key to the LOCK position without pressing the button.

   The key should turn to LOCK only when key release button is pressed.

Park Brake and Automatic Transmission PARK (P) Mechanism Check

Caution: When performing this check, the vehicle could move suddenly. Personal injury or property damage may result. Make sure there is enough room around the vehicle, in case the vehicle does move. Do not use the accelerator pedal, and be ready to turn OFF the engine immediately if it starts.

1. Ensure that the vehicle is parked on a fairly steep hill with the vehicle facing downhill.
2. Keep the regular brake firmly engaged while setting the park brake.
3. Perform the following procedure in order to test the holding ability of the park brake:
   - Ensure that the engine is running.
   - Ensure that the transmission is in the NEUTRAL (N) position.
   - Slowly remove foot pressure from the regular brake pedal.

   Do this until the vehicle is held by the park brake only.
4. Perform the following procedure in order to test the holding ability of the PARK (P) mechanism's holding ability:
   4.1. Ensure that the engine is running.
   4.2. Shift to PARK (P).
   4.3. Release all of the brakes.

Underbody Flushing Service

At least every spring, use plain water to flush any corrosive materials from the underbody. Take care to clean thoroughly any areas where mud and other debris can collect.

Explanation of Scheduled Services

For time and/or mileage intervals of scheduled maintenance items, refer to *Maintenance Schedule (Gasoline)*.

The following text and illustrations describe the details of the required scheduled maintenance services.

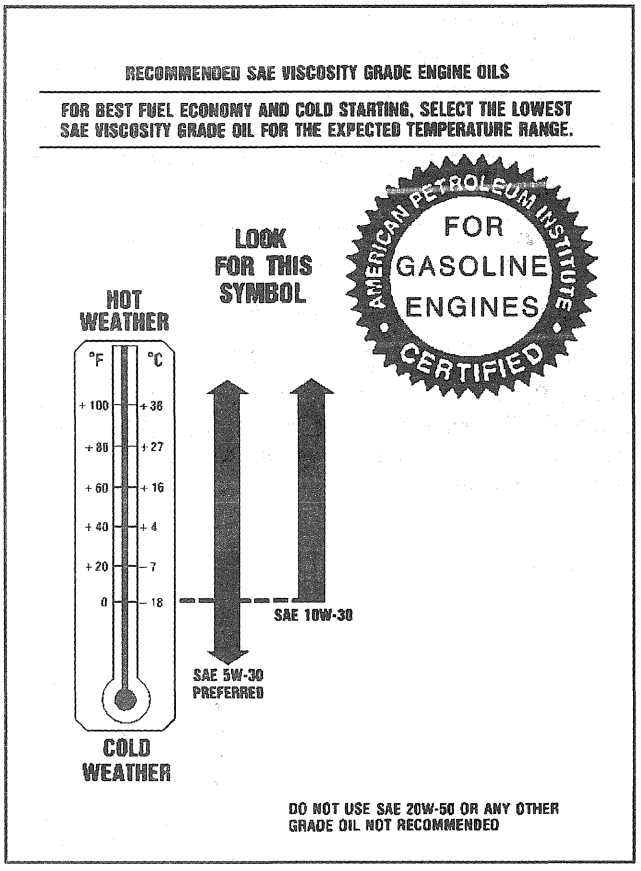
For information on the proper fluids and lubricants to use, refer to *Fluid and Lubricant Recommendations*.

Engine Oil and Filter Change

For the engine oil and filter changing procedure, refer to Engine Oil and Filter Change in Engine Mechanical.

Engine Oil Quality

Oils of the proper quality for the vehicle can be identified by looking for the STARBURST symbol. The STARBURST symbol indicates that the oil has been certified by the American Petroleum Institute (API), and is preferred for use in gasoline engines.



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Engine Oil Viscosity

The recommended oil viscosity for the C/K Truck, gasoline engines only, is SAE 5W-30 (P/N 12345610).

The recommended oil viscosity for the C/K Truck, diesel engines only, is SAE 15W-40 (P/N 12345634), and SAE 10W-30 (P/N 12345616) recommended for use in diesel engines for extremely cold conditions.

But SAE 10W-30 is approved for used in gasoline or diesel engines. GM Goodwrench Motor Oil is approved for all General Motors passenger cars, vans, and trucks with gasoline or light duty diesel engines. This oil meets or exceeds engine oil recommendations of General Motors and many other equipment manufacturers that recommend oils of this viscosity grade and quality. Refer to Fluid and Lubricant Recommendations. See your owner's manual or your GM dealer for specific oil use, filling, and change recommendations.

Notice: Using oils of any viscosity other than those recommended could result in engine damage. When choosing an oil, consider the range of temperatures the vehicle will be operated in before the next oil change. Then, select the recommended oil viscosity.

Engine oil viscosity (thickness) has an effect on the fuel economy and the cold-weather operation (starting and oil flow). Lower viscosity engine oils can provide better fuel economy and cold-weather performance. However, higher temperature weather condition require higher viscosity engine oils for satisfactory lubrication. When the temperature is consistently above 0°F (−18°C), SAE 10W-30 can be used. SAE 20W-50 or oils of other viscosity rating or quality designations are NOT recommended for use in any truck, at any time.

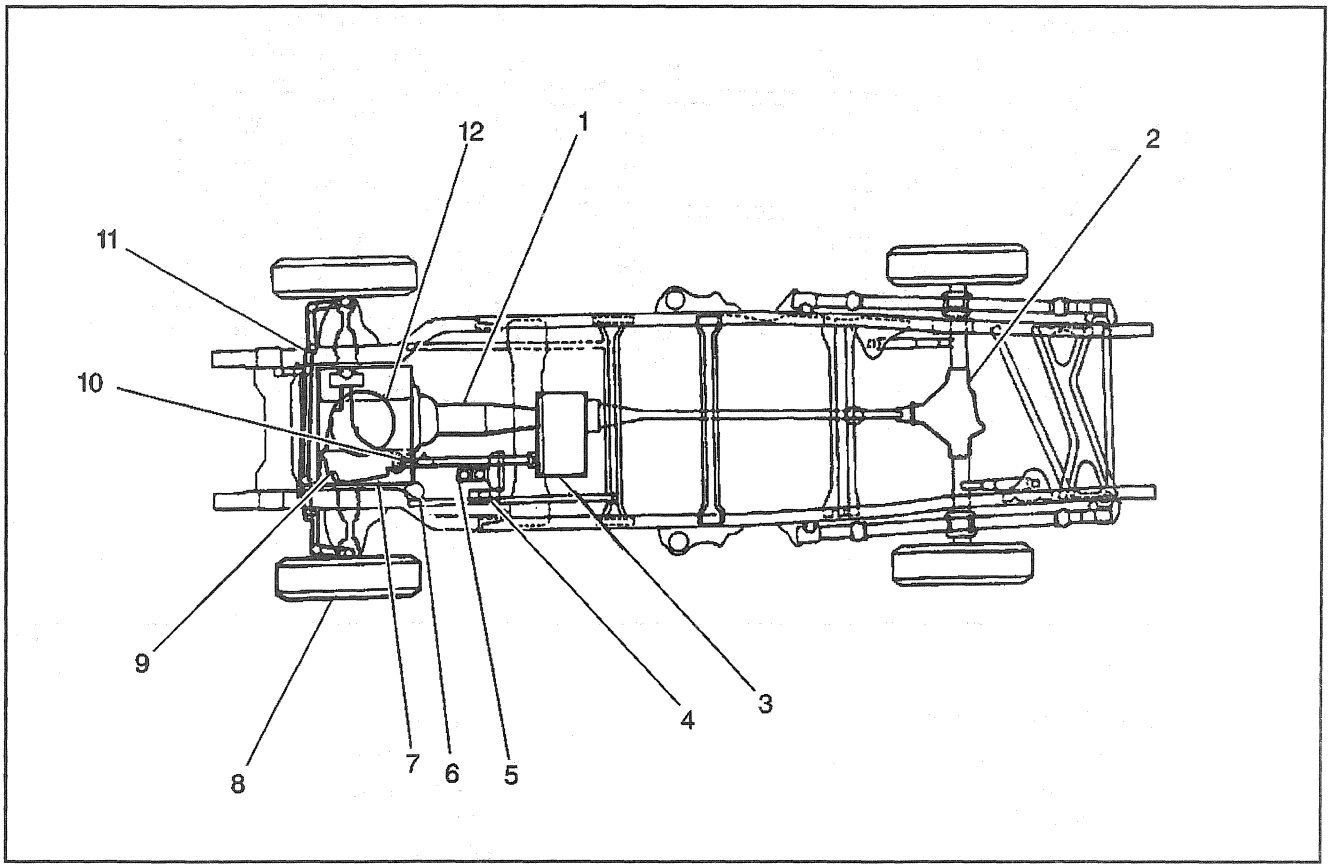
The recommended oil viscosity for the C/K Truck is SAE 5W-30.

Chassis Lubrication

Notice: Do not lubricate the parking brake cables. Lubrication destroys the plastic coating on the cable.

Refer to the illustration for the location of the lubrication points for the chassis. Lubricate transmission shift linkage. Lubricate the park brake guides, underbody contact points and linkage.

Lubrication Points (Automatic/Selectable Four-Wheel Drive)



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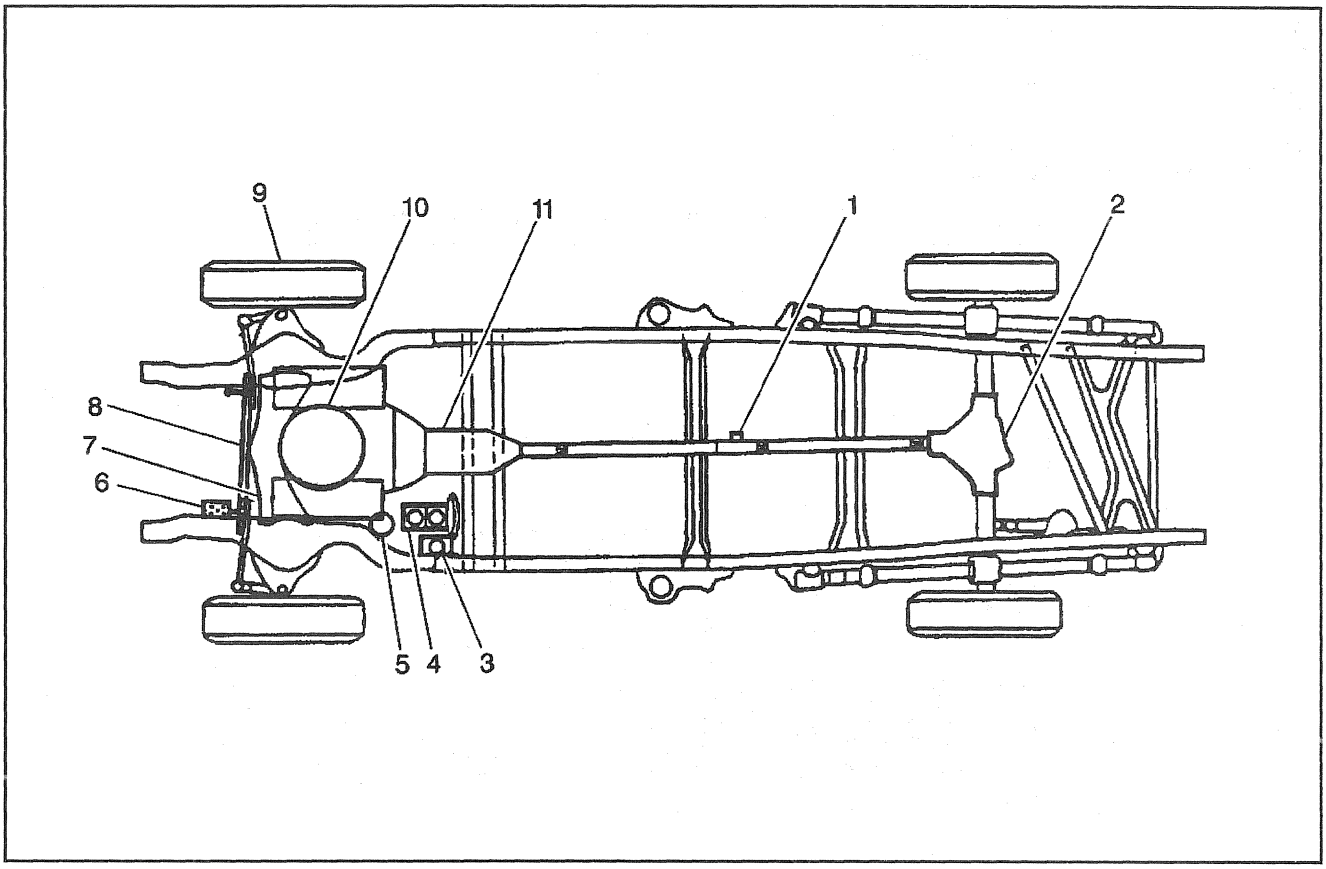
Legend

(1) Transmission
(2) Rear Axle Differential
(3) Transfer Case
(4) Clutch Actuator
(5) Brake Master Cylinder
(6) Oil Filter
(7) Engine
(8) Wheel Bearings
(9) Front Axle Differential
(10) Front Propeller Shaft
(11) Steering Linkage
(12) Air Cleaner

Lubrication Points (Rear-Wheel Drive)



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Legend

(1) Propeller Shaft-Slip Joint
(2) Rear Axle Differential
(3) Clutch Actuator
(4) Master Cylinder
(5) Oil Filter
(6) Steering Gear
(7) Engine
(8) Steering Linkage
(9) Wheel Bearings
(10) Air Cleaner
(11) Transmission

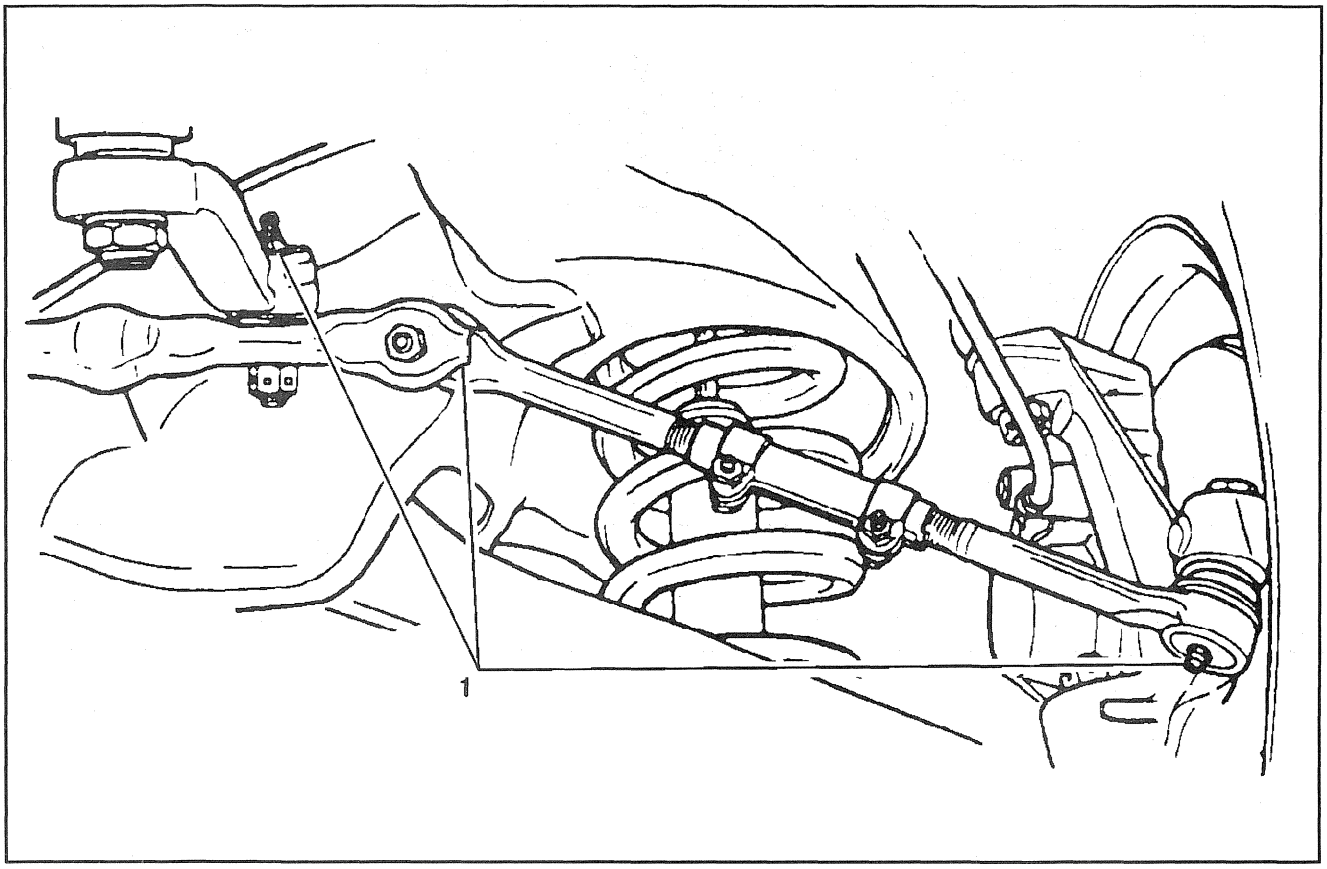
Lubricating Joints that have Grease Fittings

Refer to the illustration for the location of the grease fittings

Important: Wipe off all dirt from the grease fitting before lubricating the joint. Ball joints should not be lubricated unless their temperature is 10°F (-12°C) or higher. During cold weather, the ball joint should be allowed to warm up as necessary before being lubricated. Use a low-pressure grease gun on all joints to prevent seal damage.

Apply grease slowly while watching the grease seal. Apply grease until grease is seen bleeding from the seal. If the seal expands but no grease is seen, do not apply any more grease and allow time for the grease to bleed from the seal.

Lubrication Fittings (Driver Side)



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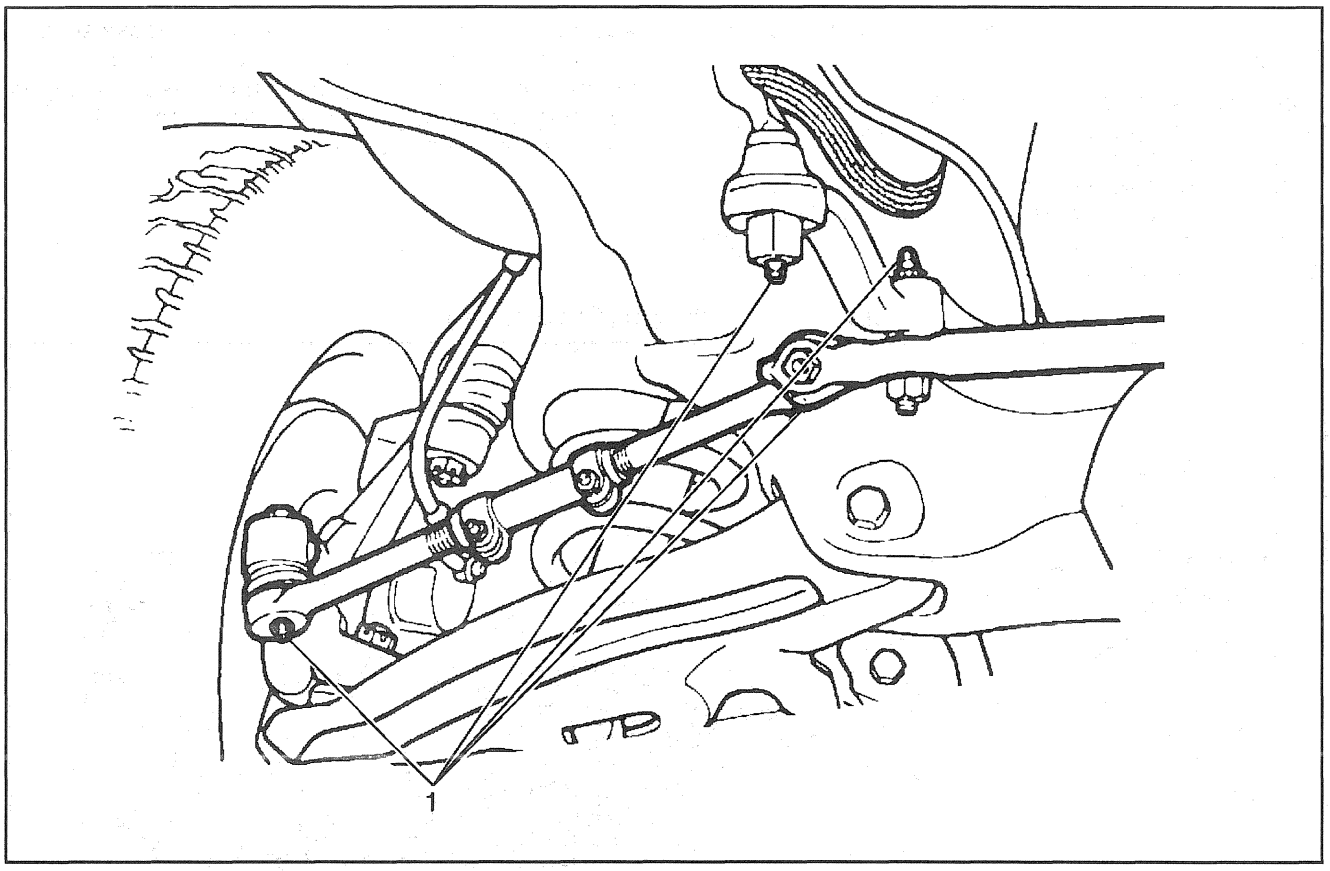
(1) Lubrication Fittings

Lubrication Fittings (Passenger Side)



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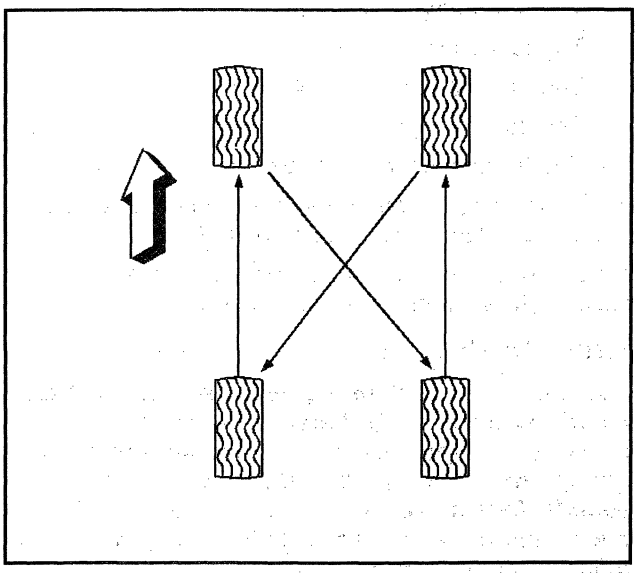
Legend

(1) Lubrication Fittings

Tire and Wheel Inspection and Rotation

Inspect the tires for abnormal wear for damage. Rotate the tires to equalize the wear and obtain maximum tire life. If irregular or premature wear exists, refer to *Abnormal or Excessive Tire Wear (Center of Tread)*, *Abnormal or Excessive Tire Wear (General)*, *Abnormal or Excessive Tire Wear (Heel and Toe Wear)*, *Abnormal or Excessive Tire Wear (Tire Edges Wear)*, *Abnormal or Excessive Tire Wear (Uneven)*, *Abnormal or Excessive Tire Wear (Excessive or Uneven)*, *Abnormal or Excessive Tire Wear (Scuffed Tires)*, and, *Abnormal or Excessive Tire Wear (Cupped Tires)*.



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Accessory Drive Belt Inspection

Inspect the accessory drive belts for the following:

- Cracks
- Fraying
- Wear
- Proper tension

Replace as needed. (Belts can have many small cracks in individual ribs without affecting the performance.) Refer to Drive Belt Diagnosis in Engine Mechanical.

Automatic Transmission

Change both the fluid and the filter according to the maintenance schedule intervals. For maintenance schedule information, refer to *Maintenance Schedule (Gasoline)* Maintenance Schedule.

For the fluid and filter changing procedure, refer to Transmission Fluid/Filter Changing in Automatic Transmission.

Spark Plug Replacement

Replace the spark plugs according to the maintenance schedule intervals with the correct type. For maintenance schedule information, refer to *Maintenance Schedule (Gasoline)* Maintenance Schedule.

For information on the correct type of spark plug, refer to *Maintenance Items* Maintenance Items.

For the spark plug replacement procedure, Refer to Spark Plug Replacement in Engine Electrical.

Spark Plug Wire Inspection

Clean the spark plug wires and inspect for burns, cracks or other damage. Inspect the wire boot fit at the coils and at the spark plugs. Replace wires as needed. Refer to Spark Plug Wire Harness in Engine Electrical.

Air Cleaner Filter Replacement

Replace the air cleaner filter according to the maintenance schedule intervals with the correct type. For maintenance schedule information, refer to *Maintenance Schedule (Gasoline)* Maintenance Schedule.

For information on the correct type of air cleaner filter, refer to *Maintenance Items* Maintenance Items.

For the air cleaner filter replacement procedure, refer to Air Cleaner Replacement in Engine Controls.

Fuel Tanks, Cap and Lines Inspection

Inspect the following components for damage or leaks:

- The fuel tanks
- The cap
- The lines
- The fuel rails
- The injection assemblies

Inspect the fuel cap gasket for an even filler neck imprint and any damage. Replace parts as needed. Periodic replacement of the fuel filter is not required. For fuel system diagnosis information, refer to Fuel System Diagnosis in Engine Controls.

Inspections and Other Services

Listed below are the vehicle inspections and services that should be made by either the owner or a qualified technician at the frequencies indicated to help ensure the following:

- Proper safety of the vehicle.
- The vehicle emission system performance.
- Dependability of the vehicle.

Complete any necessary repairs at once. Use the proper fluids or lubricants whenever adding to the vehicle. For information on fluids and lubricants to use when service is required, refer to *Fluid and Lubricant Recommendations*.

At Least Monthly

Tire Inflation Check

Inspect the tire pressure when the tires are COLD. Maintain tire pressures indicated on the Tire Placard on the driver's door of the vehicle.

Cassette Deck Service

Clean the cassette deck. Cleaning should be done every 50 hours of tape play to prevent permanent damage, or every 30 hours for maximum performance.

At Least Twice A Year

Restraint System Check

Make sure the safety belt reminder light and all the belts, buckles, latch plates, retractors, anchorages are working properly. Look for any other loose or damaged safety belt system parts. If anything is seen that might keep a seat belt system from doing it's job, have it repaired. Have any torn or frayed seat belts replaced.

Also look for any opened or broken supplemental inflatable restraint (SIR) covers.

The SIR system does not need regular maintenance.

Throttle System Inspection

Throttle system (includes accelerator and cruise control) should operate freely without hesitation between full closed and wide open throttle.

Important: The accelerator and cruise control cables should not be lubricated under any condition. Throttle system components causing hesitation or sticking should be replaced.

Inspect the following:

- Missing parts such as retainers or clips.
- Interference of the linkage or the cable conduit to critical components such as fuel lines, brake lines, harness leads, etc.
- Proximity of the cable to the exhaust system and other heat sources: inspect for melting and/or discoloration.
- Cable kinking. Avoid sharp bends of cables.
- Clearance of the throttle system moving parts throughout their travel from other stationary components.
- Damage of the components due to cable kinking, severe kinking, severe abrasion, misalignment, etc. If any of the above conditions exists, notify your dealer for a recommended rerouting, adjustment, or replacement.

Automatic Transmission Check

Inspect the automatic transmission fluid level. Add the proper transmission fluid if needed. A fluid loss may indicate a problem. Inspect the system and repair if needed. For information on the correct fluid to use, refer to *Fluid and Lubricant Recommendations*.

Weatherstrip Lubrication

Clean the weatherstrip surface, and then apply a thin film of silicone grease, GM P/N 12345579 or equivalent, using a clean, dry cloth.

Wiper Blade Check

Inspect wiper blades for wear or cracking. Replace blade inserts that appear worn or damaged, or that streak or miss areas of the windshield.

At Least Once A Year

Key Lock Cylinders

Lubricate the key lock cylinders with the proper lubricant. For information on the proper lubricant to use, refer to *Fluid and Lubricant Recommendations*.

Body Lubrication

Lubricate all body door hinges and latches, including the following:

- The hood
- The rear compartment lid
- The fuel door
- The headlamp pivot points
- The console door
- The I/P passenger compartment

For information on the proper lubricants to use, refer to *Fluid and Lubricant Recommendations*.

More frequent lubrication may be required when exposed to a corrosive environment.

Starter Switch Check

Caution: When performing this check, the vehicle could move suddenly. Personal injury or property damage may result. Make sure there is enough room around the vehicle, in case the vehicle does move. Do not use the accelerator pedal, and be ready to turn OFF the engine immediately if it starts.

On an automatic transmission vehicle, try to start the engine in each gear. The starter should crank only in PARK or NEUTRAL. If the starter operates in any other position, the vehicle needs service.

On a manual transmission vehicle, place the shift lever in NEUTRAL, push the clutch pedal down halfway and try to start the engine. The starter should operate only when the clutch pedal is fully depressed all the way to the floor. If the starter operates when the clutch pedal is not pushed all the way down to the floor, the vehicle needs service.

Brake Transmission Shift Interlock (BTSI) Check

Caution: When performing this check, the vehicle could move suddenly. Personal injury or property damage may result. Make sure there is enough room around the vehicle, in case the vehicle does move. Be ready to apply the regular brake immediately should the vehicle begin to move.

With the engine OFF, turn the ignition to RUN, but do not start the engine. Without applying the regular brakes, try to move the transmission shift lever out of PARK with normal effort. If the shift lever moves out of PARK, the brake transmission shift interlock (BTSI) needs service.

Steering Column Park Lock Check

While parked and with the park brake set, try to turn the ignition key to LOCK in each shift lever position.

On an automatic transmission vehicle, the key should turn to LOCK only when the shift lever is in PARK.

On a manual transmission vehicle, the key should turn to LOCK only when the shift lever is in REVERSE.

On all vehicles, the key should come out only in the LOCK position.

Park Brake and Automatic Transmission PARK Mechanism Check

Caution: When performing this check, the vehicle could begin to move. Personal injury or property damage may result. Make sure there is enough room in front of the vehicle, in case the vehicle begins to roll. Be ready to apply the regular brake immediately should the vehicle begin to move.

To inspect the park brake's holding ability: with the engine running and transmission in NEUTRAL, slowly remove foot pressure from the regular brake pedal. Do this until the vehicle is held by the park brake only.

To inspect the automatic transmission PARK mechanism's holding ability: with the engine running, shift the transmission to PARK, then release all brakes.

Underbody Flushing

At least every spring, use plain water to flush any corrosive materials from the underbody. Take care to thoroughly clean any areas where mud and other debris can collect.

Periodic Maintenance Inspection (General Maintenance)

Listed below are inspections and services which should be performed at least twice a year (for instance, each spring and fall). A dealer's service department or qualified service center should perform these jobs. All repairs should be completed at once.

Steering and Suspension Inspection

Inspect the front and rear suspension and the steering system for the following conditions:

- Damaged parts
- Loose parts
- Missing parts
- Signs of wear
- Lack of lubrication

Inspect the power steering lines and hoses for the following conditions:

- Proper hook-up
- Binding
- Leaks
- Cracks
- Chafing, etc.

Exhaust System Inspection

Inspect the complete exhaust system. Inspect the body near the exhaust system.

Inspect for broken, damaged, missing or out-of-position parts as well as the following conditions:

- Open seams
- Holes
- Loose connections
- Other conditions which could cause a heat build-up in the floor pan
- Other conditions which could let exhaust fumes into the vehicle.

Refer to *Exhaust Leakage (Not OBD II)*

Engine Cooling System Inspection

Inspect the hoses and replace the hoses if the hoses exhibit any of the following conditions:

- Cracked hoses
- Swollen hoses
- Deteriorated hoses

Inspect the following components and replace the components as needed:

- Pipes
- Fittings
- Clamps

Clean the outside of the radiator and the air conditioning condenser. To help ensure the proper operation, a pressure test of the cooling system and pressure cap is recommended at least once a year.

Throttle System Inspection

Inspect the throttle system for the following conditions:

- Interference
- Binding
- Damaged parts
- Missing parts

Replace any components that have high effort or excessive wear. Do not lubricate the following components:

- Accelerator cables
- Cruise control cables

Drive Axle Service

Inspect the rear/front axle fluid level and add fluid as needed. Inspect the constant velocity joints and the axle seals for leaking.

Transfer Case (Four - Wheel Drive) Inspection

Every 12 months or at oil change intervals, inspect the front axle and the transfer case and add lubricant when necessary. On the manual shift transfer case, oil the control lever pivot point. Inspect the vent hose at the transfer case for kinks and proper installation. More frequent lubrication may be required on off-road use.

Brake System Inspection

Inspect the complete system. Inspect the brake lines and the brake hoses for proper hook-up, binding, leaks, cracks, chafing, etc. Inspect the disc brake pads for wear and the rotors for surface condition. Also inspect the drum brake linings for wear and cracks. Inspect other brake parts, including the following components:

- The drums
- The wheel cylinders
- The calipers
- The park brake
- Other parts

Inspect the park brake adjustment. The brakes may need to be inspected more frequently if driving habits or conditions result in frequent braking.

Periodic Maintenance Inspection (Cooling System Maint Recommend)

Notice: Do not spray cold water on a hot radiator.

Notice: Do not use pressure greater than 138 kPa (20 psi) to test the radiator. Damage to the radiator will result if a higher pressure is used.

- Check the outside of the radiator for bent fins or signs of leakage. Do not temporarily seal the cooling system with a sealer type antifreeze or coolant additive.
- Remove any stones from between the fins.
- Clean loose debris and road film from the radiator core with a quality grease solvent and compressed air. For a more efficient cleaning, direct the stream of solvent at the front of the core. Remove the radiator grille, the fan guard, and the fan shroud in order to ensure a thorough cleaning.
- Remove the radiator cap and look for plugging and scale on the inside of the tank. Replace a badly plugged radiator. Test the cooling system and the radiator.
- Check the coolant level. If the level is low, add the recommended coolant as required.
- Check the condition of the radiator hose clamps. Tighten the clamps if any leakage is seen. Replace the clamps if you see the following conditions:
  - Cracked clamps
  - Stripped clamps
  - Corroded clamps
- Check the radiator hoses for cracking or for a spongy appearance. Replace deteriorated hoses or bursting could occur, resulting in coolant loss and extensive damage from overheating.
- Check the radiator core for leaks and for accumulation of dirt that could obstruct the air passages and reduce heat transfer.
- Check the coolant recovery reservoir for leaks.
- Inspect the radiator rubber mountings and bumpers for deterioration. Replace these as necessary. Check the mounting bolts, the supports, and the braces. Also, check for damage to the radiator core, the side flanges, and the supporting components.
- Check for clearance between the fan blade, the core, and the shroud. Check the fan attaching bolts for tightness. Make sure no bolts are missing. Replace the fan if any blade is bent. The blade and the shroud should be equal distance around the entire perimeter of the shroud. Adjust the distance as necessary after you make any adjustment to the fan or the fan mounting bracket and hub.
- Inspect the filler cap seal. Replace the cap if the following seal conditions apply:
  - Cracking
  - Separation
  - Deterioration
- In order to help maintain efficient heat dissipation, do an occasional external flush of the radiator with water. This removes the majority of dirt accumulation and foreign matter from between the core fins. Using moderate pressure, direct water from behind the core in order to force out debris. Direct the water stream in line with the fins in order to reduce the possibility of bending the fins.
- A radiator with a dirty, obstructed, or leaking core causes the engine to overheat. Radiator scale deposits result from using water that is hard and has a high mineral content in the cooling system. Heat affects the minerals in the water causing the formation of scale, or hard coating, on the metal surfaces within the radiator, reducing the transfer of heat. Some hard water produces a silt-like deposit that restricts the flow of water. Replace a radiator that is plugged, or has a heavy scale on the core.

Vibration Diagnosis and Correction

Specifications

Tire and Wheel Runout Specifications

Application	Specification	
	Metric	English
Aluminum Wheel		
Lateral	0.762 mm	0.030 in
Radial	0.762 mm	0.030 in
Steel Wheel		
Lateral	1.143 mm	0.045 in
Radial	1.015 mm	0.040 in
Tire and Wheel Assembly (Radial and Lateral)		
Off-Vehicle	1.27 mm	0.05 in
On-Vehicle	1.52 mm	0.06 in
Wheel Stud	0.25 mm	0.01 in
Wheel Hub	0.132 mm	0.0052 in

Propeller Shaft Runout Specifications

Application	Millimeters	Inches
Aluminum Wheel		
Lateral	0.762	0.030
Radial	0.762	0.030
Steel Wheel		
Lateral	1.143	0.045
Radial	1.015	0.040
Tire and Wheel Assembly (Radial and Lateral)		
Off-Vehicle	1.27	0.05
On-Vehicle	1.52	0.06
Wheel Stud	0.25	0.01
Wheel Hub	0.132	0.0052

One Piece Propeller Shaft Runout

Application	Metric	English
Front	1.016 mm	0.040 in
Center	1.27 mm	0.050 in
Rear	1.40 mm	0.055 in

Two-Piece Propeller Shaft Runout

Application	Metric	English
Front	0.762 mm	0.030 in
Center	0.762 mm	0.030 in
Rear	0.889 mm	0.035 in

Pinion Runout

Application	Metric	English
Pinion Runout	0.076 mm	0.003 in

Propeller Shaft Balancing Weight Amounts

Correction, Total Weight	Clamp Spread, Degrees
0.0	180
0.1	174
0.2	169
0.3	163
0.4	157
0.5	151
0.6	145
0.7	139
0.8	133
0.9	127
1.0	120
1.1	113
1.2	106
1.3	99
1.4	91
1.5	83
1.6	74
1.7	64
1.8	52
1.9	36
2.0	0

Diagnostic Information and Procedures

Systematic Approach

During the last 10–15 years, vehicle design and engineering have dramatically changed due to the following factors:

- Increased fuel costs
- Decreased fuel supplies
- Corporate Average Fuel Economy requirements
- Clean air legislation
- Foreign competition
- Ability to withstand collision
- Rising customer expectations

Vehicle designs have evolved from full-frame construction to lighter unibody designs. These designs transfer noise and vibration much more readily.

General Motors has greatly reduced the use of heavier and smoother running V8 engines, replacing these engines with lighter, more fuel-efficient 4-cylinder and 6-cylinder engines. During this same period, options such as the following have become more and more popular:

- Air conditioning
- Power steering
- All-wheel drive

Such options increase engine load and can also generate unwanted noise and vibration.

Customer perception of quality can be directly linked to the presence or absence of unwanted noise and vibration. A technician's ability to quickly diagnose and repair a noise or vibration directly affects that customer's loyalty to the dealership. Technicians who are capable of satisfying this need will be highly regarded and in great demand.

The intent of this section of the service manual is to provide a systematic approach to vehicle vibration diagnosis and correction. By using Strategy Based Diagnosis and troubleshooting philosophies covered in this section, technicians will be able to provide effective and timely repairs.

Vibration Diagnosis

The techniques and procedures for correcting the following types of vibrations are including in the road testing diagnosis:

- Tire and wheel shake
- Steering/suspension shimmy and shake
- Launch shudder
- Exhaust moan
- Engine firing frequency

A Process of Elimination

A few basic concepts must be understood before attempting to diagnose a vibration. As in any diagnostic process, information must be gathered and deciphered, and a correction made based on the results. Road testing and inspecting the vehicle in a manner which systematically eliminates different components, in turn supplements the information received from the customer concerning the complaint. Concentrating efforts on the areas that have not been eliminated will make repairs faster and more effective.

Duplicate the Condition

All vehicles produce vibrations. Some vibrations are normal, while others are not. Some vibrations can be repaired, some cannot. The customer's complaint must be duplicated or experienced. The vibration and the cause of the vibration must be evaluated under changing conditions. Otherwise, there is no way to know for sure that you are fixing what the customer would like fixed.

The symptoms and characteristics of a noise or vibration are also important information. Ask yourself the following questions before you begin:

- What does the vibration feel like?
- Does the vibration make noise? If so, what does the vibration sound like?

What Does the Vibration Feel Like?

Different types of noise and vibration have particular characteristics. These characteristics will help determine the cause of the condition, and the best way to correct the condition. This is the reason for duplicating the vibration.

Identifying the Complaint

The first step in diagnosing a vibration complaint is identifying the exact vibration that the customer is complaining about.

Sometimes the vibration can be duplicated at a given speed. Other vibrations may not be as evident and may require questioning the customer carefully. A road test may need to be performed with the customer in the vehicle in order to point out the specific vibration complaint.

The following questions should be asked when attempting to identify a vibration complaint:

- At what speed is the vibration the worst?
- Can the vibration be felt? If so, where?
- Can the vibration be heard?
- Does the engine or the vehicle load affect the vibration?
- Does the vibration occur in more than one gear range?
- When did the vibration first appear?

The answers to these questions will help in duplicating and diagnosing the vibration.

If the vibration that has been duplicated is suspected as being normal, compare the vibration with a vehicle that is equipped in the same way. The same equipment should include the following:

- Body style
- Engine option
- Engine driven accessories
- Transmission type
- Tire size
- Suspension performance type
- Axle ratio

Important: Once an attempt has been made to repair what may be a normal condition, the customer will likely be convinced that the vehicle has a problem. Customer satisfaction becomes extremely difficult after this point.

If necessary, make the comparison with the customer present and explain the situation.

Purpose of Road Testing

The purpose of road testing is to duplicate the vibration complaint and to find any operating conditions that change or eliminate the vibration. Most importantly, road testing will determine whether the vibration is related to the engine speed or the road speed.

In order to complete a quick and accurate road test, install an engine tachometer (such as a scan tool) and the EVA in the vehicle. Place the EVA vibration sensor in a location where the customer's concern can be felt.

Which Component Group is Causing the Vibration

After a vibration has been categorized as being engine or vehicle-speed related, the vibration can be broken down further to fit into one of the following three groups of rotating components:

- The engine, the clutch disc (manual transmission), the propeller shaft (within the driveline support assembly), the transmission flexplate (automatic transmission) and the transmission torque converter
- The transmission output shaft and the rear axle differential pinion (mounted in the rear of the differential)
- The tires, wheels, hubs, and rotors

These three groups represent the major areas that can produce vibration complaints. The components in each group are related to each other because they are either bolted or splined together. This means that each group of components rotates at the exact same speed.

These categories can be broken down further in order to identify the exact component responsible for the disturbance. The emphasis is on testing (and more testing) in order to pinpoint the source and to eliminate unnecessary parts replacement.

Types of Road Tests

Caution: Refer to Road Test Caution in Cautions and Notices.

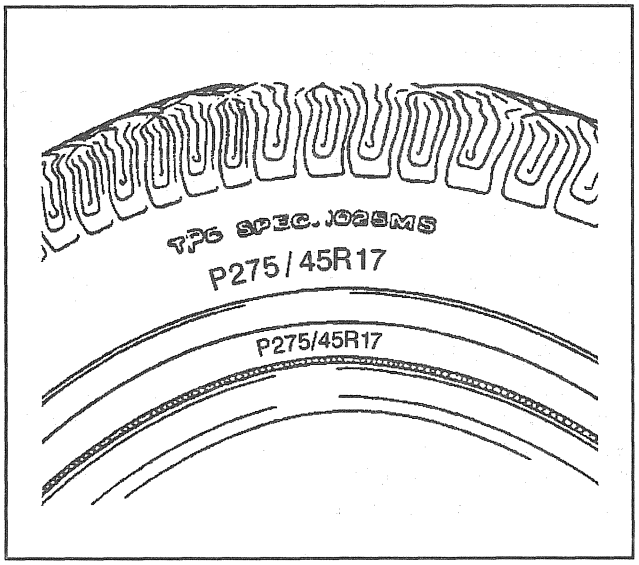
The following are the most often used and informative road test procedures:

- Tire and Wheel Inspection
- Slow Acceleration Test
- Neutral Coast-Down Test
- Downshift Test
- Neutral Run-up Test
- Brake Torque Test
- Steering Input Test
- Standing Start Acceleration Test (Launch Shudder)

These tests will help to pinpoint the vibration. Perform all of the tests on a smooth, level road.

Road Test

Tire and Wheel Inspection



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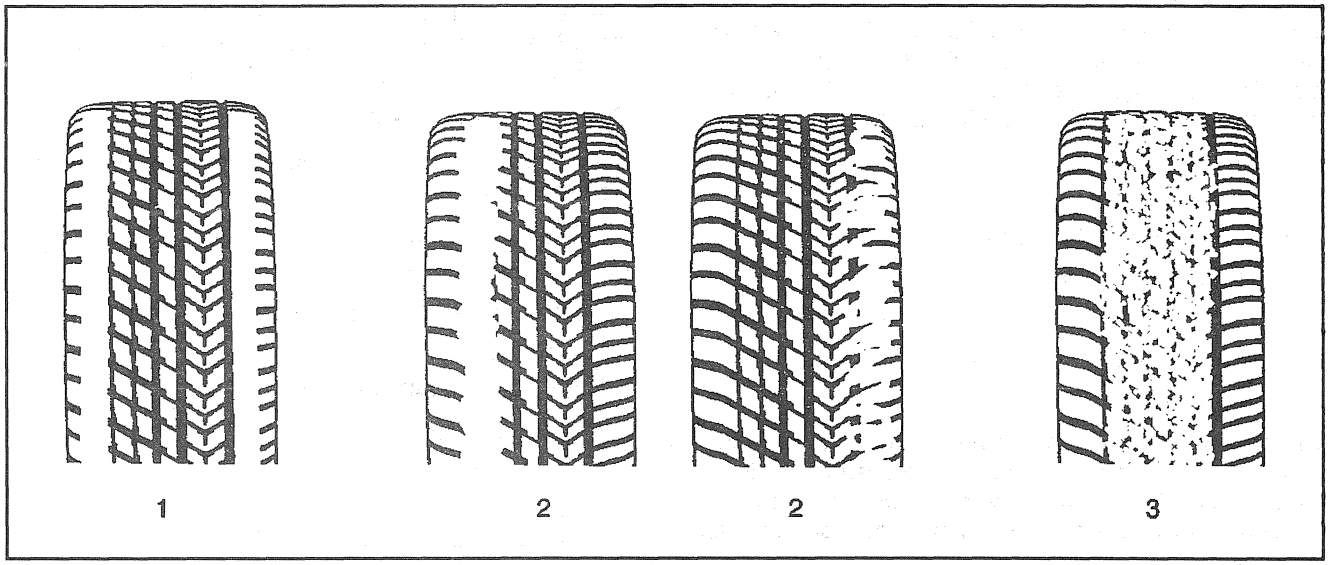
The tires on all new GM models have a tire performance criteria (TPC) rating number molded on the sidewall. The TPC rating will appear as a four-digit number preceded by TPC SPEC on the tire wall near the tire size. A replacement tire should have the same TPC rating.



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Legend

(1) Hard Cornering, Under Inflation
(2) Excessive Toe on Non–Drive Axle
(3) Heavy Acceleration on Drive Axle, Excessive Toe on Drive Axle, Over Inflation

This test should be performed for ALL vibration complaints unless the disturbance occurs only with the vehicle at a standstill.

Inspect the tire and wheel assemblies for the following conditions:

- Unusual wear such as cupping, flat spots, and heel-and-toe wear

  (These conditions can cause tire growl, howl, slapping noises, and vibrations throughout the vehicle.)
- Proper inflation
- Bulges in the sidewalls

  (Not to be confused with normal ply splices, commonly seen as indentations in the sidewall.)
- Bent rim flanges

Inspecting these characteristics of the tire and wheel assemblies may lead to the cause of the vibration. At the very least, the inspection will provide assurance that the vehicle is safe for road testing.

Slow Acceleration Test

This test will identify the engine-speed or vehicle-speed related conditions. Additional tests may be necessary in order to determine in which category the vibration belongs.

Caution: Refer to Road Test Caution in Cautions and Notices.

1. On a smooth, level road, slowly accelerate up to highway speed.
2. Look for disturbances that match the customer's description.
3. Note the following readings where the disturbance occurs:
   - The vehicle speed, km/h (mph)
   - The engine speed (RPM)
   - The frequency (if possible)

Following this test, perform the Neutral Coast-Down Test and the Downshift Test.

Neutral Coast-Down Test

Caution: Refer to Road Test Caution in Cautions and Notices.

1. On a smooth level road, accelerate to a speed slightly higher than the speed at which the vibration occurs.
2. Shift the vehicle into NEUTRAL and coast down through the vibration range.

   Note if the vibration is present in NEUTRAL.

If the vibration still occurs in NEUTRAL, then the vibration is definitely vehicle-speed sensitive. At this point, the engine, the clutch disc (manual transmission), the propeller shaft (located inside the driveline support assembly), the transmission flex plate (automatic transmission) and the torque converter have been eliminated as a cause. Depending on the symptoms or frequency, the repair will concentrate on the tire and wheel assemblies, the transmission output shaft, the rear axle differential pinion, or the rear drive axle shafts.

Downshift Test

Caution: Refer to Road Test Caution in Cautions and Notices.

1. On a smooth, level road, accelerate to the speed at which the complaint vibration occurs.

   Note the engine RPM.
2. Decelerate and safely downshift to the next lower gear (from OVERDRIVE to DRIVE, or from DRIVE to SECOND, etc.)
3. Operate the vehicle at the previous engine RPM.

If the vibration returns at the same engine RPM, the engine, the clutch disc (manual transmission), the propeller shaft (located inside the driveline support assembly), the transmission flex plate (automatic transmission), or the torque converter are the most probable causes. You may repeat this test is still smaller gears, and in NEUTRAL, in order to confirm the results.

In some cases, a vibration may be sensitive to torque or engine load, as well as being related to a specific engine (RPM) or vehicle (km/h / mph) speed. These vibrations can be most difficult to diagnose, and require additional testing. Still, following a systematic approach usually leads to pinpointing the problem.

Neutral Run-Up Test

This test is designed to identify engine-speed related vibrations. Use this test when the customer complains of vibration at idle, or as a follow-up to the downshift test. This test more than likely doesn't apply when the complaint is vehicle-speed related only (appearing at the same vehicle speed regardless of the engine speed).

Caution: Refer to Road Test Caution in Cautions and Notices.

1. Slowly increase the engine speed while looking for disturbances that match the customer's complaint.
2. Note at which engine speed (RPM) and frequency (if possible) that the vibration occurs.

Brake Torque Test

This test is designed to identify engine-related vibrations that were not uncovered with the Neutral Run-Up Test. This test also works for vibrations that are sensitive to the engine load or to the torque. This test will more than likely not apply to vehicle-speed related only vibrations.

Caution: Refer to Road Test Caution in Cautions and Notices.

1. Apply the parking brake.
2. Block the front wheels.
3. Step firmly on the brake pedal.
4. Place the vehicle in Drive.
5. Slowly increase the engine speed while looking for vibrations that match the customer's description.
6. Note the engine speed (RPM) and frequency (if possible) at which the disturbance occurs.
7. Repeat steps 4, 6, and 7 in Reverse, if necessary.

Additional Tests

You can perform one or more of the following tests for unique vibration complaints such as those that are torque/load sensitive, in addition to vehicle-speed or engine-speed sensitive:

- Steering Input Test
- Standing Start Acceleration Test

Steering Input Test

This test is intended to determine how much the wheel bearings and other suspension components contribute to the vibration, especially those relating to noises such as growl, grinding, and roaring.

Caution: Refer to Road Test Caution in Cautions and Notices.

1. Drive through slow sweeping turns with the vehicle at the vibration speed (mph) in one direction, then in the other.
2. If the vibration gets worse or goes away, inspect the following components as possible causes of the vibration:
   - The wheel bearings
   - The hubs
   - The tire tread

Standing Start Acceleration (Launch Shudder) Test

The purpose of this test is to duplicate a vibration called launch shudder. In some cases, a powertrain mount or an exhaust ground-out may also be suspected, depending on the symptoms.

Caution: Refer to Road Test Caution in Cautions and Notices.

1. Observe the necessary safety precautions.
2. With the vehicle at a complete stop and in gear, remove your foot from the brake pedal.
3. Accelerate to 48–64 km/h (30–40 mph) while looking for vibrations that match the customer's description.

Other possible causes of launch shudder include the following conditions:

- Incorrect trim height. Refer to *Trim Height* in Suspension General Diagnosis.
- A worn or damaged drive axle CV joint.
- A ground-out engine/transmission mount.
- Faulty exhaust hangers and mounts.

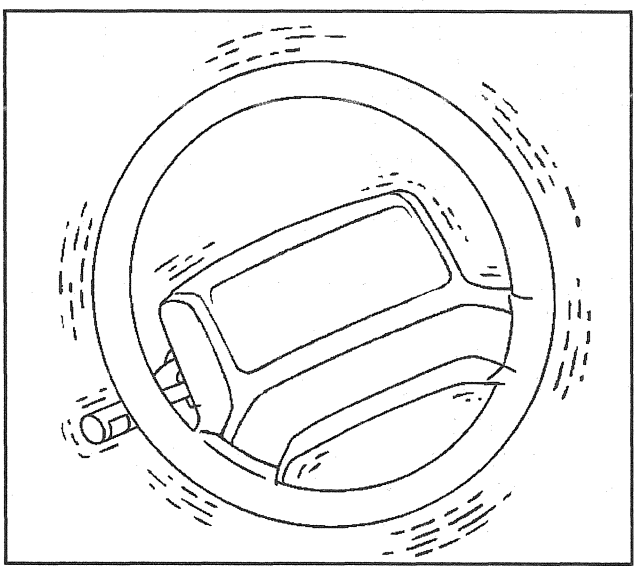
Classifying the Vibration

The next step after road testing the vehicle is to identify the frequency of the duplicated and abnormal vibration. Use the EVA in order to measure the frequency. If the EVA is not available, the frequency can be categorized into groups according to how the vibration feels or sounds. The majority of vibrations will fit into one of the following categories.

- Vibrations that can be felt:
  - Shake
  - Roughness
  - Buzz
  - Tingling
- Vibrations that make noise:
  - Boom
  - Moan and groan
  - Howl
  - Whine

Vibrations That Can Be Felt

Shake



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The shake is a low frequency vibration, typically 5–20 Hz. The shake is sometimes seen in the steering wheel, the seat, or the console. The best description is the feeling from an out-of-round or unbalanced tire. Customers may refer to shake in one of the following terms:

- Shimmy
- Wobble
- Shudder
- Waddle
- Hop

In most cases, damage to or wear of the following components is to blame for the shake:

- The tires
- The wheels
- The brake rotors (vehicle-speed sensitive)
- The steering tie rod ends
- The suspension ball joints
- The engine (engine-speed sensitive)

Roughness

Roughness is a vibration with a slightly higher frequency than the shake, usually 20–50 Hz. Roughness is similar to the feeling you get from holding a jigsaw.

Buzz

Buzz is slightly higher in frequency: 50–100 Hz. A buzz is similar to the feel of an electric razor. You may feel it in your hands through the steering wheel, in the feet through the floor, or in the seat. Inspect the following components for a possible cause:

- The exhaust system
- The A/C compressor
- The engine

Tingling

This is the highest frequency that can still be felt. Tingling may sometimes produce a PINS AND NEEDLES sensation. Customers may say the vibration puts their hands or feet TO SLEEP.

Vibrations That Make Noise

Boom

Boom is a low frequency interior noise of 20–60 Hz. Sometimes the customer complains of a pressure in their ears. Examples of similar noises include a bowling ball rolling down an alley, deep thunder, or a bass drum.

A customer may use the following words to describe boom:

- Droning
- Growling
- Moaning
- Roaring
- Rumbling
- Humming

Boom may not be accompanied by a perceptible vibration (roughness).

Moan or Drone

Moan or drone is a sustained tone at a low frequency of 60–120 Hz, somewhat higher than boom.

Examples of similar noises include a bumble bee, or blowing air across the top of a soda bottle. Examples of words to describe moan or drone are humming, buzzing, resonance. Moan or drone may be accompanied by a perceptible buzzing vibration. Inspect the following systems:

- The powertrain mounts
- The exhaust system.

Howl

Howl is a noise at mid-range frequency of 120–300 Hz. This sounds like the wind howling.

Whine

Whine is a prolonged, high-pitched sound in the 300–500 Hz range, and is usually related to the meshing gears or gear noise. Similar sounds include mosquitoes, turbine engines, and vacuum cleaners.

Matching Frequency to Component Speed

At this point in the diagnosis, the vibration has been duplicated, designated as abnormal, identified as being related to engine speed or vehicle speed, and assigned a frequency from the EVA or categorized into a symptom group based on how it feels or sounds.

Automotive vibrations are usually related to the rotating speed of a component. The speed of these components will be calculated using either an engine speed or vehicle speed method. The engine rpm readings taken during the road test will be used in diagnosing vibrations that are engine speed sensitive. If the vibration is vehicle speed sensitive, the rotational speed of the tires needs to be determined. As long as the vehicle is operated at a constant speed, the tires will operate at a constant speed. These speed is measured in rotations or cycles per second. The reading is then compared to the frequency of the vibration, which is also measured in cycles per second.

Calculating Tire Rotation

TIRE/WHEEL ROTATION WORKSHEET

Vehicle Information

Complaint Speed: _____ mph Year: _____ Model: _____

Symptom: _____ VIN: _____

Frequency: _____ Engine: _____ Trans: _____

Engine Speed: _____ rpm Tire Size: _____ Axle Ratio: _____ : ___

Gear: _____ TPC Spec: _____

Tire/Wheel Speed

Vibration Occurs at: [ ] mph ÷ 8 (km/h) 5 (mph) = [ ] increments of 8 km/h / 5 mph

Tire/Wheel Speed, RPS (Hz)

8 km/h / 5 mph increments: [ ] x [ ] tire RPS * at 8 km/h / 5 mph (from table) = [ ] **1st order**

1st order: [ ] x 2 = [ ] **2nd order**

1st order: [ ] x 3 = [ ] **3rd order**

*RPS revolutions per second; equates to cycles per second (Hz).

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Determine the rotational speed of the tires in revolutions per second, or Hertz (Hz), based on the vehicle speed at which the vibration occurs. In order to determine the rotational speed, follow this procedure:

1. Determine the complaint speed — the vehicle speed at which the vibration occurs.
2. Determine the number of 8 km/h (5 mph) increments:
   - Divide the complaint speed by 8 when using km/h.
   - Divide the complaint speed by 5 when using mph.
3. Determine the vehicle tire size.
4. Locate on the table below, the Hertz value at 8 km/h (5 mph) for that tire size.
5. Multiply the Hertz value by the number of 8 km/h (5 mph) increments.
6. The result is the rotational speed of the tires in Hertz at the complaint speed. If this figure matches the vibration frequency, a first-order vibration is present in the tire and wheel assembly.

Tire/Speed Table

Tire Size	Tread	Revs/Sec at 5 MPH
P205/75R15	OOR	1.06
P215/75R15	ALS	1.05
P235/65R15	AL2	1.07
P235/70R15	ALS	1.00
	OOR	0.99
P235/75R15	ALS	1.00
31X10.5R15/B	OOR	0.95
LT225/75R16	ALS	0.99
	OOR	0.98
LT245/75R16	ALS	0.95
	OOR	0.94
LT265/75R16	OOR	0.90
LT215/85R16	HWY	0.95
	OOR	0.94
LT235/85R16	HWY	0.91
	OOR	0.90
7.50R16	HWY	0.90
	OOR	0.90
8.75R16.5	HWY	0.98
225/70R19.5	HWY	0.89
AL2		Touring
ALS		All Season
HWY		Highway
OOR		On/Off Road

Sometimes, the tire/wheel vibration may be of a higher-order. In order to compute possible higher-order vibrations, multiply the rotational speed of the tires in Hertz at the complaint speed by the order number. If any of these matches the vibration frequency, then a vibration of that particular order is present in one of the tire and wheel assemblies.

Steering and Suspension Assembly Vibrations

Steering and suspension assembly vibrations are the first level of testing for low-frequency vibrations that are vehicle-speed sensitive. The symptoms if a steering/suspension first-order vibration are shimmy or shake, usually felt in the steering wheel or in the seat. Inspect the following components for wear or damage:

- The steering tie rod ends.
- The suspension ball joints.

Tire and Wheel Vibration

Tire and wheel assembly vibrations are the next level of testing for low-frequency vibrations that are vehicle speed sensitive. The tires, wheels, brake rotors and wheel hubs should be systematically tested, according to the symptoms.

First-Order Tire and Wheel Assembly Vibration

The following are symptoms of first-order vibrations caused by tire and wheel assemblies:

- The vibration is always vehicle-speed related.

  If the vibration is affected by the speed of the engine, or is eliminated by placing the transmission in NEUTRAL, then the vibration is not related to the tire and wheel assemblies.
- The vibration will feel like a SHAKE, usually in the steering wheel or the seat:
  - Tire and wheel vibrations that are felt in the steering wheel are most likely related to the front tire and wheel assemblies.
  - Tire and wheel vibrations that are felt in the seat or the floor are most likely related to the rear tire and wheel assemblies.

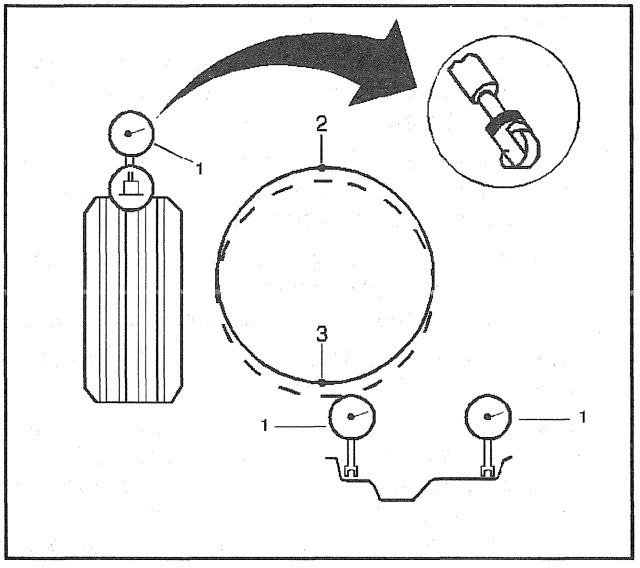
  This may not always hold true, but is a general rule that may serve to initially isolate a problem to the front or the rear of the vehicle.
- The customer may complain of a WADDLE at low speeds of 8 to 56 km/h (5 to 35 mph).
- The frequency on the EVA will correspond to the first-order of tire rotation. This frequency will usually be in the 10 to 20 Hz range, depending on the speed of the complaint and the size of the tire. The smaller the tire, the faster it will rotate at any given speed.
- The range of the human ear begins at 20 Hz. For this reason, first-order tire vibrations are rarely produce noise. The exception to this would be if the tires display an irregular tread pattern or flat spots, causing a GROWLING or SLAPPING nise.

Tire and Wheel Runout Measurement

Measure wheel runout with an accurate dial indicator. Measure with the wheel installed or with the wheel off of the vehicle. Use an accurate mounting surface such as a wheel balancer. You can measure with or without the tire mounted on the wheel.

Measure radial runout and lateral runout on the inboard and outboard rim flanges. With the dial indicator in position, rotate the wheel slowly one revolution. Record the total indicator reading. If any measurement exceeds the specifications, and if there is a vibration that wheel balancing does not correct, replace the wheel. Disregard any indicator readings that are due to welds, paint runs, or scratches.

Radial Runout



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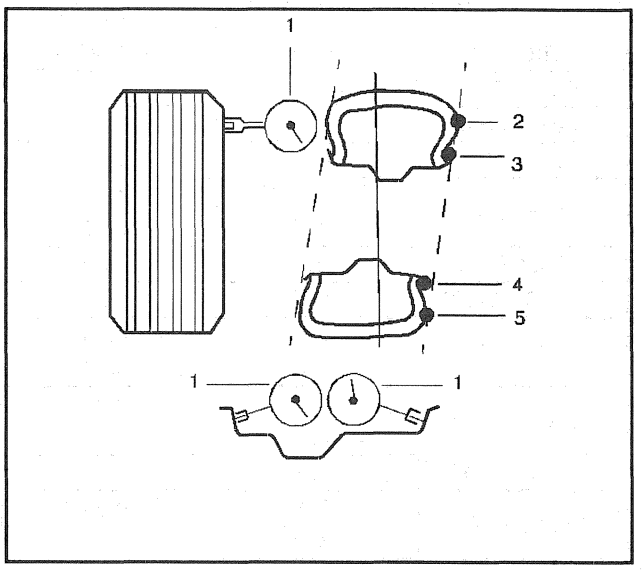
Legend

(1) Dial Indicator
(2) High Spot
(3) Low Spot

Unlike a perfect circle, the tire shape of radial runout is oval. Measure radial tire runout from the center tire tread rib. You can measure other tread ribs. The gauge reads the total runout. The high spot is the location of the maximum runout. If either flange is beyond specifications, replace the rim.

- Aluminum Wheels – 0.762 mm (0.030 in)
- Steel Wheels – 1.015 mm (0.040 in)

Lateral Runout



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Legend

(1) Dial Indicator
(2) Tire High Spot
(3) Wheel High Spot
(4) Wheel Low Spot
(5) Tire Low Spot

Lateral runout is a sideways variation of the wheel. This runout causes a twist or a wobble. Measure lateral runout on a side surface. On the tire and wheel assembly, measure the side wall of the tire as close to the tread shoulder design edge as possible. The gage reads the total runout. The high spot is the location of the maximum runout. If either flange is beyond guidelines, replace the rim.

- Aluminum Wheels – 0.762 mm (0.030 in)
- Steel Wheels – 1.143 mm (0.045 in)

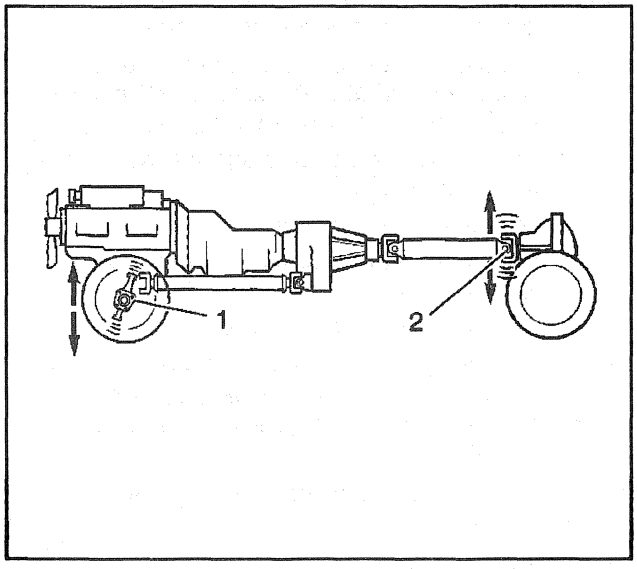
Measurement Procedures

Do the following tire and wheel runout measurement:

1. Inflate the tires to specifications.
2. Warm up the tires before taking measurements. This eliminates flat spotting. You do not need to warm up newly installed tires.
3. Raise the vehicle on a lift.
   If measurement is taken with the wheel off of the vehicle, mount each tire and wheel assembly on a dynamic balance machine.
4. Mark the tire and wheel assemblies for exact replacement.
   4.1. Mark a wheel hub bolt. Mark the hub bolt's exact position on the wheel.
   4.2. Mark each tire and wheel assembly for replacement on the exact hub/rotor assembly.

5. Take a radial measurement or a lateral runout measurement.
   5.1. Place the dial indicator in position.
   5.2. Rotate the tire and wheel assembly. Or rotate the wheel in order to find the wheel's low spot. Adjust the dial indicator to read zero.
   5.3. Rotate the tire and wheel assembly again in order to verify the low spot location. The dial indicator must return to zero. Disregard any dial activity due to welds, paint runs, or scratches on the wheel.
   5.4. Rotate the tire and wheel assembly, or rotate the wheel. Note the amount of variance (runout) from zero. Locate the high spot. Mark the high spot.
6. If there is a large difference in runout measurements from on-vehicle to off-vehicle, excessive runout of the bolt circle or the hub may be causing the problem.
7. If the measured runouts are not within specifications, vector the tire and wheel assembly in order to correct the problem.

Driveline Vibration Analysis



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The following components are possible sources of driveline vibration:

- The transmission output shaft
- The propeller shaft/s (driveshaft/s)
- The union flange
- The pinion gear

The above components are either bolted or splined together. Therefore, all of the components rotate at the same speed, vibrate at the same frequency and have the sam symptoms.

Driveline vibrations may relate either to the first or to the second order of driveline rotation. Driveline vibrations are always related to the speed of the vehicle. The vibration is often related to torque. If the vibration is worse or only noticeable when accelerating, decelerating, or crowding the throttle, then the vibration is related to the torque. The vibration will always occur at the same speed. If a vibration is both torque and speed sensitive, the driveline is the probable cause. Tire/wheel vibrations are speed sensitive, but not torque sensitive.

First-Order Driveline Vibration Symptoms

The following symptoms may indicate first-order driveline vibration:

- The vibration is related to vehicle speed.
- The vibration is torque sensitive.
- A boom or moan noise is present.
- The vibration occurs commonly above 72 km/h (45 mph), but possibly as low as 48 km/h (30 mph).
- The roughness or buzz vibration is felt in the seat, floor or steering wheel.
- The corresponding frequency on the EVA equals first-order driveline rotation (25–60 Hz), depending on the speed of the vehicle and the ratio of the axle. Refer to the worksheet in order to obtain the rotation speed of the propeller shaft.

Driveline Vibration Analysis

Once you identify a vibration that is related to the driveline, continue testing in this service area. The following components are possible sources of first-order driveline vibration:

- The propeller shafts
- The transmission output shaft
- The pinion flange
- The pinion gear

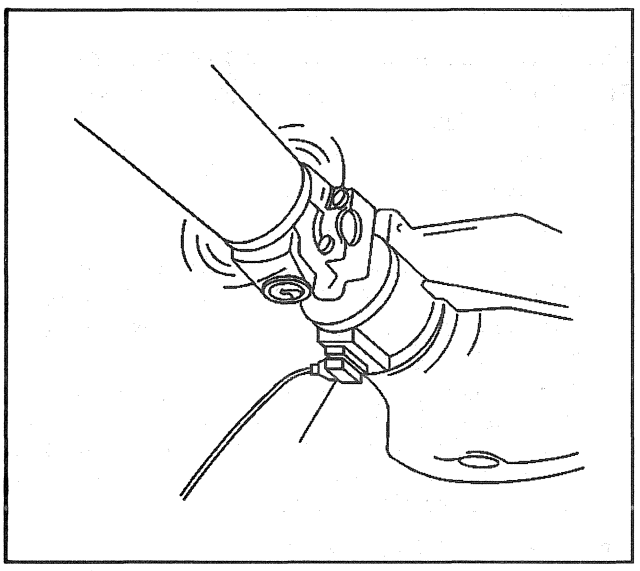
Locate the Source of Driveline Vibration with the EVA

Caution: Never run the vehicle faster than 112 km/h (70 mph) when performing propeller shaft vibration or checking for balance. Stay clear of rotating components and balance weights to avoid personal injury. Do not run the vehicle on the hoist for extended periods of time to avoid engine or transmission overheating. Do not step on the brake pedal with the brake drums removed.

In order to pinpoint the source of vibration, reproduce the vibration with the vehicle in the service stall. Then determine which component is vibrating the most using the EVA and the following procedure:

1. Raise the vehicle to curb height. Support the vehicle on a hoist or on safety stands. Do not allow the axle to hang. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tire/wheel assemblies. Refer to *Wheel Removal (Single Wheels)* in Tires and Wheels.
3. Remove the brake drums.

4. Ensure that the propeller shaft is free of undercoating.
5. Inspect the propeller shaft and U-joints for dents or damage.
6. Start the engine.
7. Place the transmission in gear.
8. Run the vehicle at the speed which the vibration occurs.



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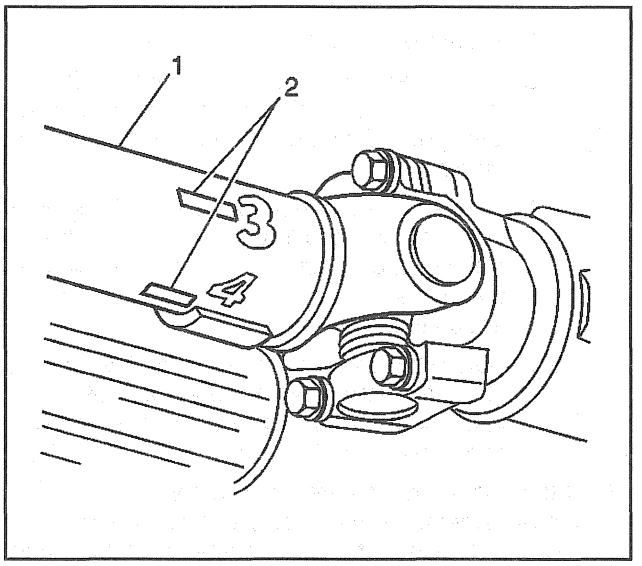
Hold the EVA sensor against the pinion nose and the transmission tailshaft assembly in order to determine which end of the propeller shaft has the most vibration. The end that has the most vibration will have a higher amplitude on the EVA.

If the vehicle has a two-piece propeller shaft, inspect the center support bearing.

If the transmission tailshaft vibrates, inspect the transmission crossmember under the transmission mount. If the mount is secured properly, there should be no vibration at the crossmember.

Runout and Balance Testing with the EVA



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Ensure that the runout of the various driveline components are within specifications. If the runouts are within specifications, strobe balance the driveline. The EVA is able to simplify the balancing process. Use the following procedure:

1. Use the EVA in order to determine which end of the propeller shaft has the most vibration.
2. Mark the end of the propeller shaft (1) that has the most vibration at four points (2), 90 degrees apart. Number the marks 1 through 4.
3. Mount the EVA sensor onto the bottom of the following components:
   - The differential housing
   - The center bearing support (for two-part propeller shafts)
   - The transmission tailshaft assembly
4. Position the sensor as close to the propeller shaft as possible. Ensure that the UP side of the sensor faces up. Ensure that the sensor is horizontal.

Notice: Do not use cruise control to maintain vehicle speed.

5. Start the engine.
6. Turn off all engine accessories.
7. Place the transmission in gear.
8. Run the vehicle at the speed which causes the most vibration in the propeller shaft.
9. Hook the timing light clip to the trigger wire.
10. Plug the vibration sensor into Input A of the EVA. Input B does not have strobe light capability.
11. Verify that the predominant frequency on the EVA display matches the frequency of the original vibration. Use the strobe light only if the rotation speed of the propeller shaft is the predominant frequency.

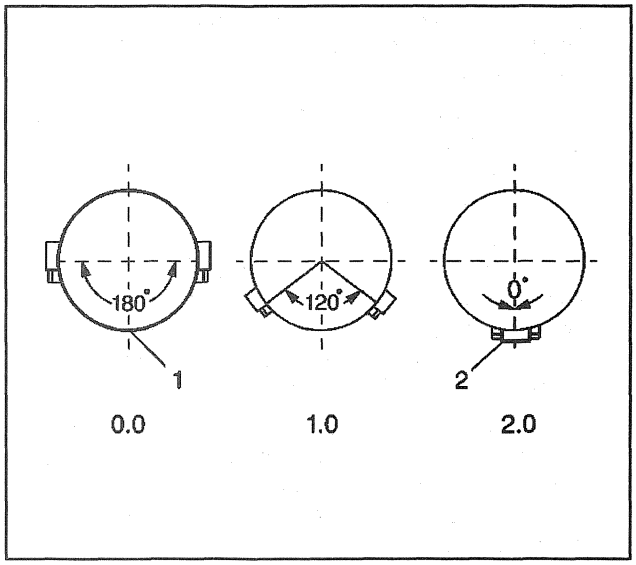
12. The EVA displays a series of questions in order to select the correct filter. Press YES in order to select the desired filter. Ensure that the frequency is in the middle of the filter range. Use the full range only as a last resort.
13. The EVA displays the test frequency, the amplitude and the filter range. The driveline is balanced when the amplitude is near two. In some cases a slightly higher amplitude will provide adequate balance.
14. Point the timing light at the propeller shaft. The strobe effect will appear to freeze the propeller shaft. Note which of the numbered marks is at the bottom of the propeller shaft (the 6 o'clock position). This position is the light spot.
15. Turn the engine off.
16. Install a weight directly on the light spot.
17. Start the engine.
18. Run the vehicle at peak vibration speed.
19. Strobe the propeller shaft again.

The propeller shaft is balanced if the strobe image is erratic and the amplitude is near two.

The propeller shaft is not balanced if one of the following conditions exist:

- The weight and the original light spot are at the 6 o'clock position — This condition means that there is not enough weight on the propeller shaft.

  In order to correct the balance, add a second weight next to the first weight. Inspect the balance again using the strobe light.



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  If the weights are now between 90 and 180 degrees off (between the 9 and the 3 o'clock positions) there is too much weight. In order to correct the balance, split the two weights equally on either side of the original light spot. Splitting the weight will produce a total weight between one and two weights.

  Inspect the balance again using the strobe light. Adjust the weights as necessary.

- The weight and original light spot are 90 to 180 degrees off (between the 9 and the 3 o'clock positions) — This condition means that one weight is too much.

  In order to correct the balance, split the two weights equally on either side of the original light spot. in order to produce a total weight less than one (between 120 and 180 degrees apart).

  Inspect the balance again using the strobe light. Adjust the weights as necessary.

- The weight and the original light spot are within 180 degrees of the 6 o'clock position.

  Move weight towards the 6 o'clock position. Inspect the balance again using the strobe light. Adjust the weight as necessary. Refer to the previous two conditions.

If the shaft will not balance using two weights, then place a third weight on the light spot. Split the first two weights in order to produce a total weight between two and three weights.

If three weights fail to balance the driveline, replace the propeller shaft.

When the propeller shaft balances, road test the vehicle in order to verify that the vibration is eliminated.

First-Order Driveline Vibration Analysis (Torque Sensitive)

If the vehicle has a vibration that is equal to first-order driveline rotation, and the vibration is not present when testing the vehicle in the stall, then internal rear axle components are the probable cause of the vibration.

Internal rear axle components are also the probable cause of the vibration if you were able to correct the vibration in the stall, but the vibration returned during the road test. Internal rear axle vibrations may be aggravated by the load of the vehicle working against the ring and pinion gear seat.

Since the propeller shaft and the pinion gear are bolted together through the pinion flange, the propeller shaft and the pinion gear operate at the same speed. Vibration in the pinion gear will therefore have the same frequency and symptoms as the propeller shaft.

In order to isolate the vibration to the pinion gear, use the following procedure:

1. Raise the vehicle to curb height. Support the vehicle on a hoist or on safety stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the tire/wheel assemblies. Refer to *Wheel Removal (Single Wheels)* in Tires and Wheels.
3. Remove the brake drums. Refer to *Brake Drum Replacement* in Drum Brakes.
4. Touch the pinion nose, or hold the EVA vibration sensor up to the pinion nose.

5. Use another technician in order to accelerate and decelerate the vehicle through the speed range at which the vibration was noticed during the road test.

Example

- If the vibration was originally noticed at 88 km/h (55 mph), accelerate from 72 km/h (45 mph) to 107 km/h (65 mph). Then decelerate from 107 km/h (65 mph) back to 72 km/h (45 mph).
- Repeat the above step and note whether or not the pinion nose vibrates under load during acceleration and/or deceleration.

If the vibration does not occur during the above procedure, install the brake drums and the tire/wheel assemblies. The brake drums and tire/wheel assemblies will add additional load on the system. Then repeat the above test.

Ensure that both axle shafts rotate at the same speed. The differential may mask a vibration when one tire is spinning faster than the other tire. Adjust the brakes in order to correct unequal tire rotation speed.

If you are unable to reproduce the vibration in the stall, apply the brake lightly in order to load the system further. Maintain the vehicle speed at which the vibration was noticed. Do not overheat the brakes.

If the pinion nose vibrates under acceleration and/or deceleration, and the other driveline components are eliminated as the cause of the vibration, then one of the following conditions may cause the vibration:

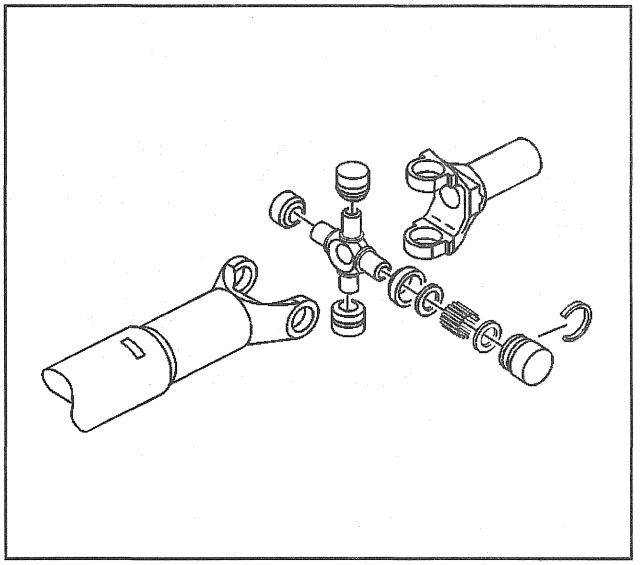
- A high spot on the pinion gear
- A bent pinion stem
- A cocked pinion bearing
- An improper axle housing bore

Anything that effects the pinion gear and how the pinion gear contacts the rotating ring gear may contribute to a first-order, torque-sensitive driveline vibration. The only way to correct the condition is to replace the faulty components. In most cases, the ring and pinion gear set and the related bearings must be replaced. In some case, however, the axle housing must be replaced. Complete a close-up visual inspection for damage or unusual wear in order to measure or identify the specific faulty component.

It is possible to isolate an internal axle vibration. Install a known good axle assembly from a stock unit. Verify that the known good axle assembly does not have a vibration problem.

Once you correct the internal axle problem, road test the vehicle. Inspect the vehicle for vibration. Balance the driveline as necessary in order to eliminate any remaining vibration.

Second-Order Driveline Vibration Theory



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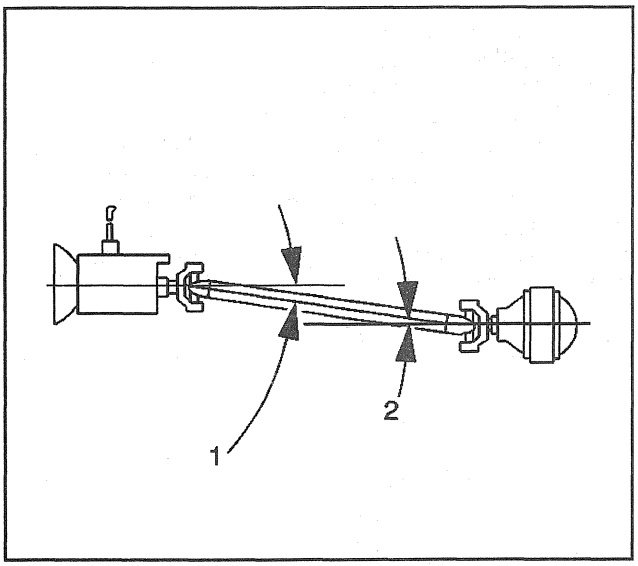
A faulty universal joint (U-joint) may cause a vibration that occurs twice for each rotation of the propeller shaft. This type of vibration is called a second-order vibration.

Second-order driveline vibrations are independent of runout or balance of a driveline component.

The following description of basic U-joint theory will help you to understand where second-order driveline vibrations originate and why they occur.

- As the propeller shaft rotates, the U-joints speed up and slow down twice for each rotation of the propeller shaft.
- The acceleration and deceleration of the U-joints is not visible. If there is vibration in the U-joints, the acceleration and deceleration will be audible and tactile.
- Compare the U-joint in a vehicle to a universal-type socket. When a universal-type socket is used to tighten a bolt, the socket will bind and release as the socket turns toward 90 degrees. The bind and release occurs twice for each revolution of the socket.
- The U-joint in a vehicle works in the same way as the universal-type socket. The bind and release effect is directly proportional to the angle that the U-joint operates: the greater the angle, the greater the effect.
- Because the transmission output speed is constant, the binding and releasing of the U-joints is better described as an acceleration and deceleration which occurs twice for each revolution of the propeller shaft.
- If the propeller shaft is running slowly, the accelerating and decelerating effect is visible. The acceleration and deceleration may create a vibration due to the fluctuations in force that are generated at high speeds.

Canceled Out Driveline Angles



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Legend

(1) Front Working Angle
(2) Rear Working Angle

Engineers design drivelines in order to compensate for the accelerations and decelerations in order to produce a smooth, constant flow of power, as listed below:

- The transmission drives the front yoke of the propeller shaft at a smooth and constant speed.
- The first U-joint causes the power to fluctuate twice for each revolution of the propeller shaft.
- The second U-joint, oriented 90 degrees from the first U-joint, causes the power to fluctuate opposite that of the first U-joint.
- As the first joint slows down, the second joint speeds up.

This design causes one U-joint to cancel out the effect of the other U-joint. The cancelled effects result in a smooth, constant power flow from the output yoke of the propeller shaft.

Second-order driveline vibrations occur when the cancellation become unequal between the front and rear U-joints.

Second-Order Driveline Vibration Symptoms

Second-Order driveline vibration has the following signs and symptoms:

- The vibration is always related to vehicle speed.
- The vibration is usually torque-sensitive.
- The vibration is worse under a torque load.

Launch shudder is the most common complaint of a second-order driveline vibration.

Launch shudder occurs during acceleration from 0–40 km/h (0–25 mph). Launch shudder appears as a low frequency shake, wobble, or shudder. The driver may feel the vibrations in the seat or steering wheel at low speeds [0–24 km/h (0–15 mph)]. The vibrations will increase in frequency as the vehicle speed increases. Launch shudder feels more like driveline roughness at higher speeds [24–40 km/h (15–25 mph)]. At speeds greater than 40 km/h (25 mph) the vibration usually disappears.

Launch shudder vibration is equal to a second-order vibration of the driveline. The EVA will not perceive frequency information due to the transitory nature of launch shudder.

Engine Related Vibration

Engine vibration is usually due to one or more of the following conditions:

- First-order engine imbalance
- Inherent engine firing sequence
- Inherent shaking engine forces
- Engine-driven accessories

Because these vibrations are engine-speed related, they are also normally torque sensitive. These vibrations may appear and disappear at different vehicle or road speeds, but will always appear at the same engine speed.

For example, if a customer states that a vibration is present at 40 km/h (25 mph), 64 km/h (40 mph), and again at 104 km/h (65 mph), and that the symptoms of the vibration are similar at all of these speeds, the vibration is probably engine-speed related. Any disturbance or vibration that is present during the following road tests would be considered engine-speed related:

- The Neutral run-up test
- The downshift test
- The brake torque test

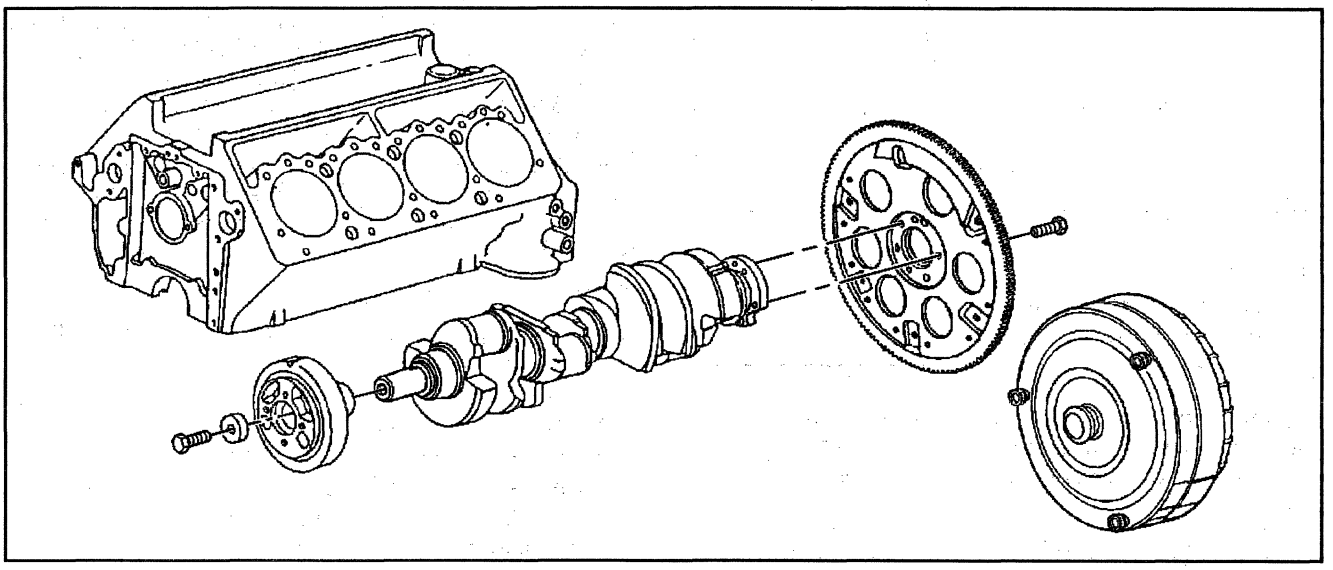
Any vibration that is present during the Neutral coast-down test is not engine-speed related. The engine-related vibrations covered in this diagnosis are engine-speed sensitive only.

First-Order Engine Imbalance

Notice: Do not accelerate against the brakes for longer than 10 seconds. Do not overheat the engine or the transmission. Depending on the vehicle design, the engine will only accelerate to a certain point under these conditions. Also, care should be taken during diagnosis as some disturbances may be created during brake torque that normally do not exist.

Notice: Proper flywheel installation requires carefully WALKING the flywheel onto the crankshaft and stagger-tightening the bolts. Proper torque converter to flywheel installation then requires gradually WALKING the torque converter to be flush with the flywheel, prior to installing the bolts. Do not draw the torque converter to the flywheel with the bolts. If these precautions are not followed, warping or bending of the flywheel and/or damage to the transmission torque converter may result.

Components Contributing to First-Order Engine Imbalance



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Engine imbalance is a condition that exists when a component that rotates at crankshaft speed is either unbalanced or has excessive runout. In rare cases, the crankshaft may be unbalanced. In any case, balancing the component or correcting the runout may bring the disturbance to an acceptable level.

Symptoms

- Vehicle shake at low speeds of 500–1200 rpm, or 8–20 Hz
- Roughness and BOOM at higher speeds of 1200–3000 rpm, or 20–50 Hz
- Vibration usually detected during the Neutral run-up test

Isolating the Components

1. Perform the Neutral run-up test, noting the rpm at which the vibration is the worst, and the severity. Refer to *Road Test*.
2. Inspect all powertrain mounts. Repair or replace as needed.
3. Inspect for any bindings or ground-outs in the exhaust system.

Important: The following steps apply to A/T-equipped vehicles only.

4. Matchmark the torque converter and the flywheel.
5. Disconnect the torque converter from the propeller shaft, pushing the converter back from the flywheel.
6. Tie up the converter, away from the flywheel.
7. Perform the Neutral run-up test again. Refer to *Road Test*.
   - If the flexplate shows any wobble or lateral runout, replace the flexplate. Refer to *Engine Flywheel Replacement (Automatic Transmission)* in Engine Mechanical.
   - Reindex the torque converter in three different positions. If the disturbance still exists, replace the torque converter.
8. If the vibration still exists, inspect the propeller shaft runout.
9. If the vibration still exists, inspect the harmonic balancer.
10. If the vibration still exists, the problem is related to residual engine imbalance. Refer to the procedure below.

Correcting Residual Engine Imbalance

1. Install washers on the harmonic balancer pulley bolts.
2. Replace bolts with longer bolts of equal hardness as needed.

3. (M/T only): Inspect the flywheel and the pressure plate for the following conditions:
   - Correct factory indexing. (The white paint spot on the flywheel and the pressure plate should line up.)
   - Warping
   - Balance

Excessive Inherent Engine Firing Frequency

Engine Speeds and Frequencies

Type of Vibration	First Order		Firing Frequency
	rpm	Hz	V8 Fourth Order
Shake	500	8.3	33.2
	750	12.5	50.0
	1000	16.6	66.4
	1500	25.0	100.0
Roughness	2000	33.3	133.2
	2500	41.6	166.4
Buzz	3000	50.0	200.0
	3500	110.6	233.2
	4000	132.4	266.4

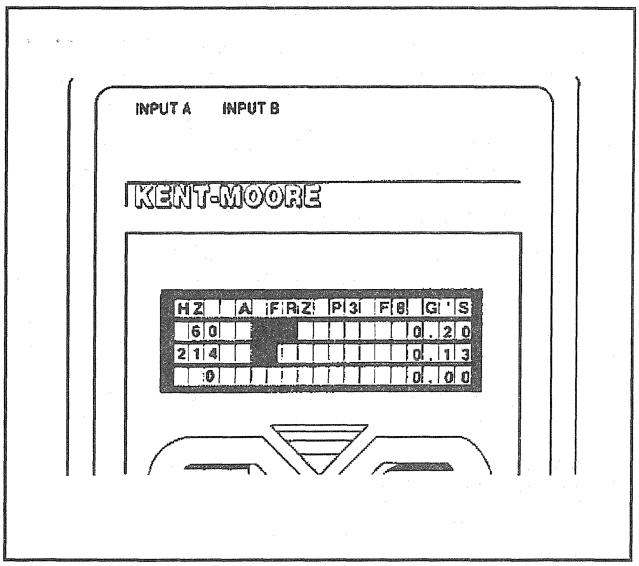
Firing frequency is a term used to describe the pulses created as the engine fires each cylinder. All engines have a firing frequency — but the object is to keep these disturbances from entering the passenger compartment. Initially, inspect for the following conditions:

- The engine and the exhaust system are mounted in a relaxed position.
- All of the mounts and hangers should be in good condition and correct for the application.
- No components, hoses, or lines are grounding to the frame or to the body.

The frequency of these disturbances will depend on the number of cylinders. The engine order will always be equal to one-half the number of cylinders. This is because a four-stroke engine requires two complete revolutions of the crankshaft in order to fire all of the cylinders.

For example, a V8 engine will fire cylinders 1, 3, 5, and 7 on the first revolution. Cylinders 2, 4, 6, and 8 will fire on the second revolution. This results in four firing pulses per revolution of the crankshaft, or fourth order.

Engine Vibration Diagnosis with the EVA



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1. Place the EVA vibration sensor on the seat track rail with the UP label facing upward.
2. Plug the EVA into a 12-volt power supply.
3. Prepare the EVA for data recording:
   3.1. Press RECORD.
   3.2. Select a snapshot tag number.
   3.3. Press ENTER in order to begin recording.
4. Slowly accelerate until the vibration occurs.
5. Note the vehicle and engine rpm where the disturbance occurs.
6. Press ENTER on the EVA in order to record the vibration data.
7. Perform the road test diagnoses in order to determine engine-speed or vehicle-speed sensitivity. Refer to *Road Test*.

Engine Firing Frequency Symptoms

- The vibration may be torque sensitive.
- The vibration is engine-speed related.
- The vibration is heard as a boom or a moan.
- The vibration is felt ass shake, roughness, or buzz (depending on the number of cylinders).
- The vibration excites the resonance of a system or a component, causing the system or the component to have a narrow rpm range.

The key to correcting these types of complaints is to isolate the vibration from the passenger compartment or the body.

Diagnosis and Repair of Engine Firing Frequency-Related Vibrations

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Take the necessary safety precautions. Refer to *Work Stall Test Caution* in General Information.
3. Attempt to duplicate the vibration.
4. While the vibration is present, find the area(s) of the vehicle excited by the vibration.
5. Inspect for witness marks due to a rubbing component.
6. Isolate the component and re-evaluate the vibration.
7. Inspect for proper torque on the excited component(s). Tighten as needed.
8. If the vibration still exists, proceed to the procedure below.

Engine Firing Frequency-Related Vibration Causing Components

1. Inspect for collapsed engine mounts.

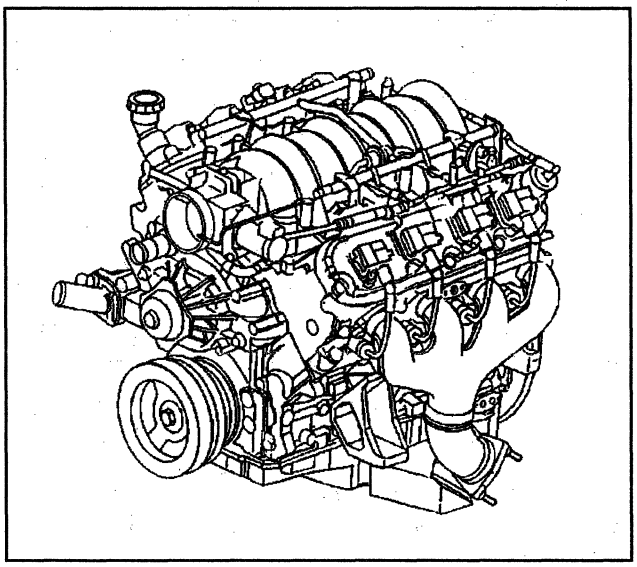
   Replace as needed. Refer to *Engine Mount Replacement (Front K)* in Engine Mechanical.
2. Inspect the exhaust hangers.
   - Exhaust systems can expand one to two inches when hot.
   - Remove the hangers one at a time.
   - Adjust or replace as needed.
3. Lubricate the manifold flexible coupling.
4. Inspect the A/C and P/S lines.
   - Isolate the hoses from the body.
   - Install the retainers.
5. Inspect the drive belts for whipping.
6. Inspect the accessory unit fasteners for damage or looseness.
7. Inspect the body panels for missing or loose welds.
8. Remove any aftermarket equipment that may complete a transfer path into the passenger compartment.
9. Inspect the exhaust system and powertrain mounts. Re-bed the engine and align the exhaust system as follows if needed:
   - Loosen the mounts and hangers.
   - Tighten all fasteners with the powertrain in the relaxed position.

Some residual vibrations may be normal. Compare the vibrations with a similar vehicle to get a feel for what is commercially acceptable, preferably with the customer present. Also, refer to bulletins for updates on the use of mass damper weights for specific applications.

Inherent Engine Shaking Forces

Engine Order Vibration Table

Engine Order	V8 90°
1/2 Order Torque Sensitive	Single Cylinder Misfire
1st Order Imbalance	Abnormal
1.5 Order Torque Sensitive	—
2nd Order	Abnormal
2nd Order Torque Sensitive	Bank-to-Bank EGR/Fuel Var.
3rd Order Torque Sensitive	—
4th Order Torque Sensitive	Normal



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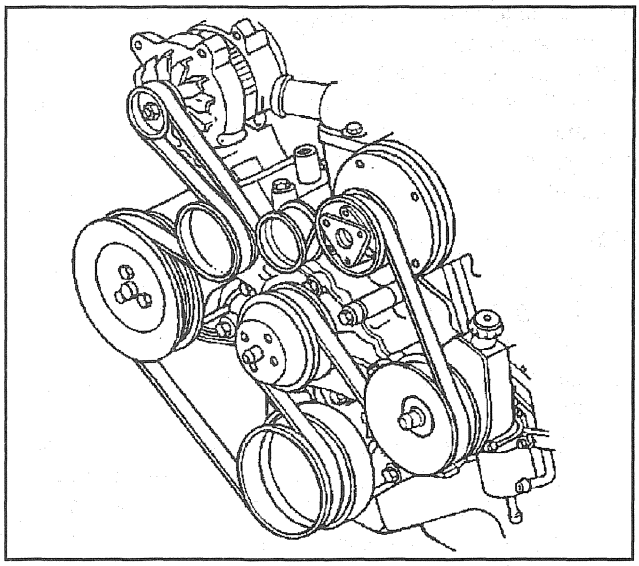
Just like firing frequency, some engine disturbances are the result of normal operation. Some engines can have additional inherent vibration due to the cylinder arrangement, the design, and the firing order.

Before attempting to repair a disturbance, compare the disturbance to another known good vehicle. Although some vibrations could be normal, they may not be pleasant to the customer.

The key to resolve an inherent engine disturbance is to isolate the vibration from the passenger compartment. Follow the same procedures as outlined for the engine firing frequency-related vibrations.

Engine-Driven Accessories



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Engine driven accessories that exhibit vibration pose some special challenges. For example, the drive belts can no longer be removed one at a time in order to isolate the condition. If removing the belt eliminates the vibration, reinstall the belt and operate each accessory one at a time in order to see which has the most effect on the vibration. However, one component may affect another because the drive belt drives all of the accessories.

Inspect that the accessory load is not exciting the engine firing frequency.

Diagnosis

1. Compare the vibrations to a known good vehicle in order to ensure they are abnormal.
2. Remove the drive belts.
3. If the vibration stops, perform the following steps:
   3.1. Install the drive belts.

Important: The drive belts drive all of the engine accessories. Therefore, one component may affect another.

   3.2. Operate each accessory one at a time in order to see which has the most effect on the vibration.
4. Inspect for accessory load affecting the engine firing frequency.
5. Inspect the pulleys for misalignment or bends. Repair or replace as needed.
6. Inspect the A/C system for overcharging. Evacuate and Recharge as needed. Refer to Evacuation and A.C Charging in HVAC Systems with A/C – Manual.
7. Inspect the engine oil level. Add or drain as needed.

Repair Instructions

General Service Precautions

Caution: One or more of the following guidelines may apply when performing specific required tests in the work stall:

1. ***When a test requires spinning the drive wheels with the vehicle jacked up:***
   - ***On vehicles equipped with a limited-slip differential, do not attempt to spin one drive wheel with the other wheel on the ground. The vehicle may drive through this wheel and cause the vehicle to move unexpectedly, or drive off the safety stands. This may result in personal injury or damage.***
   - ***Do not exceed 56 km/h (35 mph) when spinning one drive wheel with the other drive wheel stopped. This limit is necessary because the speedometer indicates only one-half the actual wheel speed under these conditions. If all drive wheels are spinning at the same speed, do not exceed 112 km/h (70 mph). Personal injury may result from excessive speed wheel spinning. All persons should stay clear of rotating components and balance weight areas to avoid possible personal injury.***
   - ***When running an engine in the repair stall for an extended period of time, use care not to overheat the engine and transmission.***
2. ***When a test requires jacking up the vehicle and running with the wheels and brake drum removed:***
   - ***Do not apply the brake with the brake drums removed.***
   - ***Do not place the transmission in Park with the propeller shaft still spinning.***
   - ***Turn off the ignition to stop the powertrain components from spinning.***

Correcting Tire and Wheel Vibration

A first order tire and wheel vibration is usually the result of one of the following five conditions:

- Excessive radial runout
- Excessive lateral runout
- Excessive imbalance
- Excessive radial force variation
- Excessive lateral force variation

These conditions must be eliminated one at a time in order to attain a set of tires that are free from vibration causing elements. Substitute a set of tires from another vehicle only as a last resort, and only after the tires have been tested on a similar vehicle under the same conditions. Correcting the existing tire and wheel assemblies is the most accurate and least time consuming approach. This is due to vehicle-to-vehicle sensitivities and the differences between the hubs of any two vehicles.

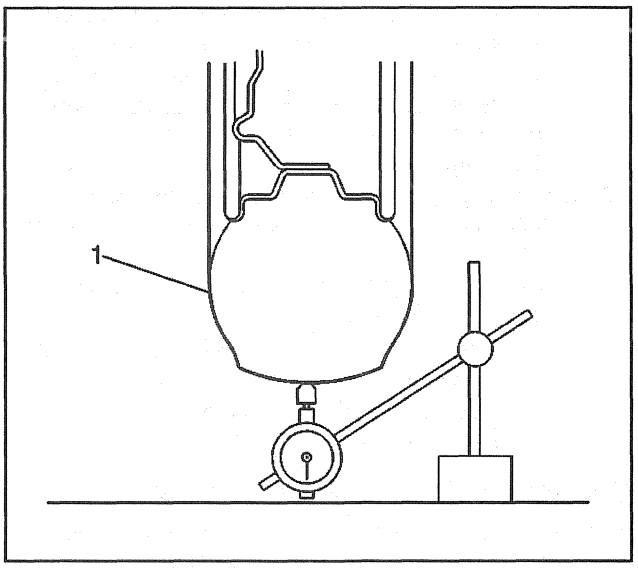
Methods of Measuring Tire/Wheel Assembly Runout

The tire and wheel assembly runout will directly affect the amount of the imbalance and the radial force variation. Therefore, correct the runout first before further diagnosis. The less runout, the less imbalance and radial force variation. Radial and lateral runout can be corrected at the same time. There are two methods for correcting the tire and wheel assembly runout:

- The on-vehicle method, with the tire and wheel assembly mounted on the hub. The wheel bearing must be in good condition.
- The off-vehicle method, with the tire and wheel assembly mounted on a spin-type tire balancer.

Perform the following initial on-vehicle inspections prior to the off-vehicle runout checks:

1. Inspect the tires for any uneven bead seatings. The distance from the edge of the ring to the concentric rim locating ring should be equal around the entire circumference.
2. Properly mount the tires if the beads are not seated properly in order to avoid excessive runout and imbalance.



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The off-vehicle method is the easiest way of measuring the tire and wheel runout. Properly mounting the dial indicator in the correct location in relation to the tire (1) is easier. The dial indicator is less likely to be subjected to water, snow, dirt, or other elements. After measuring the correct runout off-vehicle, inspect the runout with the tire and wheel assembly mounted on the vehicle. The runout measurement may vary greatly between these two methods. If so, the runout is due to one of the following conditions:

- Stud circle runout
- Hub flange runout
- A mounting problem between the wheel and the vehicle

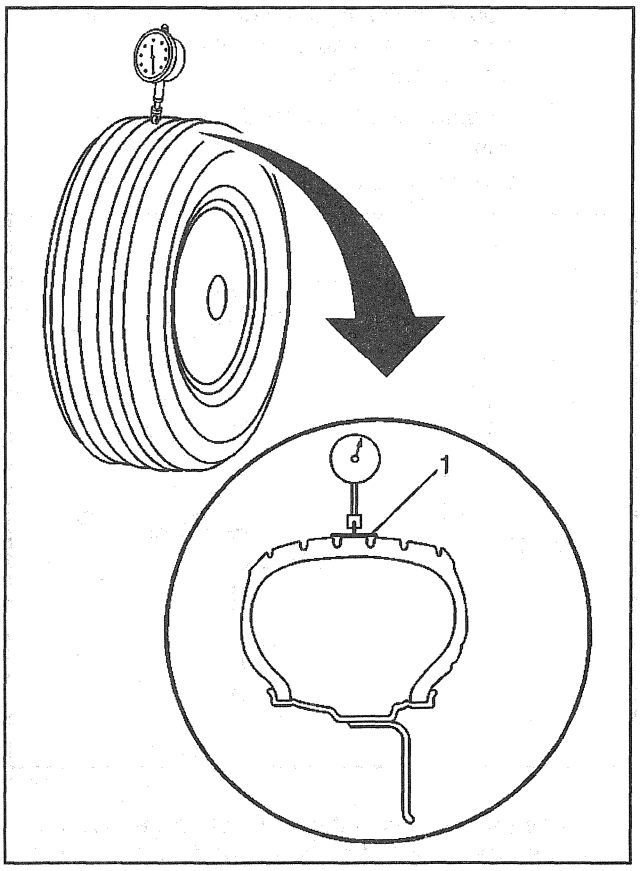
Measuring Tire/Wheel Assembly Runout

If the vehicle has been sitting in one place for an extended period of time, the tires may develop flat spots at the point where the tires were resting on the ground. These flat spots will affect the runout readings. In order to eliminate these flat spots, drive the vehicle long enough to warm up the tires. The flat spots must be eliminated prior to taking any runout measurements.

Measurement Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Obtain an initial indication of how much runout exists:
   2.1. Spin the each tire and wheel assembly on the vehicle by hand (or at a slow speed using the engine to run the drive wheels).
   2.2. Visually inspect the amount of runout from the front or rear of the tire.
3. Matchmark the each of the tire and wheel assemblies in relation to the wheel studs and to their position on the vehicle (LF, LR, RF, RR) for future reference.
4. Remove the tire and wheel assemblies one at a time and mount on a spin-type wheel balancer. Refer to *Wheel Removal (Single Wheels)* in Tires and Wheels.

   Locate the tire and wheel assembly on the balancer with a cone through the back side of the center pilot hole.



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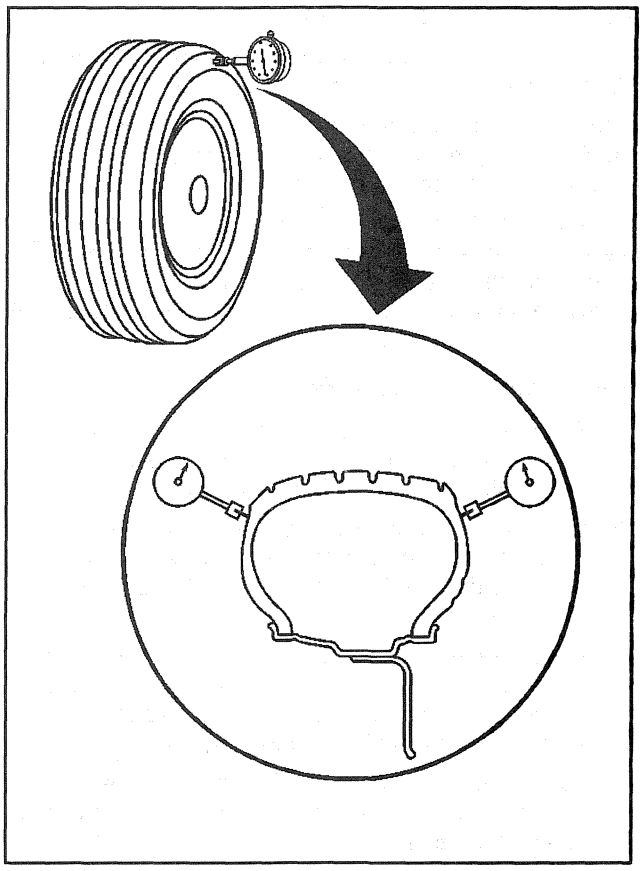

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5. Wrap the outer circumference of tires that use an all-season or aggressive tread pattern with tape (1), in order to accurately measure the radial runout.
6. Measure the tire and wheel assembly radial runout.
   6.1. Slowly rotate the tire and wheel assembly one complete revolution and ZERO the dial indicator on the low spot.
   6.2. Rotate the assembly one more complete revolution and note the total amount of runout indicated.

   Maximum Radial Runout

   - Measured off-vehicle: 1.27 mm (0.050 in)
   - Measured on-vehicle: 1.52 mm (0.060 in)
7. Measure the tire and wheel assembly lateral runout.

   Lateral runout should be measured on a smooth area of the sidewall as close to the tread as possible. Ignore any jumps or dips due to sidewall splices and attain an average amount of runout.
   7.1. Slowly rotate the tire and wheel assembly one complete revolution and ZERO the dial indicator on the low spot.
   7.2. Rotate the assembly one more complete revolution and note the total amount of runout indicated.

   Maximum Lateral Runout

   - Measured off-vehicle: 1.27 mm (0.050 in)
   - Measured on-vehicle: 1.52 mm (0.060 in)
8. Make the necessary repairs to the tire and wheel assembly.
9. Install the tire and wheel assembly to the vehicle. Refer to *Wheel Removal (Single Wheels)* in Tires and Wheels.
10. Repeat the procedure until all the wheel runouts have been measured.
11. Lower the vehicle.

Measuring Wheel Runout

If tire and wheel assembly runout cannot be brought within tolerance, measure the wheel runout.

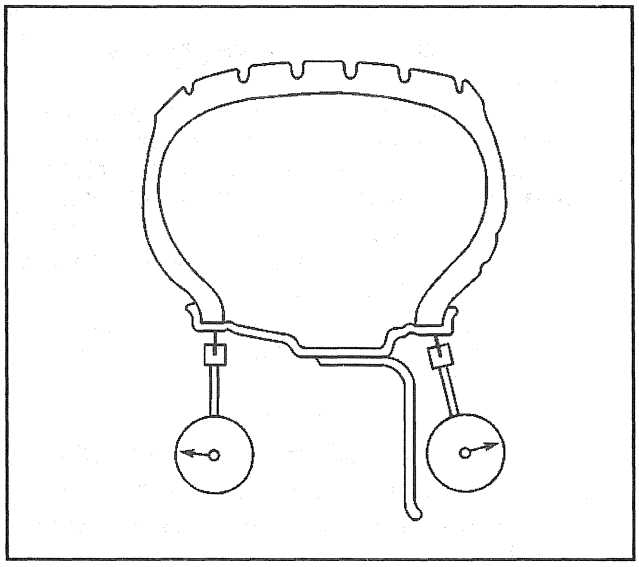
If any runout measurement of a wheel exceeds specifications, the wheel should be replaced. (ALWAYS measure the runout of a new wheel.)

If the runout of the wheel is within tolerance, and the tire and wheel assembly runout cannot be reduced to an acceptable level, the tire should be replaced. (ALWAYS measure the tire and wheel assembly runout after replacing the tire.)

Measurement Procedure

1. Raise and suitably support the vehicle. Refer to *Lifting and Jacking the Vehicle* Vehicle Lifting and Jacking in General Information.
2. Matchmark the each of the tire and wheel assemblies in relation to the wheel studs and to their position on the vehicle (LF, LR, RF, RR) for future reference.
3. Remove the tire and wheel assemblies one at a time and mount on a spin-type wheel balancer. Refer to *Wheel Removal (Single Wheels)* Wheel Removal in Tires and Wheels.

   Locate the tire and wheel assembly on the balancer with a cone through the back side of the center pilot hole.



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4. Measure the wheel radial runout on the outside of the wheel (with the tire mounted), if the wheel disign allows.

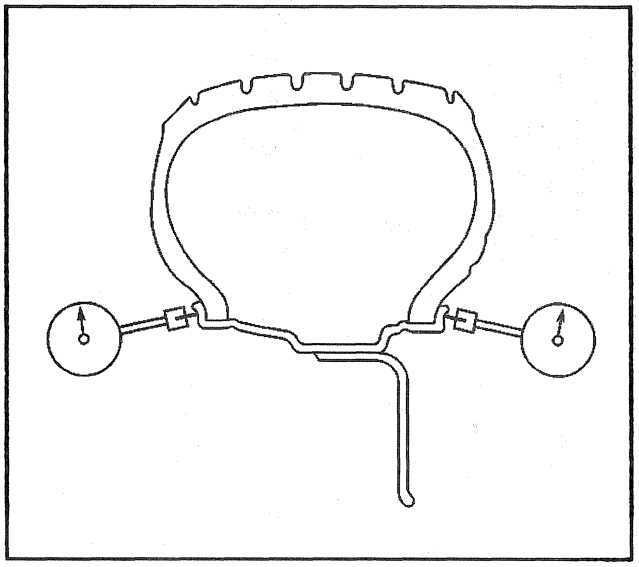
   Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.

   4.1. Slowly rotate the tire and wheel assembly one complete revolution and ZERO the dial indicator on the low spot.

   4.2. Rotate the assembly one more complete revolution and note the total amount of runout indicated.

   Aluminum Wheel Maximum Radial Runout

   0.762 mm (0.030 in)



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5. Measure the wheel lateral runout on the outside of the wheel (with the tire mounted), if the wheel design allows.

   Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.

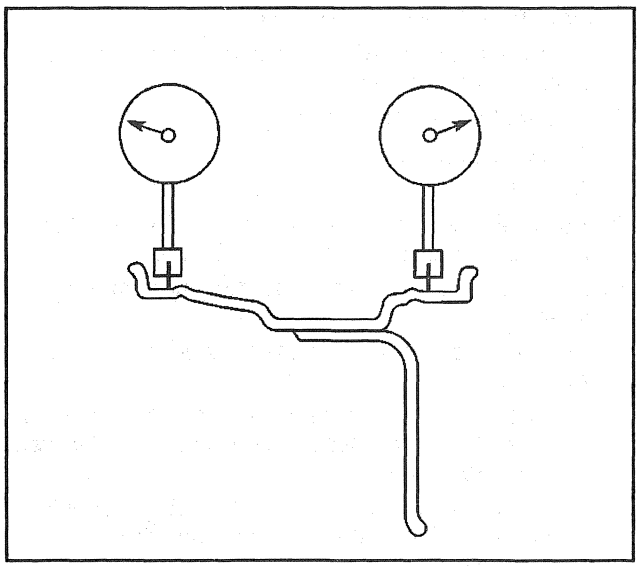
   5.1. Slowly rotate the tire and wheel assembly one complete revolution and ZERO the dial indicator on the low spot.

   5.2. Rotate the assembly one more complete revolution and note the total amount of runout indicated.

   Aluminum Wheel Maximum Lateral Runout

   0.762 mm (0.030 in)

6. If the wheel design does not allow runout measurements to be made with the tire mounted, dismount the tire from the wheel. Refer to *Tire Mounting and Dismounting* in Tires and Wheels.



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7. Measure the wheel radial runout on the inside of the wheel.

   Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.

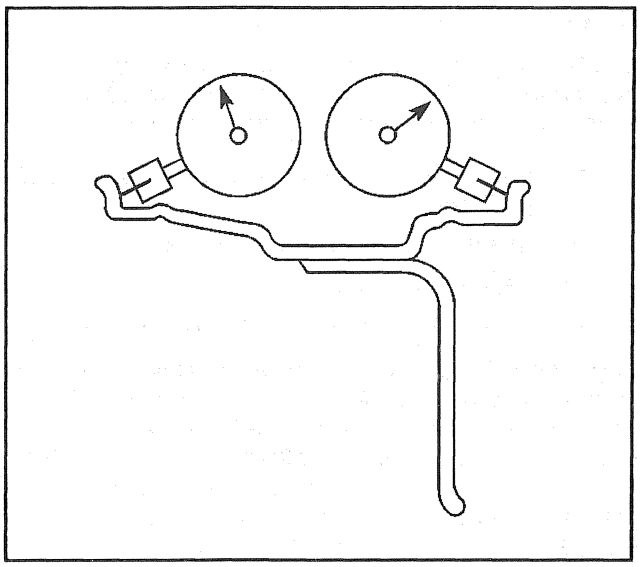
   7.1. Slowly rotate the wheel one complete revolution and ZERO the dial indicator on the low spot.

   7.2. Rotate the wheel one more complete revolution and note the total amount of runout indicated.

   Aluminum Wheel Maximum Radial Runout

   0.762 mm (0.030 in)

8. Measure the wheel lateral runout on the inside of the wheel.



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   Wheel runout should be measured on both the inboard and outboard rim flanges. Ignore any jumps or dips due to paint drips, chips, or welds.

   8.1. Slowly rotate the wheel one complete revolution and ZERO the dial indicator on the low spot.

   8.2. Rotate the wheel one more complete revolution and note the total amount of runout indicated.

   Aluminum Wheel Maximum Lateral Runout

   0.762 mm (0.030 in)

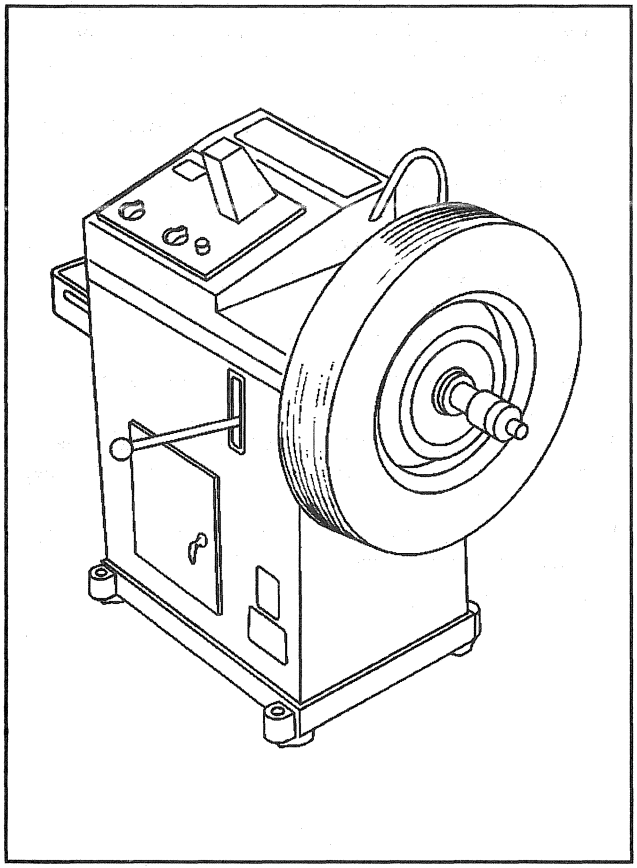
9. Make the necessary repairs to the tire and wheel assembly.
10. Install the tire and wheel assembly to the vehicle. Refer to *Wheel Removal (Single Wheels)* in Tires and Wheels.
11. Repeat the procedure until all the wheel runouts have been measured.
12. Lower the vehicle.

Balancing Tires and Wheels

Caution: Failure to adhere to the following precautions before tire balancing can result in personal injury or damage to components:

- ***Clean away any dirt or deposits from the inside of the wheels.***
- ***Remove any stones from the tread.***
- ***Wear eye protection.***
- ***Use coated weights on aluminum wheels.***

Important: The tires can be balanced either on-vehicle or off-vehicle, but the off-vehicle balancing procedures are recommended. Off-vehicle methods are better because tire rotation will not affect the balancing. The off-vehicle balancers are also more accurate than the on-vehicle balancers. Off-vehicle balancers can perform dynamic balancing as well as static balancing.



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Tire and wheel balancers can drift out of calibration without warning, or can become inaccurate as a result of abuse. The balancer calibration should be inspected every two weeks, and whenever the readings are questionable.

Tire Balancer Calibration Test

1. Spin the balancer without a wheel or any of the adapters on the shaft.
2. Inspect the balancer readings.

   Specification

   0.00–0.25 oz
3. Balance a tire and wheel assembly that is within radial and lateral tolerances to ZERO.
4. Add a 3 ounce test weight to the wheel at any location.
5. Spin the tire and wheel assembly again, noting the readings.
   - In the static and dynamic modes, the balancer should call for 3 ounces of weight, 180 degrees opposite the test weight.
   - In the dynamic mode only, the weight should be called for on the flange of the wheel opposite the last weight.
6. With the assembly unbalanced to 3 ounces, cycle the balancer 5 times.
7. Take the balancer readings:

   Specification

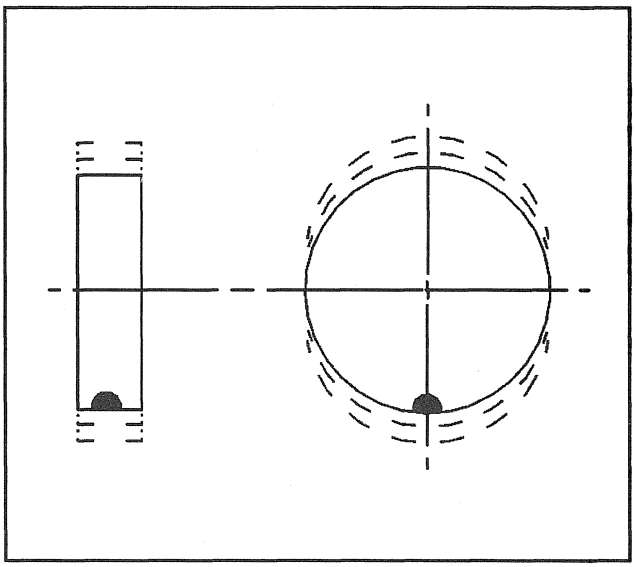
   Variation: 0.25 oz or less
8. Index the tire and wheel assembly at four separate locations on the balancer shaft, 90 degrees apart.
9. Cycle the balancer with the assembly at each location.
10. Take the balancer readings:

    Specification

    Variation: 0.25 oz or less

Tire Balancing Guidelines

Static and dynamic balance are two kinds of tire/wheel balance:



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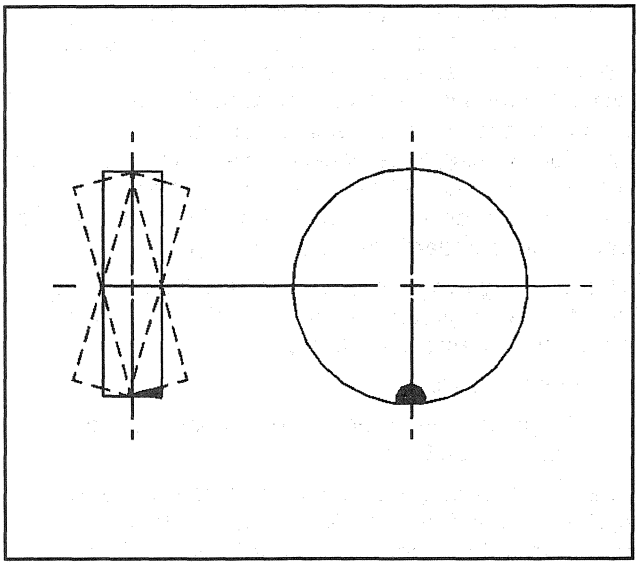
- Static balance, also called single plane balance, affects the distribution of weights around the wheel circumference.



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- Dynamic balance, or two-plane balance, affects the distribution of weight on each side of the tire/wheel centerline.

Most off-vehicle balancers are capable of checking both types of balance simultaneously.

As a general rule, most vehicles are more sensitive to static imbalance than to dynamic imbalance, with as little as 0.50–0.75 oz capable of inducing a vibration in some vehicles. Vibration induced by static imbalance will cause a vertical or BOUNCING motion of the tire.

Dynamic imbalance results in a side-to-side motion of the tire. This motion is referred to as SHIMMY.

- Balance all four tires as close to ZERO as possible.
- Carefully follow the wheel balancer manufacturer's instructions for proper mounting techniques to be used on different types of wheels.
- Regard aftermarket wheels, especially those incorporating universal lug patterns, as potential sources of runout and mounting problems.
- Use the correct coated weights on aluminum wheels.
- Recheck the tire and wheel assemblies for excessive runout after they have been corrected and installed.
- Evaluate the vehicle at the complaint speed and note if the vibration has been corrected.
- If the vibration is still present, or is reduced but still unacceptable, you may find one of two possibilities:
  - On-vehicle imbalance
  - Radial or lateral force variation

Correcting On-Vehicle Imbalance

On-vehicle imbalance may result from components other than the tire and wheel assemblies having imbalance. An on-vehicle high-speed balance or replacement of suspected components may be necessary in order to correct the condition.

Rotors do not have a set tolerance. However, rotors with more than 0.75 ounce imbalance have the potential to cause vibration. The rotors can be inspected for imbalance using either the on-vehicle or the off-vehicle method as described below:

Checking Rotor Imbalance (On-Vehicle)

1. Support the vehicle rear axle on a suitable hoist. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tire and wheel assemblies. Refer to *Wheel Removal (Single Wheels)* in Tires and Wheels.
3. Reinstall the wheel nuts in order to retain the rotors.
4. Take the necessary precautions. Refer to *Work Stall Test Caution* in Cautions and Notices.
5. Run the vehicle at the complaint speed while inspecting for vibration.
6. If the vibration still exists, perform the following steps:
   6.1. Remove the rotors.
   6.2. Run the vehicle back to speed.
7. If the vibration is eliminated, perform the following steps:
   7.1. Remove the rotors one at a time.
   7.2. Perform the vibration test for each rotor.
   7.3. Replace the rotor causing the imbalance.
   7.4. Inspect the balance of the new rotor.

Checking Rotor Imbalance (Off-Vehicle)

1. Measure the diameter and the width of the rotor.
2. Mount the rotor on a balancer in the same manner as a wheel.

Important: The rotors can only be inspected for static imbalance. Ignore the dynamic imbalance reading.

3. Inspect for static imbalance.

On-Vehicle Balancing Procedure

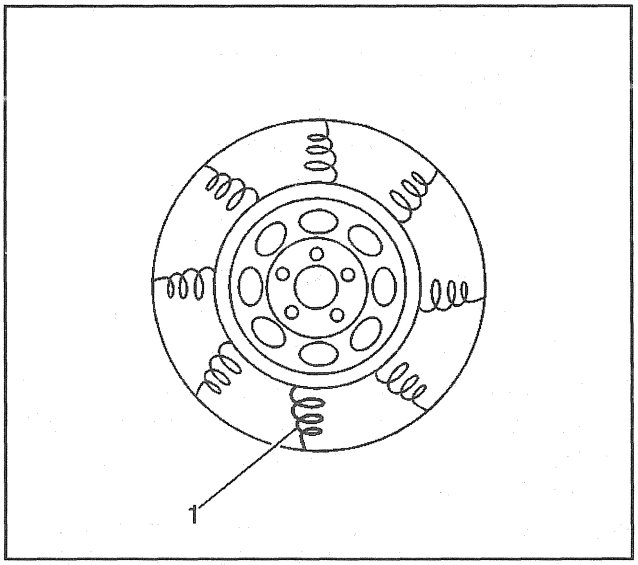
The vibration problem may not be correctable with the components removed from the vehicle. An on-vehicle high-speed balancer may be required in order to balance the tire and wheel assemblies while still mounted on the vehicle. On-vehicle balancing will balance the hubs and the rotors simultaneously, and will compensate for any residual runout encountered as a result of mounting the tire and wheel assemblies on the vehicle as opposed to off-vehicle balancing.

Follow the on-vehicle balancer manufacturer operator's manual for specific instructions while keeping the following tips in mind:

Balancing Tips

- Do not remove the off-vehicle balancing weights. The purpose of on-vehicle balance is to FINE TUNE the assembly balance already achieved, not to start over again.
- If the on-vehicle balance calls for more than 1 ounce of additional weight, split the weight between the inboard and outboard flanges of the wheel, so as not to upset the dynamic balance of the assembly that was achieved in the off-vehicle balance.
- An EVA vibration sensor placed on the fender of the vehicle during the on-vehicle balance is an excellent indicator of the amplitude of the vibration, and the effect that the balance has on the vibration.
- Evaluate the vibration after the on-vehicle balance in order to determine if the vibration condition has been resolved.

Radial Force Variation



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Radial force variation is the difference in the stiffness of a tire as the tire rotates and contacts the road. The tire and wheel assemblies have some variation due to splices in the tire plies. These splices do not cause a problem unless the force variation is excessive. These STIFF SPOTS in the tire (1) can deflect the tire and wheel assembly upward as the assembly contacts the road.

If the tire has only one stiff spot, the spot will deflect the spindle once per each revolution of the tire and wheel assembly, thus causing a first-order tire/wheel vibration. If the tire has two stiff spots, the spots cause a second-order vibration. First- and second-order tire/wheel vibrations are the most common to occur as a result of radial force variation. Third-, fourth-, or higher orders are possible but rarely occur.

The most effective way to minimize the possibility of force variation as a factor in tire and wheel assembly vibrations is to ensure that the tire and wheel assembly runout is at an absolute minimum. However, some tire and wheel assemblies exhibit vibration-causing force variation even though they are within runout and balance tolerances. These instances are becoming rare due to tighter tolerances and higher standards in manufacturing.

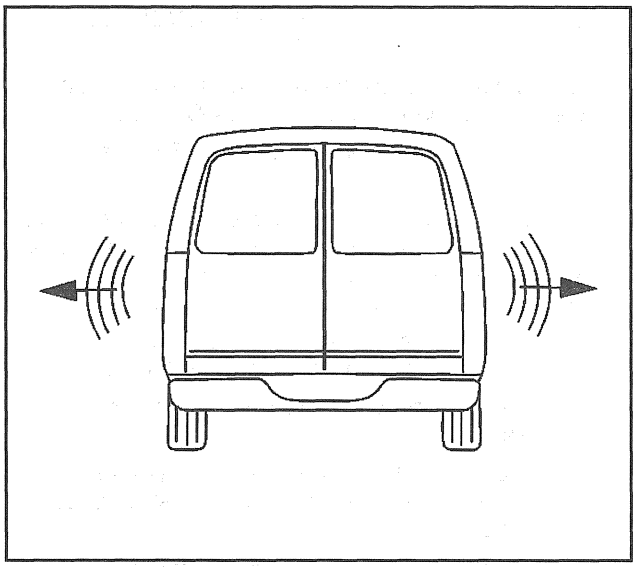
The following two alternatives are available if force variation is suspected as a factor in tire and wheel assembly vibration complaints:

- Buff the tires.
- Substitute one or more known good tire and wheel assemblies.

The tires may be buffed on a tire matching machine that is designed to remove small amounts of rubber from the outer rows of the tread blocks at the location of the stiff spots under load. This eliminates the spindle deflection. This type of equipment is not currently in widespread use. Do not use a TRUER or any tool that is designed to make the tire perfectly round. These tools will not correct the condition.

You may substitute one or more known good tire and wheel assemblies when a tire manufacturer is not available locally.

Lateral Force Variation



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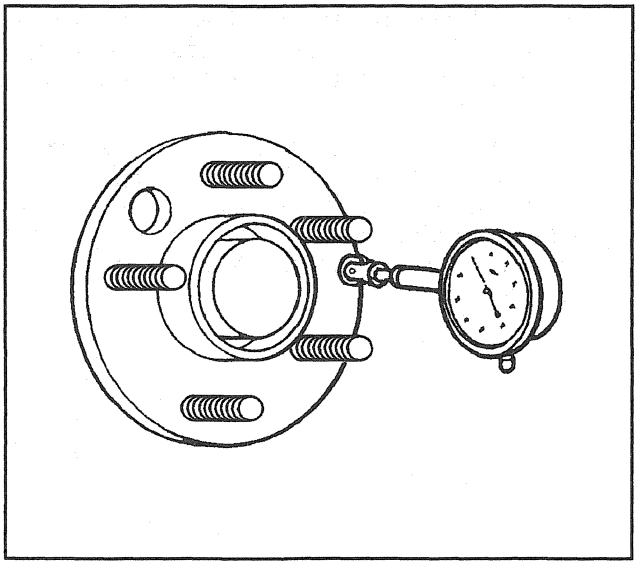
Lateral force variation tends to deflect the vehicle sideway, or laterally. Lateral force variation is based on the same concept as radial force variation. A SNAKY belt inside the tire may be the cause of lateral force. The tire substitution method may have to be used before tire replacement.

A lateral force variation condition is rare. The best way to eliminate lateral force variation as a factor in tire and wheel vibration conditions is to ensure that the lateral runout of the tire and wheel assemblies is at an absolute minimum.

The vehicle will WOBBLE or WADDLE at slow speeds of 8–40 km/h (5–25 mph) when lateral force variation is excessive. This condition is usually related to the first-order of tire and wheel rotation.

Wheel Hub/Axle Flange Runout

Inspect the wheel hub/axle flange runout when lateral runout occurs during on-vehicle testing but not during off-vehicle testing. The tolerances provided are only guidelines. Perform corrections only if the on-vehicle runout cannot be brought to within tolerance.



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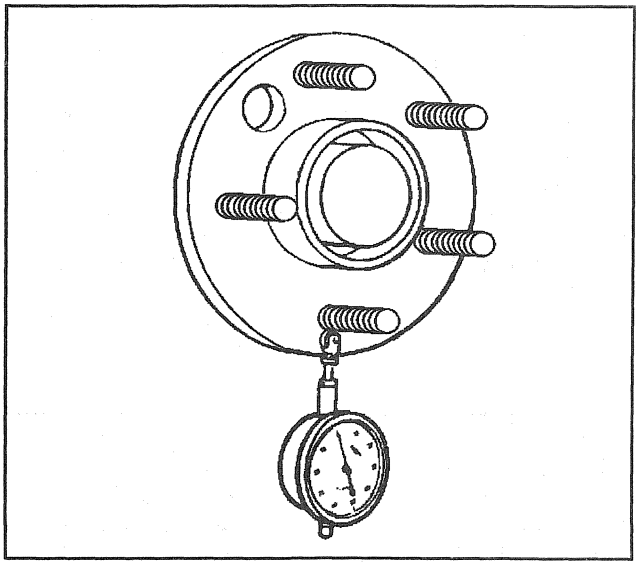
1. Position the dial indicator on the machined surface of the hub, the axle flange, or the rotor, outside of the wheel studs.
2. Rotate the hub in order to find the low spot.
3. Set the dial indicator to zero at the low spot.
4. Rotate the hub again and check the total amount of runout.

   Specification (Guideline)

   Runout tolerance: 0.130 mm (0.0050 in)

Wheel Stud (Stud Circle) Runout

Use the following procedure whenever the off-vehicle radial runout and the on-vehicle radial runout are significantly different, and earlier attempts to correct the tire and wheel vibration condition have not been successful.



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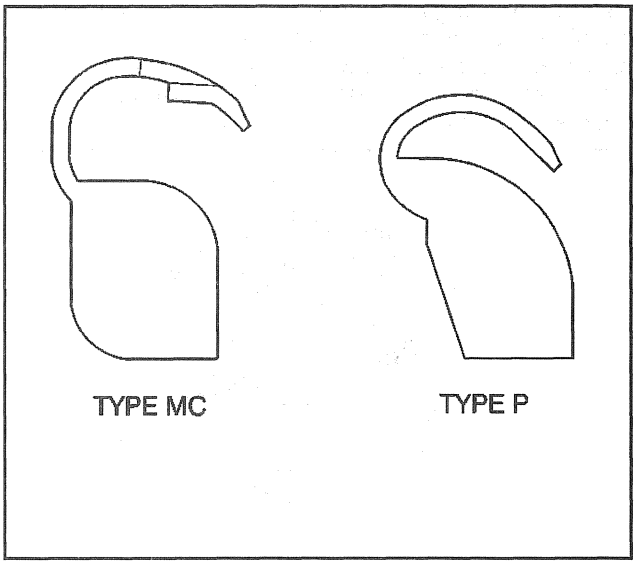
1. Position the dial indicator in order to contact the wheel mounting studs.

   Measure the stud runout as close to the flange as possible.
2. Turn the hub to register on each of the studs.
3. Zero the dial indicator on the lowest stud.
4. Rotate the hub again and check the total amount of runout.

   Specification (Guideline)

   Runout tolerance: 0.80 mm (0.030 in)

Wheel Weight Usage



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Locate the wheel weights on the inboard rim flange. If during static balancing more than 28 grams (1 ounce) is needed, split the weights as equally as possible between the inboard and outboard flanges.

Special polyester-coated clip-on wheel weights are to be used to balance factory aluminum wheels. These weights are designated MC or P, and must be used on aluminum wheels having a wide, 7.6 mm (19/64 in) flange. A plastic tipped hammer should be used to prevent damage to the weight's coating during installation.

Adhesive wheel weights are also available. Use the following procedure to install adhesive wheel weights.

1. Determine where the wheel weight is to be located on the inboard side of the wheel and clean that area by sanding it to bare aluminum. Do not sand the outboard side of the wheel as this will damage the clear coat finish.
2. Wipe the sanded area with a mixture of half ispopropyl alcohol and half water. Use a clean cloth or paper towel.
3. Dry the area with hot air until the wheel surface is warm to the touch.
4. Warm the adhesive backing on the wheel balance weight to room temperature.
5. Remove the tape from the back of the weight. Do not touch the adhesive tape.
6. Apply the wheel weight and press on with hand pressure.
7. Secure the wheel weight with a 70 to 110 N·m (16 to 25 lb ft) force applied with a roller.

Correcting Non-Uniform Tires

Use the following two methods to correct tires which cause a vibration, although the tires are balanced properly:

1. This method uses an automatic machine that loads the tire and buffs small amounts of rubber from high spots on the outer two tread rows.
   - Using this method in order to correct the tires is usually permanent. This method does not significantly affect the appearance or the tire tread life.
   - Do not true the tires with a blade-type machine. This reduces the tread life substantially, and this often does not permanently correct the problem.
2. The second method is to dismount the tire and rotate it 180 degrees on the rim. It is important that this is be done on the tire and wheel assemblies which are known to be causing a vibration, as it is just as likely to cause good assemblies to vibrate.

Correcting Driveline Vibration - RWD and 4WD

Diagnosis will be much easier once you have identified a vibration as first-order of driveline rotation during the road test. Then identify the exact area that the vibration is coming from and take proper action.

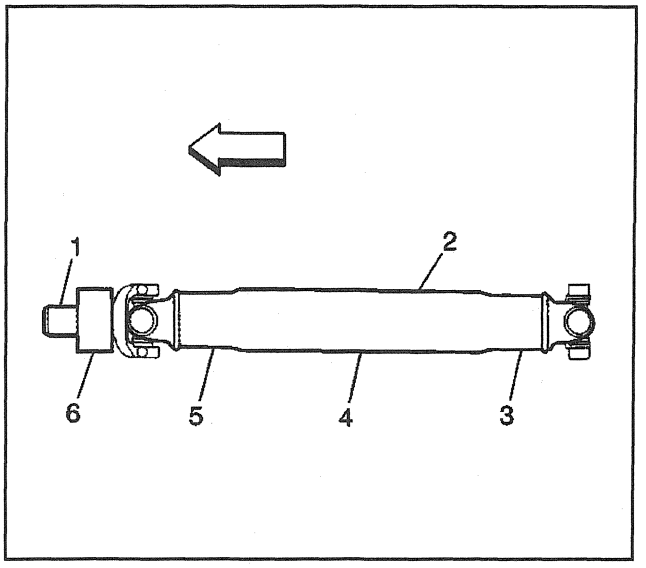
In most cases, vibration may be reproduced in the stall. In the stall the vibration may be better or worse than that experienced during the road test.

The objective is to reduce the vibration to the lowest point possible in the stall, than evaluate the results on a road test. Many times, a vibration you were able to reduce drastically in the stall will be completely eliminated on the road.

The cause of first-order drive line vibration is usually excessive runout or an imbalanced component.

The following procedure offers a systematic process of elimination in order to determine which component is at fault:

1. Raise the vehicle to curb height. Support the vehicle on a hoist or heavy stands. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the rear tire/wheel assemblies. Refer to *Wheel Removal (Dual Rear Wheels)* in Tires and Wheels.
3. Remove the brake drums. Refer to *Brake Drum Replacement* in Drum Brakes.
4. Inspect the propeller shaft. The propeller shaft should be free of undercoating before continuing this diagnosis.
5. Inspect the propeller shaft or U-joints for any obvious dents or damage. Dents or damage will contribute to first-order driveline vibrations.
6. Start the engine.
7. Place the transmission in gear.
8. Run the vehicle up to the speed at which the vibration was most severe. Do not step on the brake while the brake drums are removed.
9. Note the vibration present, and at what speed.
10. If the vibration is not present, refer to First-Order Driving Vibration Testing (Torque Sensitive) in the Road Testing Diagnosis.
11. If the vibration is present, determine which end of the driveshaft is vibrating the most. Hold your hand against the pinion nose and the transmission tailshaft, or hold an EVA vibration sensor up to each component.



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12. If the vehicle is equipped with a two-piece propeller shaft, inspect the center support bearing for vibration.
13. If the transmission tail is vibrating, touch the transmission crossmember under the transmission mount. If there is no vibration on the crossmember, then the transmission mount is working properly.
14. Note which end of the driveshaft is the worst, and how severe the vibration is. The inspection will be a reference by which to judge future progress.

Helpful Hints

Do not fill the propeller shaft with foam, oil, or any other substance in order to correct a vibration. Filling the propeller shaft is only effective in reducing an unrelated condition called Torsional Rattle. Filling the propeller shaft should only be done in strict adherence to the procedure outlined in corporate bulletins that address Torsional Rattle. Failure to follow the correct procedure will induce a vibration and/or affect the structural integrity of the propeller shaft. The propeller shaft will then have to be replaced.

Propeller Shaft Runout

A propeller shaft or pinion (companion) flange with excessive runout causes first-order driveline vibrations. Use the following procedure in order to measure runout of the propeller shaft (2). The tolerances are critical for smooth operation of the driveline.

- Remove excess corrosion of the propeller shaft surface before checking runout. Also inspect for damage and dents. Replace dented propeller shafts. Remove any undercoating from the propeller shaft before proceeding.
- The measurement procedure that follows applies to all one-piece and two-piece propeller shaft assemblies.

  The splined end (1)of a propeller shaft is critical to the smooth operation of a two-piece propeller shaft. When checking stub-shaft runout, ensure that the dial indicator readings are accurate.

Measuring Propeller Shaft Runout

Tools Required

- *J 8001* Dial Indicator Set
- *J 7872* Magnetic Base Dial Indicator Set

1. Raise the vehicle on a suitable hoist. Refer to Lifting and Jacking in General Information.
2. Allow the wheels to spin freely.
3. Attach a *J 8001 J 7872*

4. Place the transmission in Neutral. Rotate the pinion flange or transmission yoke by hand while taking the measurements for runout. The propeller shaft will turn easier in one direction than in the other. Removing the wheels and drums will also help.

   Do not include fluctuations on the dial indicator due to welds or surface irregularities.
5. For one piece propeller shafts, if the runout exceeds the tolerances at one or more points:
   5.1. Rotate the propeller shaft 180 degrees in the pinion flange. Reinstall the propeller shaft and recheck the measurement.
   5.2. If the runout still exceeds the tolerance, double-check the pinion flange runout before replacing the propeller shaft.
6. For two-piece propeller shafts, if the runout exceeds the tolerances at one or more points:
   6.1. Measure the rear propeller shaft.
   6.2. Mark the position of the rear shaft in the pinion flange, then remove the rear shaft.
   6.3. Measure the front propeller shaft runout on the tube and the stub shaft.
   6.4. Replace the propeller shaft if either measurement is out of tolerance.

Refer to *Propeller Shaft Runout Specifications*

Important: When you replace a propeller shaft, check the new shaft for runout. Double-check the pinion flange runout if the replacement shaft runout is also out of tolerance.

Measuring Pinion Flange Runout

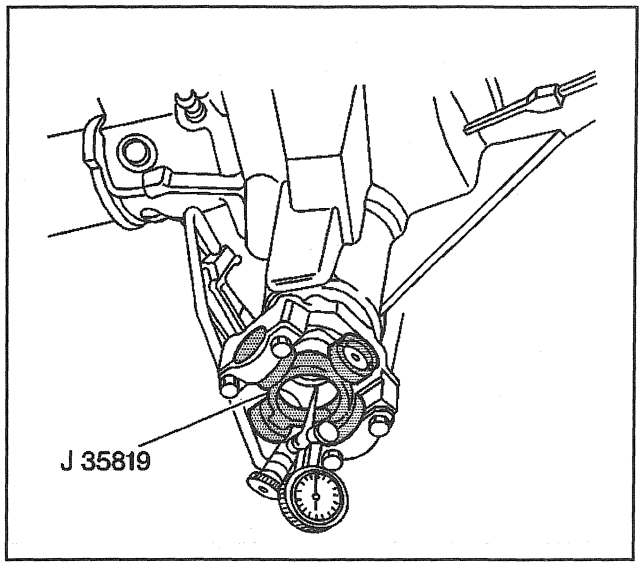
Tools Required

- *J 8001* Dial Indicator Set
- *J 23409* Dial Indicator Extension
- *J 35819* Flange Runout Guage

1. Place the vehicle on a suitable hoist. Refer to *Lifting and Jacking the Vehicle* in General Information. Allow the wheels to rotate freely.
2. Remove the propeller shaft from the pinion flange.
3. Install the *J 35819*.

Important: The dial indicator will have inverted readings. You are measuring the inside diameter of the flange, and not the outside diameter. The highest reading on the dial indicator is the low spot. The lowest reading is the high spot.

4. Rotate the pinion shaft 360 degrees and zero the dial indicator on the low spot.
5. Rotate the pinion flange again and record the total runout.
6. If the pinion flange runout is 0.15 mm (0.006 in) or less, remove the pinion flange balance weight.



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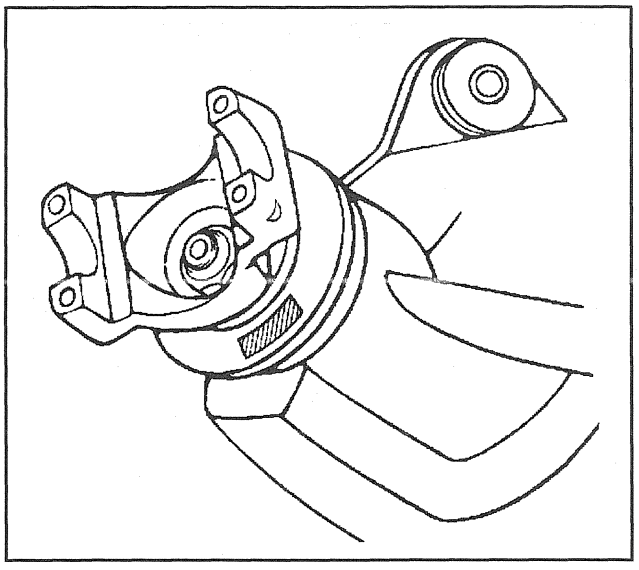
7. If the pinion flange runout is over 0.15 mm (0.006 in) but no less than 0.28 mm (0.011 in), and the runout compensation weight is at or near the low spot, then no further action is necessary. Remove the weight if the runout compensation weight is not at or near the low spot.
8. If the pinion flange runout is more than 0.28 mm (0.011 in) but no greater than 0.38 mm (0.015 in), and the balance weight is at or near the low point, then no further action is necessary. Remove the weight and re-index the pinion flange until the runout is 0.25 mm (0.010 in) or less if the runout compensation weight is not at or near the low spot.
9. Replace the pinion shaft when the runout is 0.25 mm (0.010 in) or less. Then, recheck the runout. Service replacement flanges do not have balance weights.



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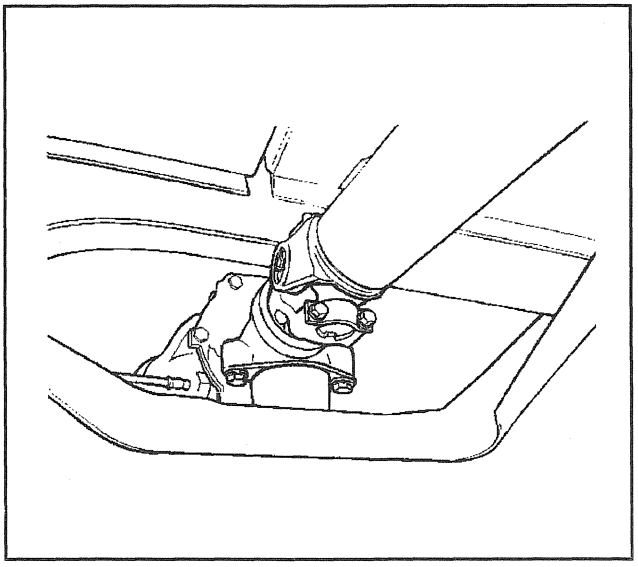
Helpful Hints

- If a *J 35819* is not available measure the pinion runout as close as possible to the pinion flange.
- If necessary, add compensation weights on the face of the pinion flange dust slinger. These weights are tack-welded onto the slinger. You may remove the weights with a die-grinder.
- Carefully remove the spot weld at either end of the weight.
- Do not remove the weight unless you have inspected the pinion flange runout and the procedure calls for weight removal.
- Do not remove any weights on the outboard edge of the dust slinger. These weights are present in order to internal axle components. The weights are not related to the pinion flange runout.



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Correcting Vibration at the Pinion Nose

Most first-order driveline vibrations originate at the pinion nose end of the driveshaft. Ensure that the vibrations are at a minimum at this location in order to achieve acceptable results. Reduce the runout of the components to a minimum. Balance the driveline as a system when necessary.

1. Measure the runout of the propeller shaft and check the tolerance.
2. If the tolerance is excessive, mark the position of the shaft for future reference and rotate the shaft 180 degrees.
3. Reinstall the shaft and recheck the runout. Inspect the level of vibration in order to determine if the vibration is lower or corrected.

4. If the runout is still excessive, or if the vibration is still present, refer to Measuring Pinion Flange Runout. Replace the pinion flange or re-index the flange 180 degrees if the pinion flange runout exceeds the tolerance.

   Remove and reinstall the pinion flange only once on axles utilizing a crush type sleeve. Replace the sleeve with a new sleeve if the sleeve is crushed. Removing the sleeve requires removal of the ring and pinion set. Therefore, replace flanges with excessive runout. Regardless of the method used, measure the pinion flange runout in order to ensure that the flange is within tolerance.
5. Recheck the propeller shaft runout if the vibration is present after the pinion flange runout is corrected. If the propeller shaft runout is still excessive, correct the runout before doing a driveline system balance. Either replace the shaft with a shaft that is within tolerance or sublet the shaft to a reputable independent for straightening and re-balance. Ensure that the new or rebuilt shaft is within runout tolerance before you continue.
6. Once the propeller shaft and pinion flange are within runout tolerances, check if the vibration is gone. If the level of the vibration is still unacceptable, perform a driveline system balance procedure.

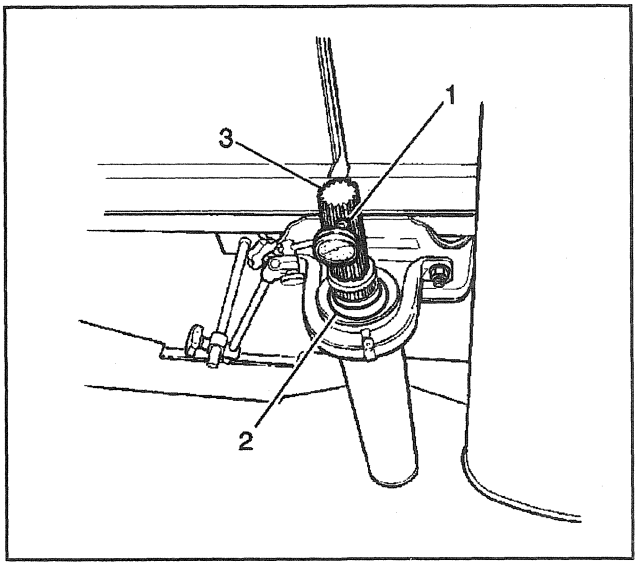
Correcting Vibration at the Transmission Tailshaft

First-order driveline vibrations that originate at the transmission end of the propeller shaft are rare. If the tailshaft of the transmission is vibrating, inspect the tailshaft housing bushing for wear or damage. A leaky transmission tailshaft oil seal indicates bushing problems.

Feel for vibration at the crossmember underneath the transmission mount. If there is no vibration, the transmission mount is doing its job of isolating the vibration from the structure of the vehicle. The transmission mount is therefore probably not cause of vibration.

Use the following procedure if you can feel vibration on the crossmember and the tailshaft bushing, and if transmission output is normal:

1. Measure the propeller shaft runout. If the runout is excessive, replace the shaft with one that has acceptable runout. Alternatively, sublet the shaft to a reputable independent service shop in order to have the shaft rebalanced and the runout corrected.
2. Test drive the vehicle. If the vibration is still unacceptable, valance the shaft on the vehicle. Refer to Rear Driveline System Balance.



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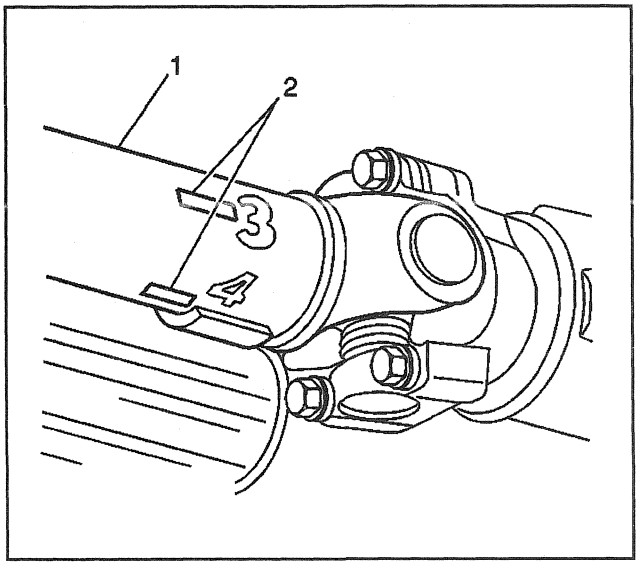

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Correcting Vibration at the Center Support Bearing

These guidelines apply to the two-piece propeller shaft only. First-order driveline vibrations that occur mainly at the center support bearing (2) are usually the result of excessive runout at the stub (splined) shaft (3).

Unlike other first-order driveline vibrations, these vibrations can appear at unusually low speeds of 40 km/h (25 mph) and up.

Follow the following procedure to correct this type of vibration:

1. Mark the position of the rear propeller shaft at both ends for proper reassembly. Remove the rear propeller shaft form the vehicle.
2. Measure the runout of the splines about 12.7 mm (0.5 in) from the end (1).
3. Replace the shaft if the runout exceeds the tolerances.

   Stub shaft/spline runout 0.076 mm (0.003 in)

Troubleshooting Hints

Vibration is eliminated with the correction of the propeller shaft runout. If some vibration is still present, perform a vehicle road test. Then, determine if an on-vehicle system balance is necessary.

Driveline System Balance with Electronic Vibration Analyzer (EVA)

To pinpoint the source, you must reproduce the vibration in the service stall and then determine which component is vibrating the most using the EVA:

1. Support the vehicle on a suitable hoist or on safety stands. Ensure that the rear of the rear axle is at curb height. Do not allow the axle to hang. Refer to General Information.
2. Remove the rear tire/wheel assemblies. Refer to *Wheel Installation (Single Wheels-Front or Rear)* in Tires and Wheels.
3. Remove the brake drums. Refer to *Brake Drum Replacement.*
4. Ensure that the propeller shaft is free of undercoating. Check for dents or damage to the propeller shaft or U-joints.
5. Start the engine. Place the transmission in gear and run at the vehicle speed at which the vibration occurs at.

Caution: Do not run the vehicle higher than 89 km/h (55 mph). Stay clear of the universal joints and the balance weight area in order to avoid personal injury. Do not run the vehicle on the hoist for extended periods of time. Running the vehicle on the hoist for extended periods of time may cause the engine or the transmission to overheat.

Determine which end of the propeller shaft is vibrating the most. Hold the EVA's sensor against the pinion nose and the transmission tailshaft assembly. The higher the amplitude reading, the greater the vibration.

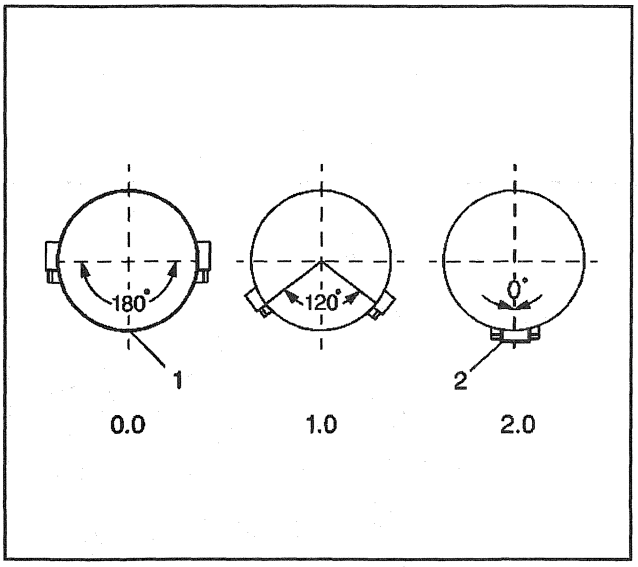
If the vehicle has a two-piece propeller shaft, check the center support bearing.

If the transmission tailshaft vibrates, check the transmission crossmember under the transmission mount. The vibration should not be present if the mount is doing its job.

Runout and Balance Testing with the Electronic Vibration Analyzer (EVA)

Ensure that the runout of the various driveline components are within specifications. If the runouts are within specifications, strobe balance the driveline. The EVA is able to simplify the balancing process, using the following procedure:

1. Use the EVA in order to determine which end of the propeller shaft has the most vibration.
2. Mark the end of the propeller shaft (1) that has the most vibration at four points, 90 degrees apart. Number the marks 1 through 4 (2).
3. Mount the EVA sensor onto the bottom of the following components:
   - The differential housing
   - The center bearing support (for two-part propeller shafts)
   - The transmission tailshaft assembly
4. Position the sensor as close to the propeller shaft as possible. Ensure that the UP side of the sensor faces up. Ensure that the sensor is horizontal.
5. Start the engine.
6. Turn off all engine accessories.
7. Place the transmission in gear.
8. Run the vehicle at the speed which causes the most vibration in the propeller shaft.
9. Hook the timing light clip to the trigger wire.
10. Plug the vibration sensor into Input A of the EVA. Input B does not have strobe light capability.
11. Verify that the predominant frequency on the EVA display matches the frequency of the original vibration. Use the strobe light only if the rotation speed of the propeller shaft is the predominant frequency.
12. The EVA displays a series of questions in order to select the correct filter. Press YES in order to select the desired filter. Ensure that the frequency is in the middle of the filter range. Use the full range only as a last resort.
13. The display shows the test frequency, the amplitude and the filter range. The driveline is balanced when the amplitude is near two. In some cases a slightly higher amplitude will provide adequate balance.
14. Point the timing light at the propeller shaft. The strobe effect will appear to freeze the propeller shaft. Note which of the numbered marks is at the bottom of the propeller shaft, or the 6 o'clock position. This position is the light spot.
15. Turn the engine off.



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16. Install a weight directly on the light spot.
17. Start the engine.
18. Run the vehicle at peak vibration speed.
19. Strobe the propeller shaft again.

The propeller shaft is balanced if the strobe image is erratic and the amplitude is near two.

The propeller shaft is not balanced if one of the following conditions exist:

- The weight and the original light spot are at the 6 o'clock position.

  The above condition means that there is not enough weight on the propeller shaft. In order to correct the balance, add a second weight next to the first weight. Inspect the balance again using the strobe light.

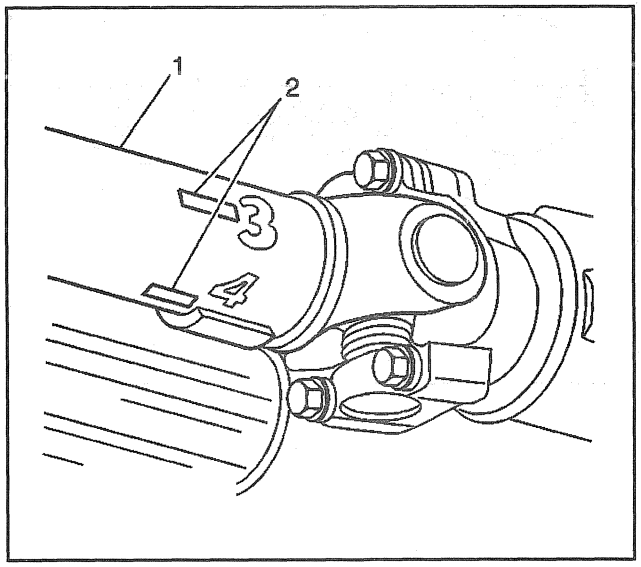
  If the weights are now between 90 and 180 degrees off (between the 9 and the 3 o'clock positions) too much weight exists. In order to correct the balance, split the two weights equally on either side of the original light spot in order to produce a total weight between one and two weights (between 0 and 120 degrees apart). Inspect the balance again using the strobe light. Adjust the weights as necessary.

- The weight and original light spot are 90 to 180 degrees off (between the 9 and the 3 o'clock positions).

  The above condition means that one weight is too much. In order to correct the balance, split the two weights equally on either side of the original light spot in order to produce a total weight less than one (between 120 and 180 degrees apart). Inspect the balance again using the strobe light. Adjust the weights as necessary.

- The weight and the original light spot are within 180 degrees of the 6 o'clock position.

  Move weight towards the 6 o'clock position. Inspect the balance again using the strobe light. Adjust the weight as necessary. Refer to the previous two conditions.



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If the shaft will not balance using two weights, then place a third weight on the light spot. Split the first two weights in order to produce a total weight between two and three weights.

If three weights fail to balance the driveline, then replace the propeller shaft.

When the propeller shaft balances, road test the vehicle in order to verify that the vibration is eliminated.

Driveline System Balance without the Electronic Vibration Analyzer

The following procedure is designed to fine-tune the balance of the propeller shaft while it is mounted in the vehicle. The procedure also is able correct residual imbalance of the remaining driveline components.

Prior to balancing the driveline system, verify that the propeller shaft and the pinion flange runout are within specification.

Do not overheat the engine when performing this procedure.

1. Raise the vehicle to curb height. Support the vehicle on a hoist or on safety stands. Do not allow the axle to hang. Refer to *Lifting and Jacking the Vehicle.Brake Drum Replacement.*
2. Remove the rear tire/wheel assemblies. Refer to *Wheel Removal (Single Wheels).*
3. Remove the brake drums. Refer to *Brake Drum Replacement.*
4. Determine which end of the propeller shaft has the most vibration in order to identify where to begin installing the hose clamps.
5. Mark the end of the propeller shaft (1) which has the most vibration at four points, 90 degrees apart. Number the marks 1 through 4 (2).

Troubleshooting Hints

The following procedure uses a trial and error method of determining where to place the hose clamps on the shaft. Use the following tips in order to help locate the clamps:

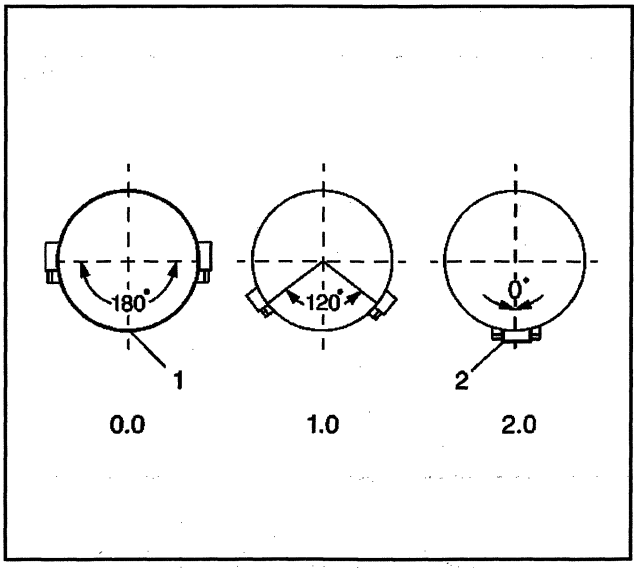
1. Because the imbalance may be related to propeller shaft runout, begin installing the clamps at the low point of the propeller shaft runout.
2. When the plant workers balance the propeller shaft, they use weights in graduated increments: 1/16 oz, 1/8 oz, etc. If the stock weight is too light or too heavy, place the hose clamp either directly in line with or opposite to the stock weight.

The last method involves road testing the vehicle at a speed which the vibration is felt.

1. Carefully hold a piece of chalk up to the very end of the propeller shaft. Barely touch the chalk to the shaft.
2. Shut the engine off in order to stop the propeller shaft from rotating. Do not step on the brake pedal. Do not put the transmission in Park.
3. Inspect the chalk mark.

If you performed the above procedure correctly, the chalk mark will indicate the heavy spot on the shaft. The heavy spot deflected downward and touched the chalk. If the chalk mark circle the entire shaft, touch the chalk more gently to the shaft. Ensure that the chalk touches only the heavy spot. Once the heavy spot is located, place the hose clamp 180 degrees opposite to the chalk mark. Then perform the following steps:

1. Place the hose clamp at the light spot, or at any of the four points marked previously.
2. Test drive the vehicle at the speed at which the vibration occurred. Record any changes in the vibration.
3. Move the clamp to the other positions.
4. Test drive the vehicle each time the clamp is moved. Record any changes in vibration. Note which position gives the best balance.



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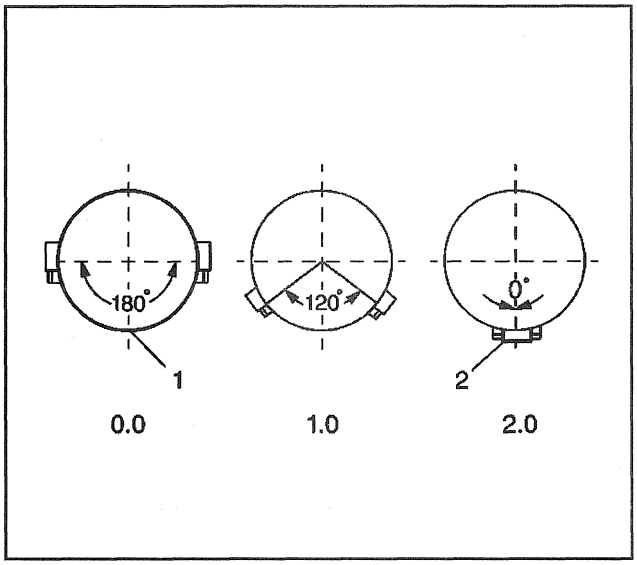

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If the vibration does not change at all, or gets worse, then one clamp is too light or too heavy.

- If the vibration did not change at all, then repeat the procedure using two clamps together.
- If the vibration got worse, repeat the procedure using two clamps separated. Separate the clamps to reduce the spinning weight.

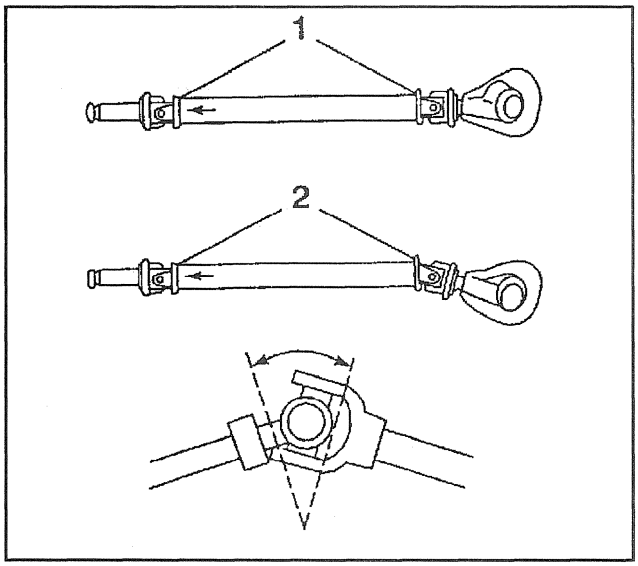
Continue the trial and error procedure using different weights in different locations until you achieve the best balance. If more that three clamps aligned in the same position are required, then replace the propeller shaft.

If you are able to reduce the vibration in the stall, but are unable to eliminate the vibration completely, perform a road test on the vehicle. A slight vibration noticeable in the stall may not be noticeable on the road.

Propeller Shaft Balance Weights

When using clamps in order to balance a propeller shaft with the total wight method, the correction weight required will often be a fraction or a multiple of one hose clamp. Use the following phasing procedure with two hose clamp in order to accurately place any required amount between zero weights (0.0 total weight) to two weights (2.0 total weight).

1. Ensure that the clamps are located with even spaces on either side of the light spot, or 180 degrees opposite the heavy spot.
2. The following table contains the weight amounts in terms of the total weight and the included angle (spread) between the clamps. Refer to *Propeller Shaft Runout Specifications*



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The main objective of this section is to correct the conditions that interfere with the proper cancellation effect of the U-joints. The most common condition, especially where the where launch shudder is concerned, is incorrect driveline working angles. However, other factors may aggravate the condition.

Address these factors before you attempt to measure or correct driveline working angles:

- Worn, failed, damaged, or improperly installed U-joints
- Worn, collapsed, or improper powertrain mounts
- Incorrect vehicle trim height adjustment for the front suspension. This condition aggravates launch shudder.
- Incorrect trim height adjustment for the rear suspension.
- Trim height inspection includes trim heights that are too low or too high. Vehicles equipped with aftermarket lift kits, vehicles that are constantly loaded with cargo, and custom conversion vans all fit in this category. On rear drive vehicles, the pinion nose tilts upward as the rear trim height is lowered.

If a second-order driveline vibration exists after these conditions are corrected, measure and correct the driveline angles.

If the complaint is present only with cargo in the vehicle, perform the measurements with the vehicle fully loaded. Once a second-order driveline vibration has been corrected with the vehicle loaded, the vibration may reappear with the vehicle unloaded. The reverse of this is also true. You may have to reach a compromise with the customer in this case.

Driveline Working Angles

Tools Required

- *J 38460* Digital Inclinometer
- *J 23498-A* Driveshaft Inclinometer
- *J 23498-20* Driveshaft Inclinometer Adapter

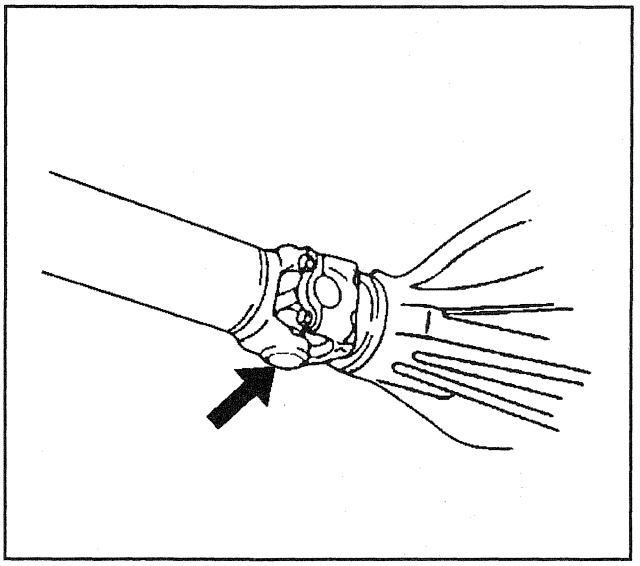
Driveline working angle does not refer to the angle of any one shaft, but to the angle that is formed by the intersection of two shafts, as shown.

The procedure for measuring and correcting driveline working angles depends on whether the vehicle is equipped with a one or two-piece propeller shaft.

To verify the accuracy of the adapter, check the angle of an angle of an accessible joint with the inclinometer prior to assign it on an inaccessible joint.

Preliminary Checks

Raise the vehicle on a suitable hoist or on safety stands. Ensure that the rear axle is supported at curb height and that the wheels are free to spin. Refer to *Lifting and Jacking the Vehicle* in General Information. Place the transmission in Neutral. Make sure the vehicle has a full tank of fuel or the equivalent amount of weight in the rear to simulate a full tank. 3.8 liters of gasoline (one gallon) weighs approximately 2.8 kg (6.2 lb).



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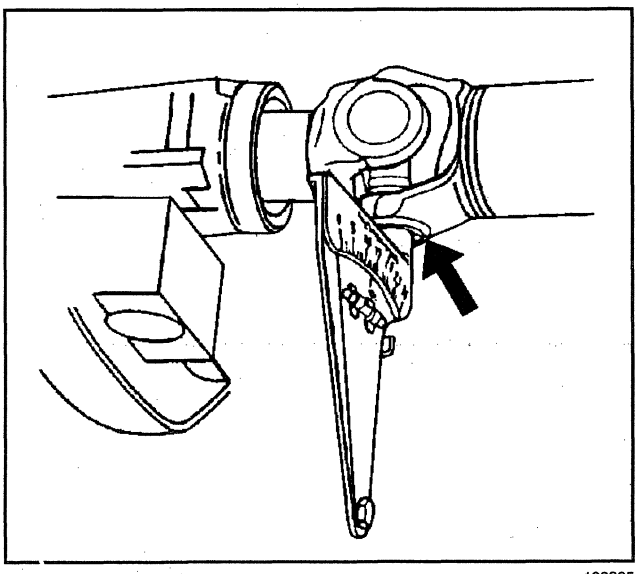
Checking Phasing of U-joints

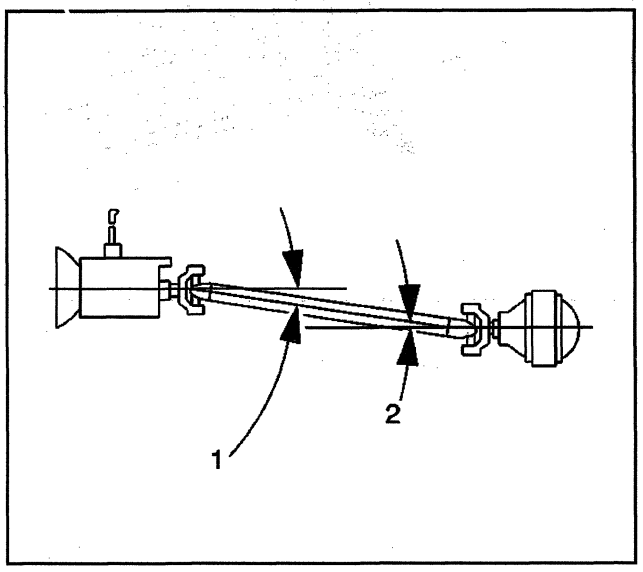
Inspect the propeller shaft for correct phasing. This means that the front and rear U-joints are directly in line or parallel with each other so that proper cancellation takes place.

1. Rotate the propeller shaft so that the propeller shaft rear U-joint bearing cap (1) is vertical as shown.
2. Ensure that the front bearing cap (1) is also vertical.
3. Place the inclinometer on the propeller shaft rear U-joint bearing cap in order to ensure that both U-joints are vertical.
4. Set the indicator line above the sight glass on 15 (the horizontal reference) and rotate the propeller shaft until the bubble centers in the sight glass. This brings the rear U-joint to vertical.
5. Remove the inclinometer without disturbing the setting. Leave the setting on 15 and install the inclinometer on the front U-joint. The bubble should remain centered plus or minus 3 degrees if the shaft is properly phased.



182325

The out of phasing of the single-piece propeller shaft is very unusual. If the shaft is visibly out of place, the end yokes are welded on in the wrong position, or the shaft is damaged due to twisting. In either case, replace the propeller shaft before continuing with this procedure.



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Measuring the Working Angles

The working angle of a U-joint is the difference between the angles formed when two shafts intersect. One piece propeller shaft systems have two working angles, the front and the rear.

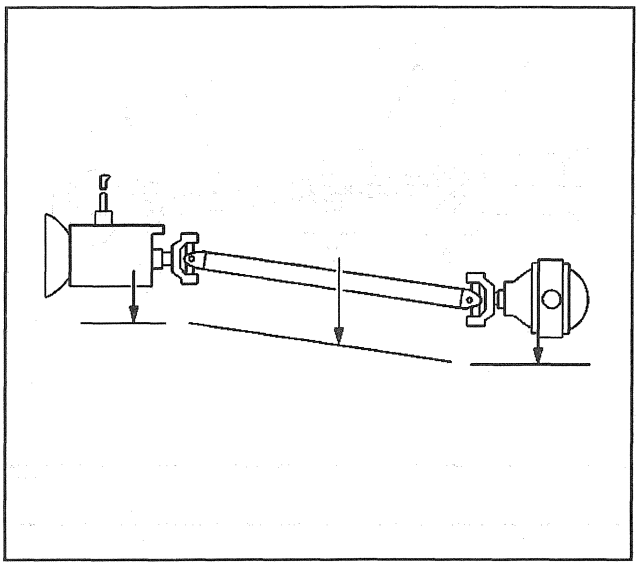
- The two working angles should be equal within 1/2 of a degree.
- The working angles themselves should not exceed 4 degrees.
- The working angles themselves should not be equal to zero because a zero working angle will cause premature U-joint wear due to lack of rotation of the U-joints.

The angle of the propeller shaft and the rear axle pinion form the rear working angle (2). The angle of the propeller shaft and the transmission output shaft form the front working angle (1).

The angles of these components are most accurately measured from the U-joint bearing caps. The bearing caps should be free of corrosion or foreign material to ensure accurate readings. Remove any snap rings that may interfere wit the correct placement of the inclinometer. Do not forget to reinstall them after you take the measurements.

Take the measurements from the same side of the propeller shaft to maintain consistent angle measurements (either driver or passenger side).

It is extremely helpful to record the readings on a diagram like the one shown as you proceed through the measurements.



182332

Evaluation

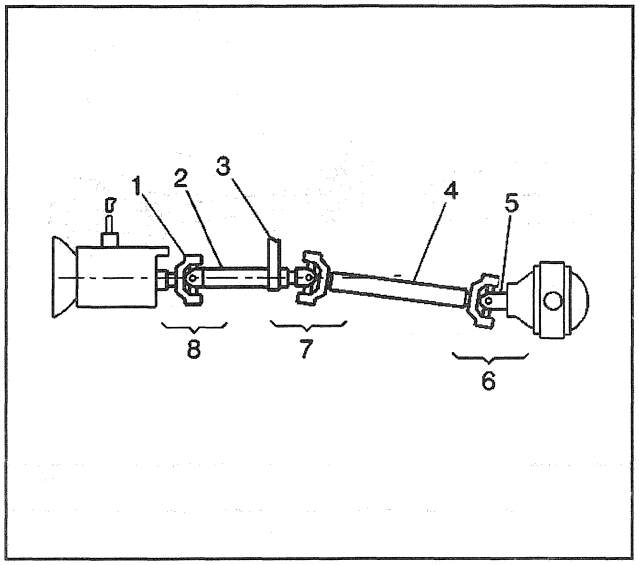
The two working angles in a one-piece propeller shaft system should be equal to within 1/2 of a degree for effective cancellation.

Measuring Two-Piece Propeller Shaft System Working Angles

Introduction

Two-piece propeller shaft systems have three working angles instead of two as in one-piece systems.

- The first angle is the front working angle (8). It is formed by the angle of the output shaft of the transmission (1) and the angle of the front propeller shaft (2).
- The second angle is the middle working angle (7). It is formed by the angle of the front propeller shaft (2) and the angle of the rear propeller shaft (4).
- The third angle is the rear working angle (6). It is formed by the angle of the rear propeller shaft (4) and the angle of the pinion yoke of the rear axle (5).



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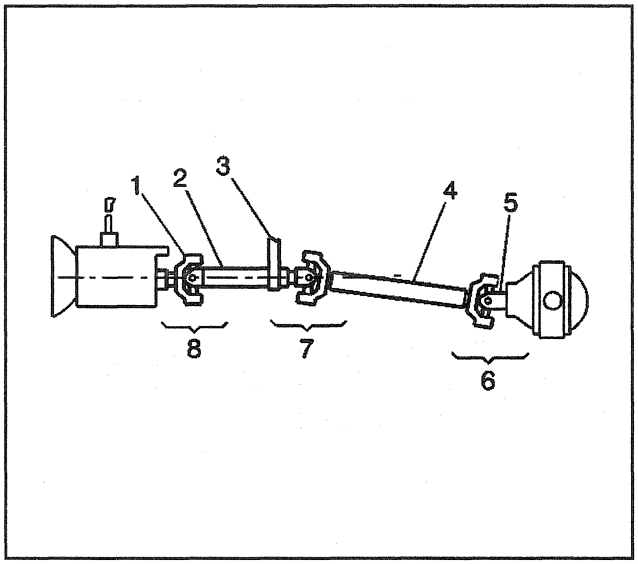

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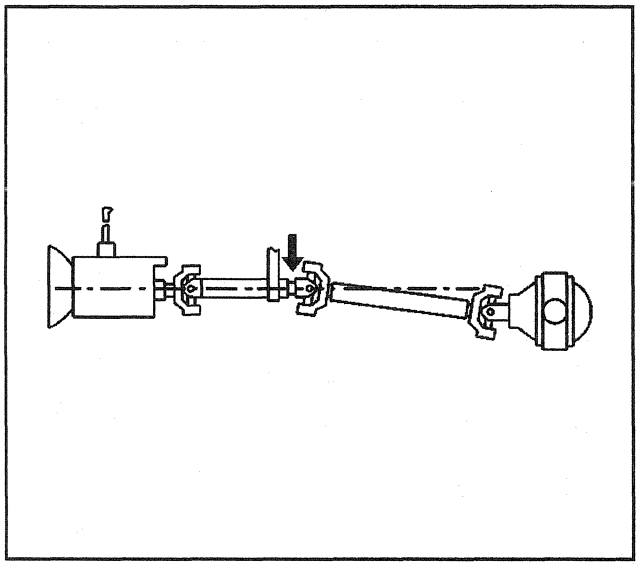
This system has an odd joint that does not have another joint to provide cancellation. Therefore, the rear working angle (6) and the middle working angle (7) act as a pair of joints to cancel each other out, like in one-piece propeller shaft systems.

The front angle (8) is considered the odd joint because it does not have another joint to provide cancellation. Because of this, the working angle of the odd joint must be kept at or under 1/2 or a degree.

Keep the working angle of this odd joint to a minimum so that there are not any great fluctuations in speed that need to be canceled out. The front joint is used as the odd joint because the front joint angle does not change with suspension bounce, rebound, or axle windup. For this reason, think of the front propeller shaft of a two piece system as an extension of the transmission output shaft.



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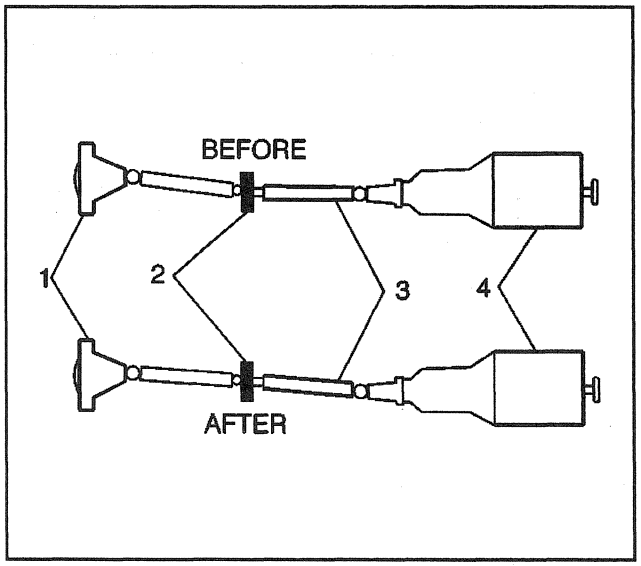
Two-Piece Propeller Shaft Phasing

The setup and measurement techniques are identical to that of a one-piece propeller shaft system. First, check for proper phasing:

1. Turn the rear shaft so the rear U-joint is straight up and down. Ensure that the front U-joint of the rear propeller shaft is also straight up and down.
2. Rotate the shafts 90 degrees so that the front propeller shaft front U-joint is straight up and down. Ensure that the front propeller shaft is also straight up and down (actually part of the slip yoke on the rear shaft).



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If the two U-joints of the front propeller shaft are not in this phase, the two halves of the propeller shaft may have been assembled incorrectly.

Two-Piece Propeller Shaft Lateral Alignment

The procedure for lateral alignment of a two-piece propeller shaft is used for launch shudder or any second-order, driveline vibrations. Adjust the lateral alignment before you measure and adjust the driveline angles.

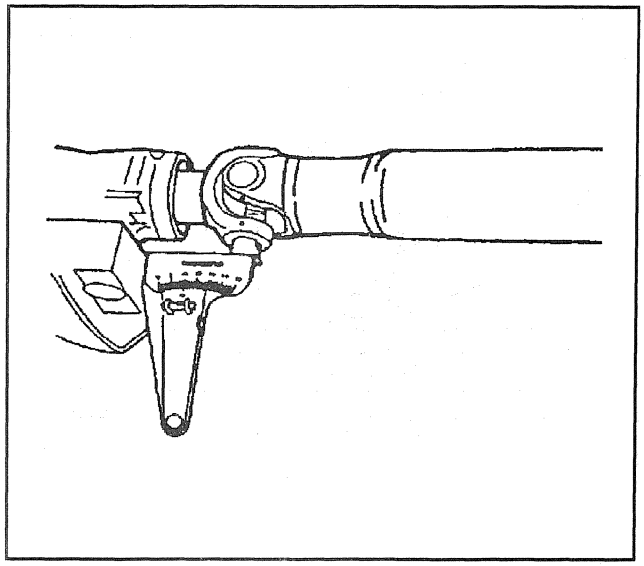
1. Raise and suitably support the vehicle on a hoist. Refer to General Information.
2. Look down the front of the propeller shaft (3).
3. If the propeller shaft is not straight, or if the center bearing support (2) is off to one side, relocate center support bearing to make the propeller shaft assembly as straight as possible. Ensure that you do not create a ground-out condition against the exhaust or another component.

If launch shudder or second-order driveline vibration is still present, measure and correct the driveline angles.

Measuring Two-Piece Propeller Shaft Working Angles

This procedure is essentially the same as for one-piece propeller shafts. You must, however, take into account the third angle.

1. Place the inclinometer on the propeller shaft bearing cap (1).



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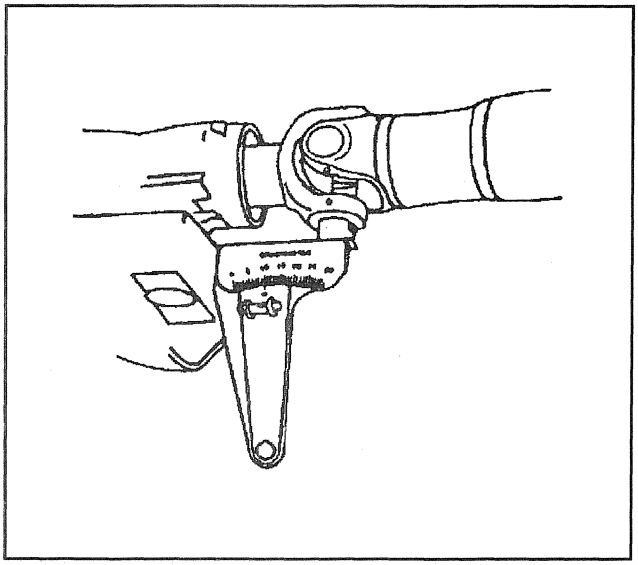
2. Center the bubble in the sight glass and record the measurement. The bearing cap must be straight up and down to obtain accurate measurement. Enter the measurements on your diagram.
3. Rotate the propeller shaft 90 degrees and place the inclinometer on the transmission output yoke bearing cap. Again, the bearing cap must be straight up and down to obtain an accurate measurement.
4. Center the bubble in the sight glass and record the measurement.
5. Subtract the smaller reading from the larger reading to obtain the front U-joint working angle.



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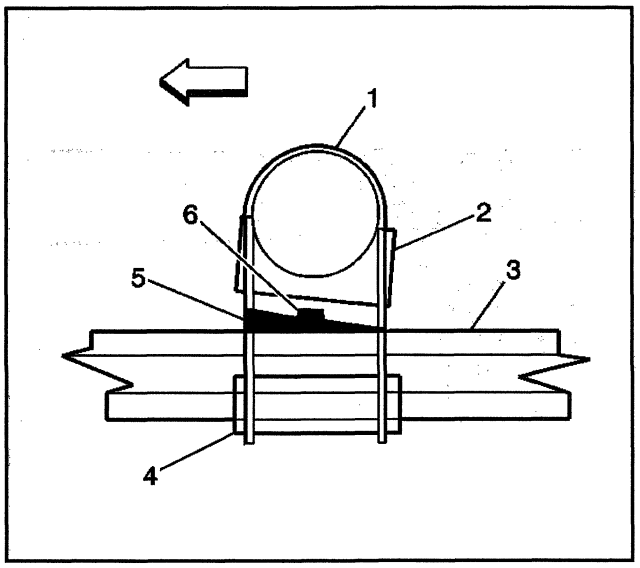

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Evaluation

The working angle is within tolerance, following the rule that the working angle of an odd joint in a two-piece joint system is 1/2 degree or less. Notice that in each of the good examples that the front working angle (FWA) is 1/2 degree or less and is treated as a separate joint. The middle working angle (MWA) and rear working angle (RWA) are subtracted and the difference (DIFF) is 1/2 degree or less. The middle and rear joints may cancel each other.

Correcting Working Angles

In order to change the working angles, shim the components up or down. Look closely at the existing angles. Use the existing angles and the shims in order to achieve the correct working angles.

Compared to horizontal or true level, the components located at the rear of the vehicle are usually lower than the components located at the front of the vehicle. This condition is called down in the rear. If a component with a down in the rear angle is shimmed up at the rear, then the shim will bring the component closer to the horizontal (zero). Alternately, if a component with a down in the rear angle is shimmed down, then the component will move farther from the horizontal (zero).

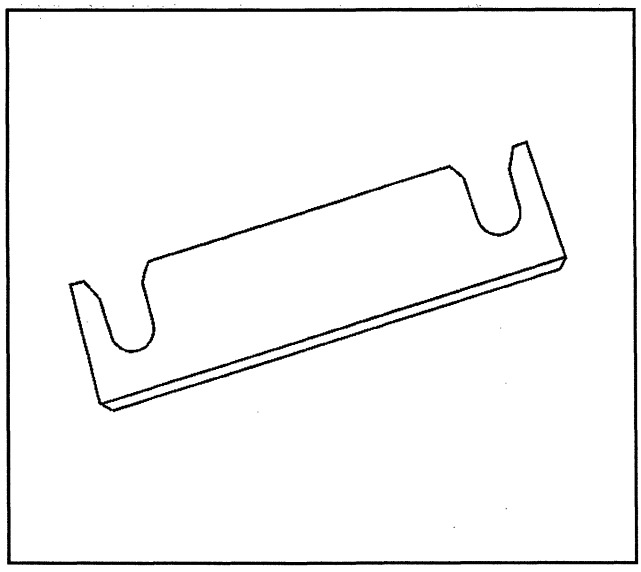
Rear Axle Wind-Up

Rear axle wind-up may cause launch shudder even when all of the working angles are within specifications. Rear axle wind-up occurs when heavy torque during acceleration causes the pinion nose to point upward. In order to compensate for axle wind-up, tip the pinion nose downward. Install the axle shims incrementally, performing a road test after each shim. Add shims until the road test indicates that the shudder is eliminated.

Rear Axle Shims

Wedge shims of different sizes are available through GMSPO and independent suppliers for the purpose of shimming the rear axle angle. GM shims are available in two, three and four degrees.

Caution: Never attempt to shim a rear axle using anything except shims that are designed for this purpose. Failure to do so will result in the shims falling out and a loss of vehicle control and that could cause personal injury.



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Install the shims (5) in order to increase or decrease the angle of the rear axle pinion. Install the shims between the leaf spring (3) and the spring seat. Depending on the design of the suspension (leaf spring on top or underneath the axle), and the direction of the desired change, install the shims with either the thick side toward the front of the vehicle or toward the rear of the vehicle.

Important: After installing the shims, ensure that the U-bolt has two or three threads above the nut. Ensure also that the center bolt, located in the spring seat, is long enough to seat in the locator hole. If these two conditions do not exist, use longer U-bolts and center bolts. Longer U-bolts and center bolts are available through local spring shops.

Transmission Shims

If a transmission requires shims, order the shims through GMSPO.

Installing most shims will change the transmission angle approximately ½ degree.

When shimming transmissions, use a shim made from steel stock at the necessary thickness. Ensure that the shim contacts the full width of the area to be shimmed. Do not use washers.

Description and Operation

General Description

Vibration Theory

The vehicle designs and the engineering requirements have undergone drastic changes in this decade. The following factors drive many of these requirements:

- Increased fuel costs
- Decreased fuel supplies
- Corporate Average Fuel Economy (CAFE)
- Clean air legislation
- Foreign competition
- Crashworthiness
- Rising customer expectations

The vehicle designs have evolved from the full frame construction, where multiple isolating body mounts were used, to the lighter unibody designs of today. The unibody designs transfer any noise or vibration faster.

The use of heavier V8 engines has been reduced, being replaced with lighter, more fuel-efficient four and six-cylinder engines. During this same period, options such as A/C and PS have become more popular. These types of options increase the engine load, resulting in more unwanted noise and vibration.

The presence/absence of unwanted noise and vibration is linked to the customer's perception of the overall vehicle quality.

Vibration is the repetitive motion of an object, back and forth, or up and down. The following conditions cause most vehicle vibrations:

- A rotating component
- The engine combustion process firing impulses

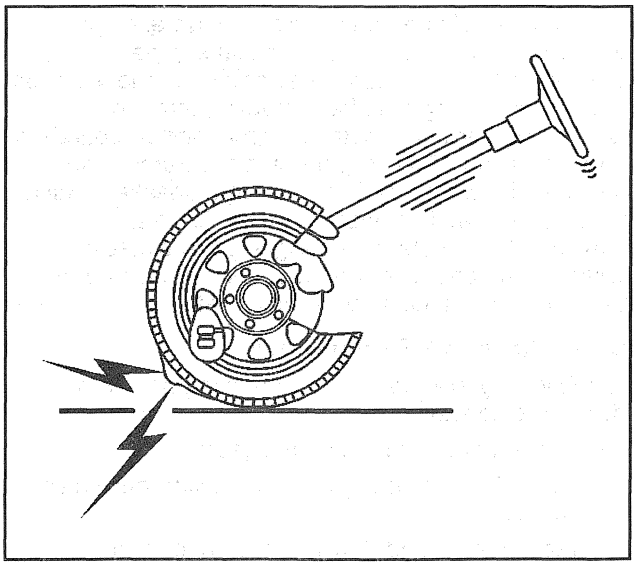
Rotating components will vibrate with excessive imbalance or runout. During vibration diagnosis, the amount of allowable imbalance or runout should be considered a TOLERANCE and not a SPECIFICATION. In other words, the less imbalance or runout the better.

A vibration concern will occur when the firing impulses of the engine are not properly isolated from the passenger compartment.

A vibrating component operates at a consistent rate (km/h, mph, or rpm). Measure the rate of vibration in question. When the rate/speed is determined, relate the vibration to a component that operates at an equal rate/speed in order to pinpoint the source. Vibrations also tend to transmit through the body structure to other components. Therefore, just because the seat vibrates doesn't mean the source of vibration is in the seat.

Vibrations consist of the following three elements:

- The source — the cause of the vibration
- The transfer path — the path the vibration travels through the vehicle
- The responder — the component where the vibration is felt



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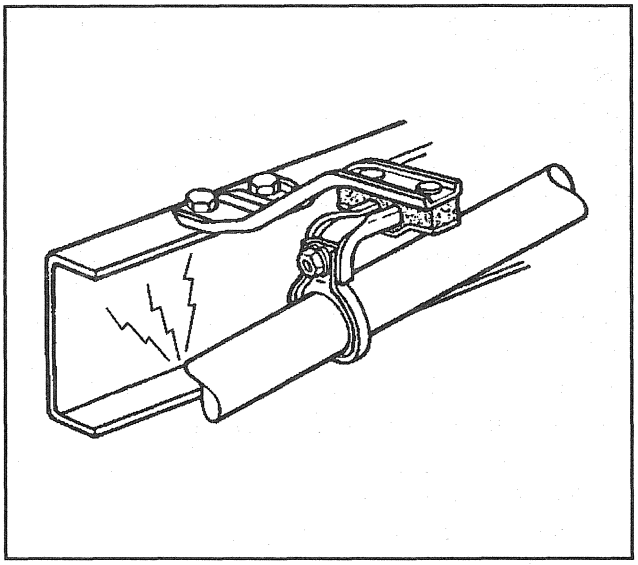
In the preceding picture, the source is the unbalanced tire. The transfer path is the route the vibrations travels through the vehicle's suspension system into the steering column. The responder is the steering wheel, which the customer reports as vibrating. Eliminating any one of these three elements will usually correct the condition. Decide, from the gathered information, which element makes the most sense to repair. Adding a brace to the steering column may keep the steering wheel from vibrating, but adding a brace is not a practical solution. The most direct and effective repair would be to properly balance the tire.



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Vibration can also produce noise. As an example, consider a vehicle that has an exhaust pipe GROUNDED to the frame. The source of the vibration is the engine firing impulses traveling through the exhaust. The transfer path is a grounded or bound-up exhaust hanger. The responder is the frame. The floor panel vibrates, acting as a large speaker, which produces noise. The best repair would be to eliminate the transfer path. Aligning the exhaust system and correcting the grounded condition at the frame would eliminate the transfer path.

Basic Vibration Terminology

The following are the two primary components of vibration diagnosis:

- The physical properties of objects
- The object's properties of conducting mechanical energy

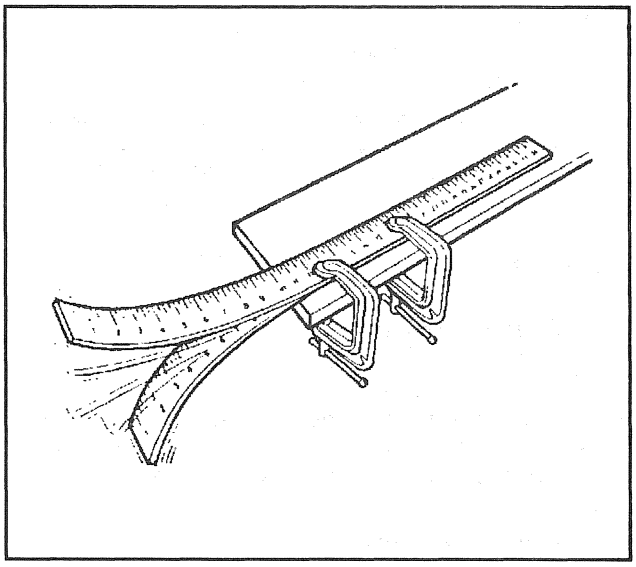
The repetitive up and down or back and forth movement of a component cause most customer vibration complaints. The following are the common components that vibrate:

- The steering wheel
- The seat cushion
- The frame
- The I/P

Vibration diagnosis involves the following simple stepwise outline:

1. Measure the repetitive motion and assign a value to the measurement in cycles per second or cycles per minute.
2. Relate the frequency back on terms of the rotational speed of a component that is operating at the same rate or speed.
3. Inspect and test the components for conditions that cause vibration.

For example, performing the following steps will help demonstrate the vibration theory:



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1. Clamp a yardstick to the edge of a table, leaving about 50 cm (20 in) hanging over the edge of the table.
2. Pull down on the edge of the stick and release while observing the movement of the stick.

The motion of the stick occurs in repetitive cycles. The cycle begins at midpoint, continues through the lowest extreme of travel, then back past the midpoint, through the upper extreme of travel, and back to the midpoint where the cycle begins again.

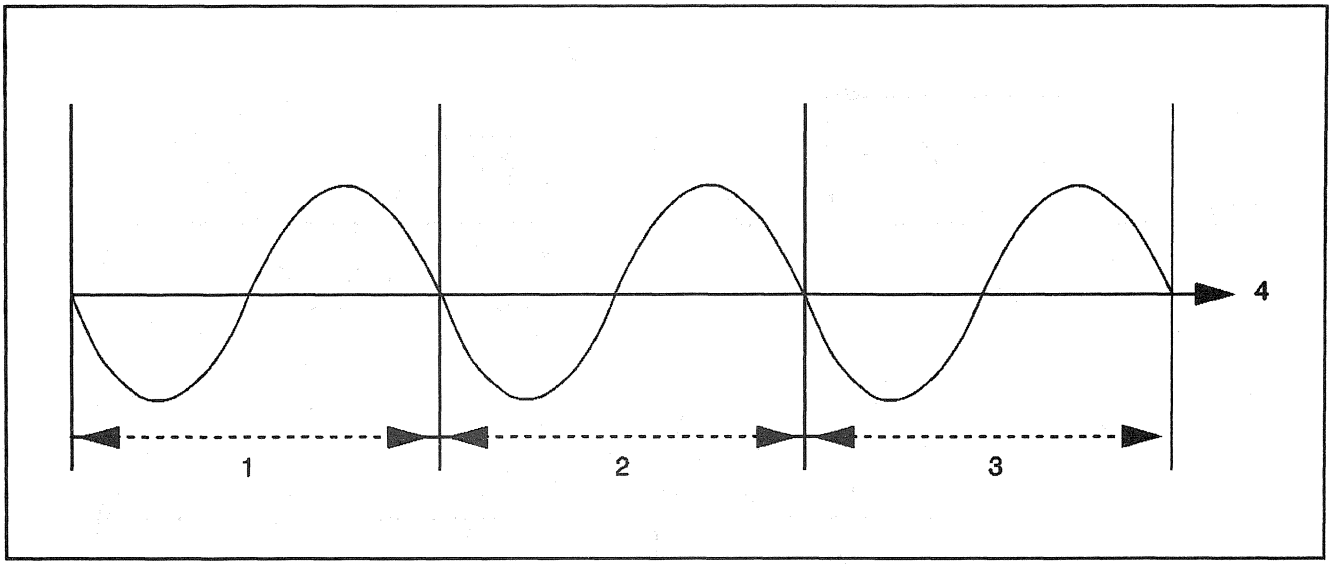
The cycle occurs over and over again at the same rate, or frequency. In this case, about 10 cycles in one minute. If we measure the frequency to reflect the number of complete cycles that the yardstick made in one minute, the measure would be 10 cycles x 60 seconds = 600 cycles per minute (cpm).

We have also found a specific amount of motion, or amplitude, in the total travel of the yardstick from the very top to the very bottom. Redo the experiment as follows:

1. Reclamp the yardstick to the edge of a table, leaving about 25 cm (10 in) hanging over the edge of the table.
2. Pull down on the edge of the stick and release while observing the movement of the stick.

The stick vibrates at a much faster frequency: 30 cycles per second (1800 cycles per minute).

Cycle



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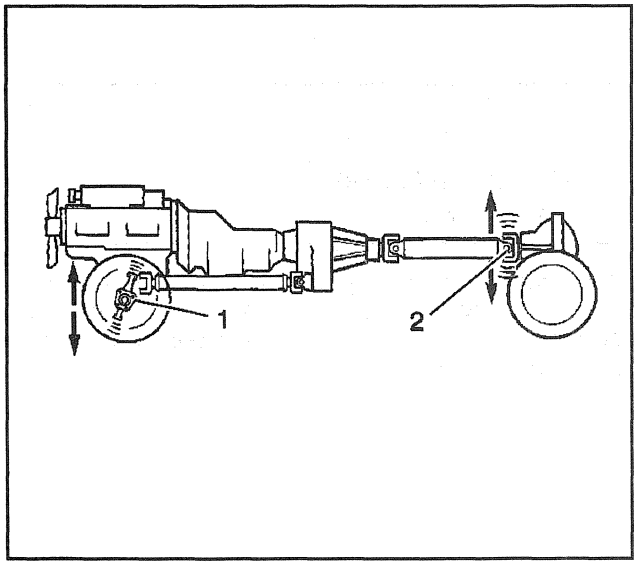
Legend

(1) 1st Cycle
(2) 2nd Cycle
(3) 3rd Cycle
(4) Time

Vibration Cycles in Powertrain Components



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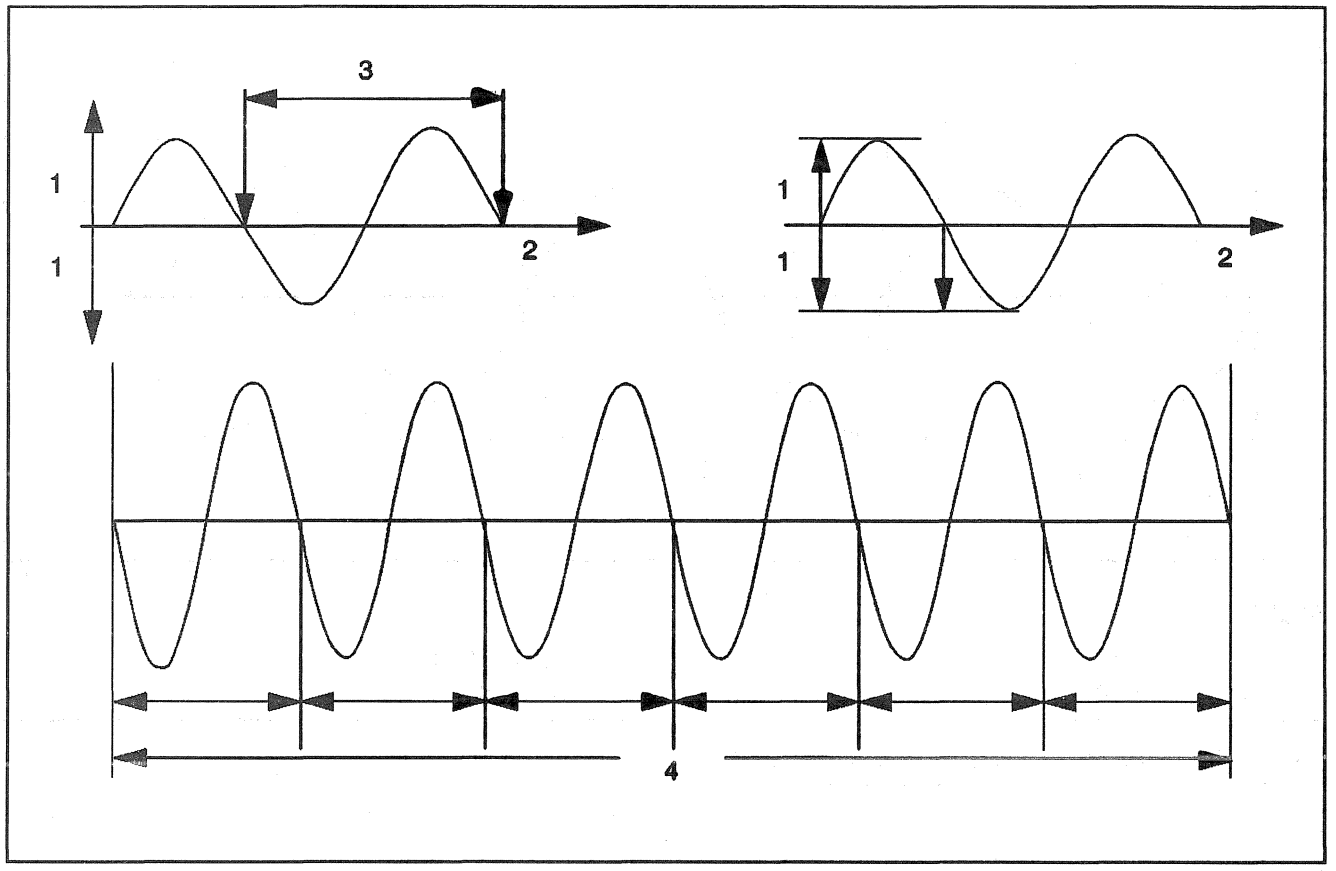
Legend

(1) Spindle
(2) Pinion Nose

The word CYCLE comes from the same root as the word CIRCLE. A circle begins and ends at the same point, as thus, so does a cycle. All vibrations consist of repetitive cycles.

Frequency



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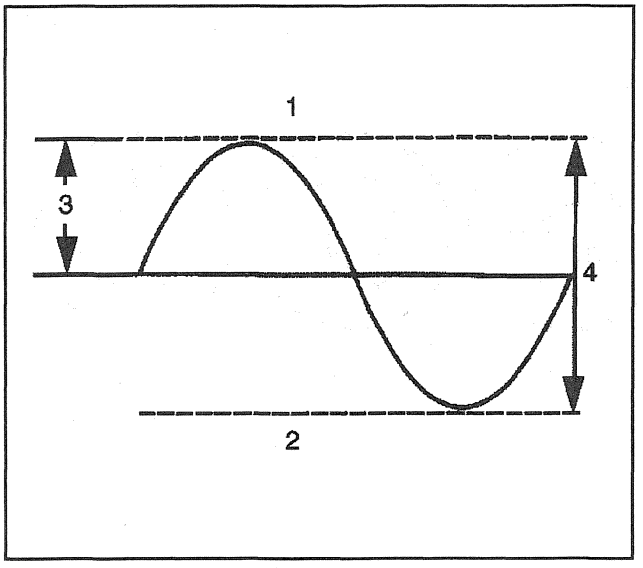
Legend

(1) Amplitude
(2) Reference
(3) Time in Seconds
(4) 1 Second

Frequency is defined as the rate at which an event occurs during a given period of time. With a vibration, the event is a cycle, and the period of time is one second. Thus, frequency is expressed in cycles per second.

The proper term for cycles per seconds is Hertz (Hz). This is the most common way to measure frequency. Multiply the Hertz by 60 to get the cycles or revolutions per minute (RPM).

Amplitude



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Legend

(1) Maximum
(2) Minimum
(3) Zero-to-Peak Amplitude
(4) Peak-to-Peak Amplitude

Amplitude is the maximum value of a periodically varying quantity. Used in vibration diagnostics, we are referring it to the magnitude of the disturbance. A severe disturbance would have a high amplitude; a minor disturbance would have a low amplitude.

Amplitude is measured by the amount of actual movement, or the displacement. For example, consider the vibration caused by an out-of-balance wheel at 80 km/h (50 mph) as opposed to 40 km/h (25 mph). As the speed increases, the amplitude increases.

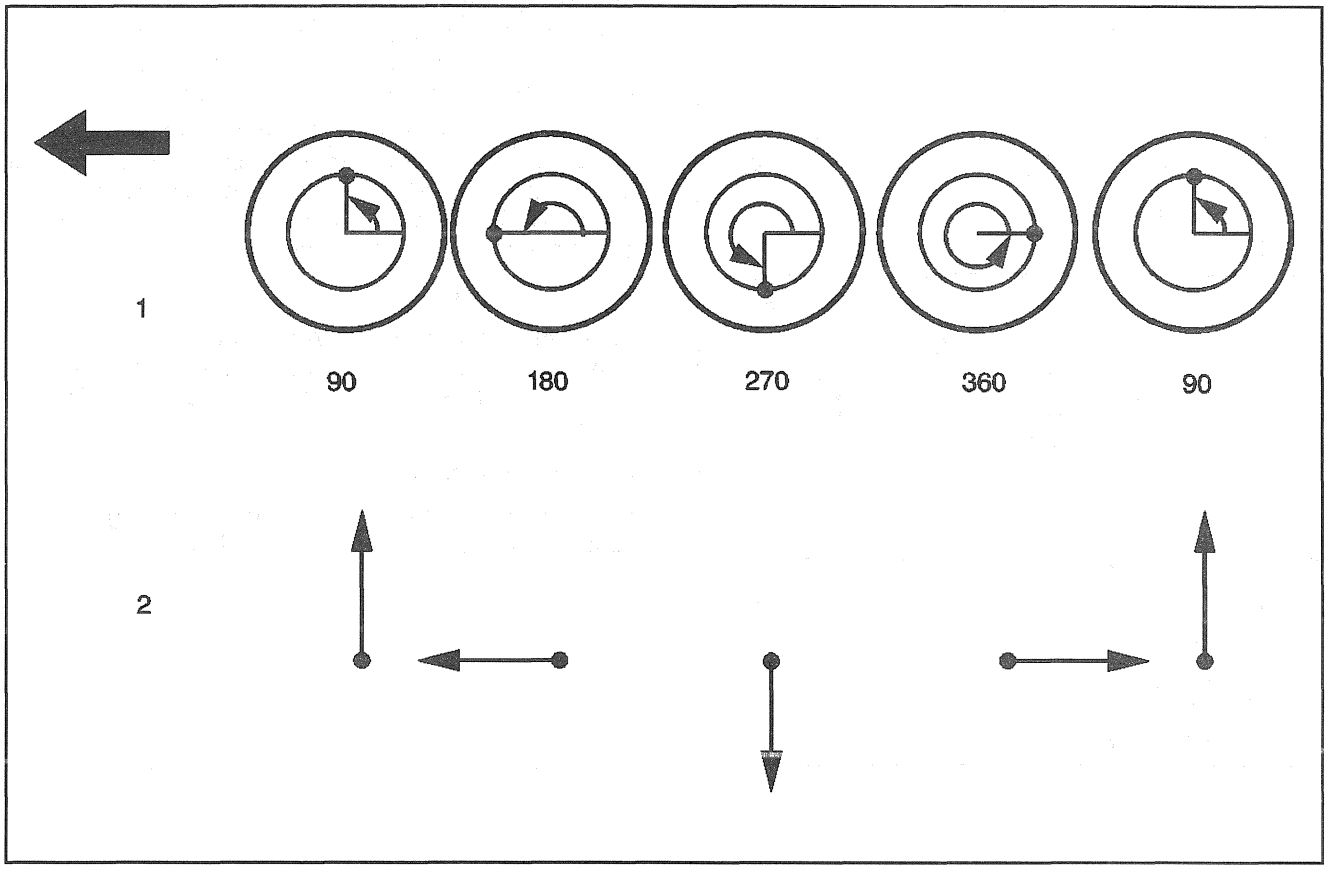
Free Vibration

Free vibration is the continued vibration in the absence of any outside force. In the yardstick example, the yardstick continued to vibrate even after the end was released.

Forced Vibration

Forced vibration is when an object is vibrating continuously as a result of an outside force.

Centrifugal Force Due to an Imbalance



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Legend

(1) Location of Imbalance (Degrees)

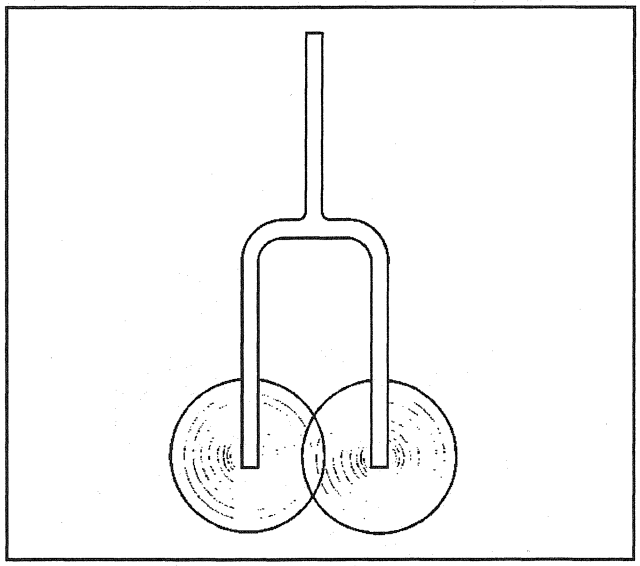
(2) Centrifugal Force Acting on Spindle

A spinning object with an imbalance generates a centrifugal force. Performing the following steps will help to demonstrate centrifugal force:

1. Tie a nut to a string.
2. Hold the string. The nut hangs vertically due to gravity.
3. Spin the string. The nut will sin in a circle.

Centrifugal force is trying to make the nut fly outward, causing the pull you feel on your hand. An unbalanced tire follows the same example. The nut is the imbalance in the tire. The string is the tire, wheel, and suspension assembly. As the vehicle speed increases, the disturbing force of the unbalanced tire can be felt in the steering wheel, the seat, and the floor. This disturbance will be repetitive (Hz) and the amplitude will increase. At higher speeds, both the frequency and the amplitude will increase. As the tire revolves, the imbalance, or the centrifugal force, will alternately lift the tire up and force the tire downward, along with the spindle, once for each revolution of the tire.

Natural or Resonant Frequency



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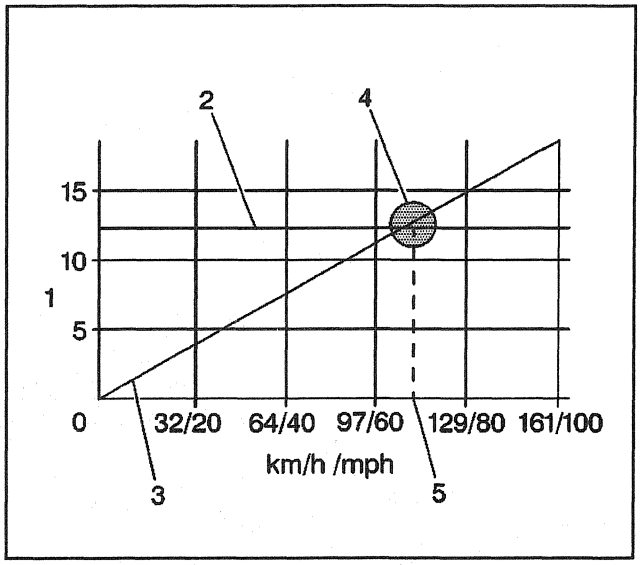
The natural frequency is the frequency at which an object tends to vibrate. Bells, guitar strings, and tuning forks are all examples of objects that tend to vibrate at specific frequencies when excited by an external force.

Suspension systems, and even engines within the mounts, have a tendency to vibrate at certain frequencies. This is why some vibration complaints occur only at specific vehicle speeds or engine RPM.

The stiffness and the natural frequency of a material have a relationship. Generally, the stiffer the material, the higher the natural frequency. The opposite is also true. The softer a material, the lower the natural frequency. Conversely, the greater the mass, the lower the natural frequency.

Resonance



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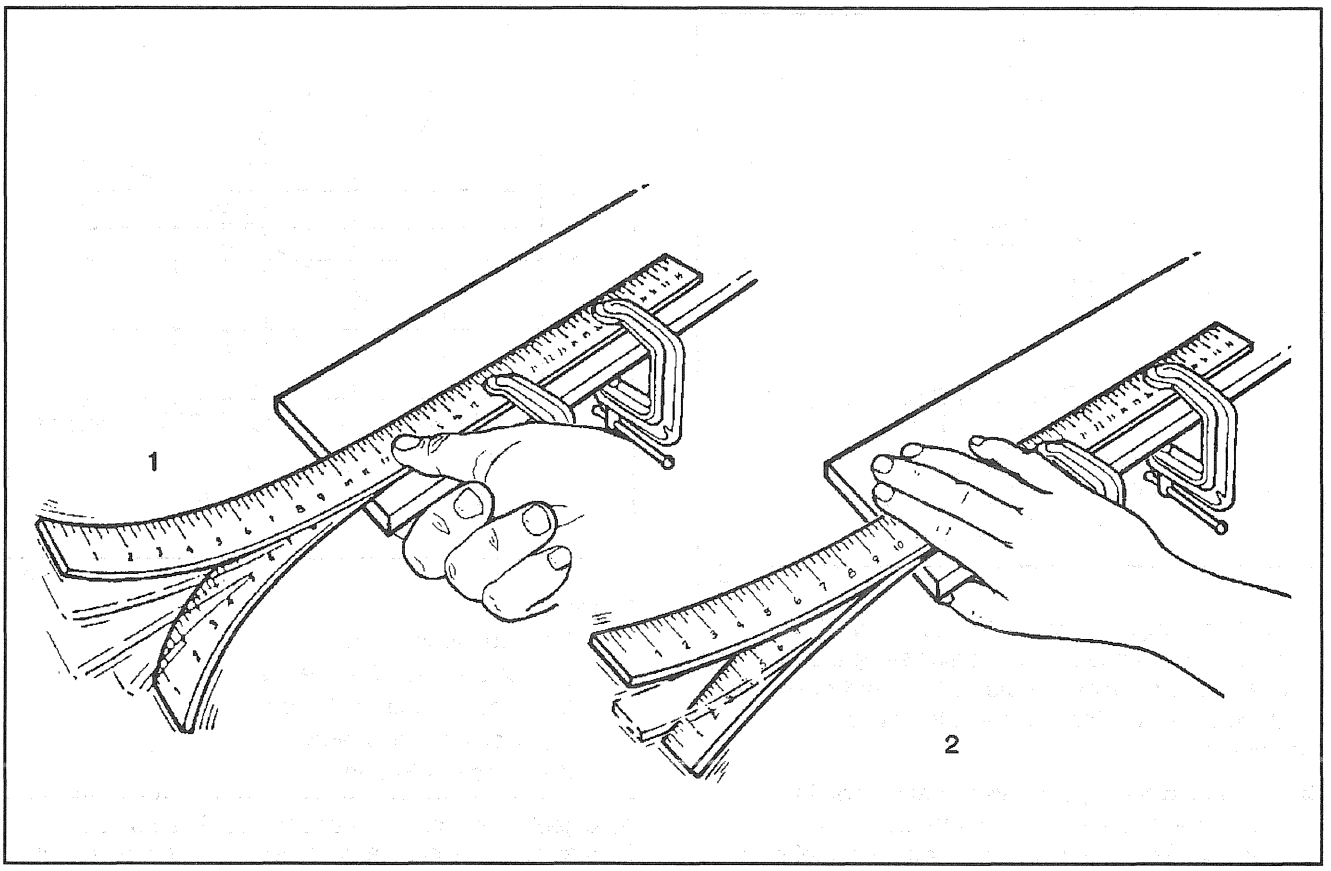
Legend

(1) Frequency – cps
(2) Suspension Frequency
(3) Unbalanced Excitation
(4) Point of Resonance
(5) Problem Speed

All objects have natural frequencies. The natural frequency of a typical automotive front suspension is in the 10–15Hz range. This natural frequency is the result of the suspension design. The suspension's natural frequency is the same at all vehicle speeds. As the tire speed increases along with the vehicle speed, the disturbance created by the tire increases in frequency. Eventually, the frequency of the unbalanced tire will intersect with the natural frequency of the suspension. This causes the suspension to vibrate. The intersecting point is called the resonance.

The amplitude off a vibration will be greatest at the point of resonance. While the vibration may be felt above and below the problem speed, the vibration may be felt the most a the point of resonance.

Damping



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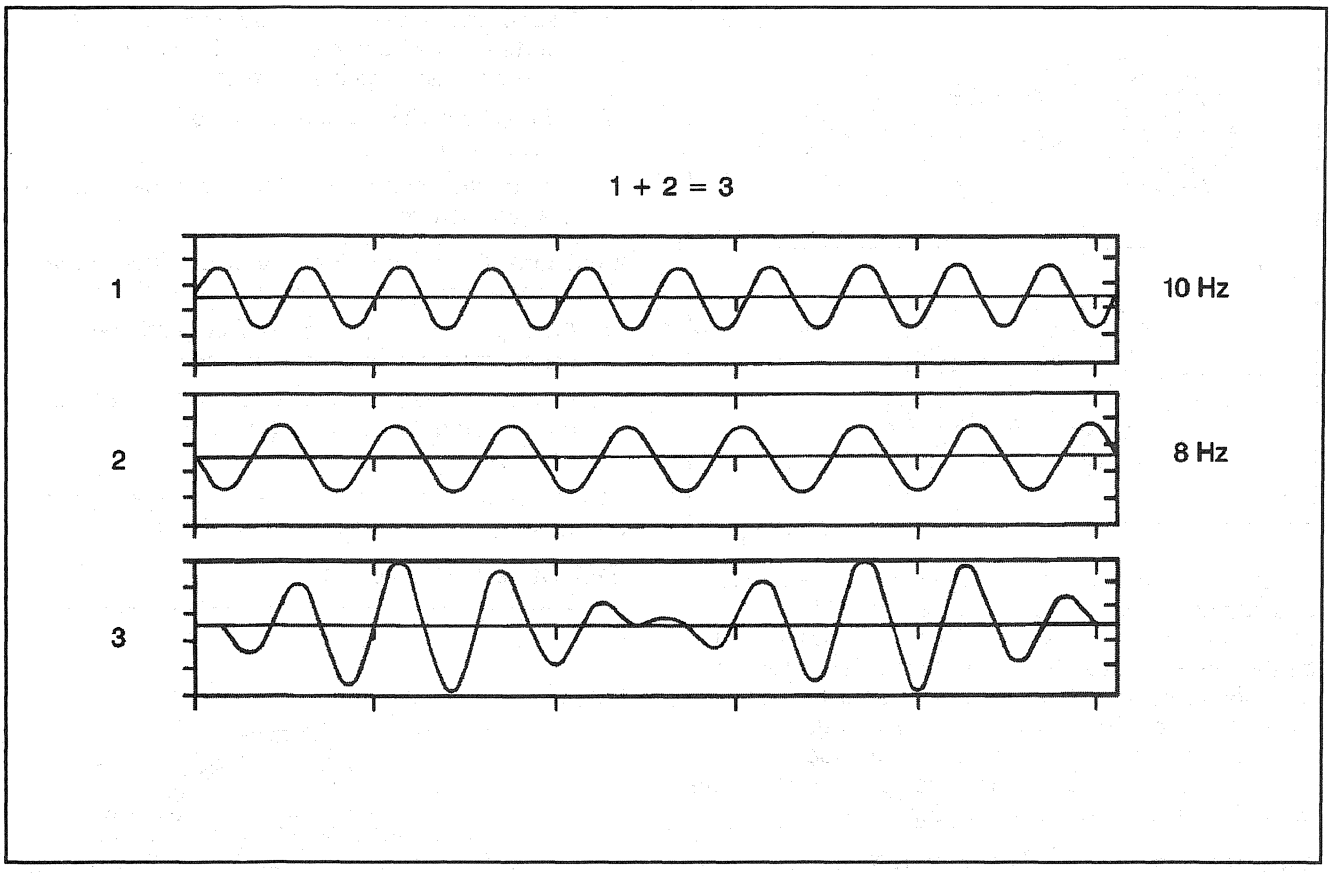
Legend

(1) Low Damping

(2) High Damping

Damping is the ability of an object or material to dissipate or absorb vibration. The automotive shock absorber is a good example. The function of the shock absorber is to absorb or dampen the oscillations of the suspension system.

Beating (Phasing)



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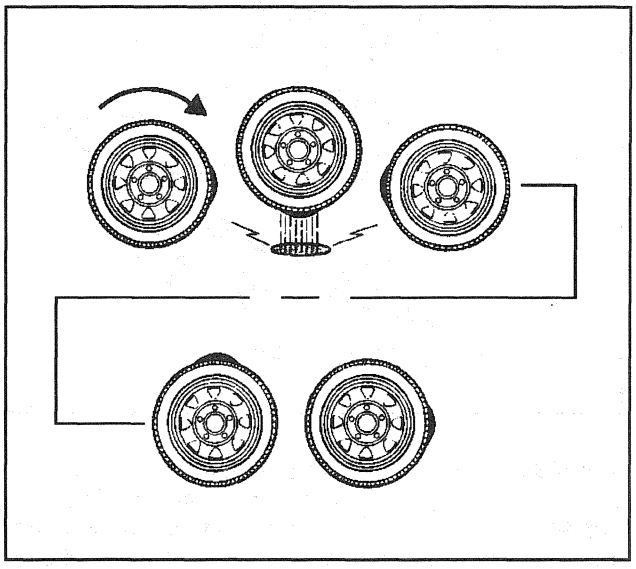
Two separate disturbances that are relatively close together in frequency will lead to a condition called beating, or phasing. A beating vibration condition will increase in intensity or amplitude in a repetitive fashion as the vehicle travels at a steady speed. This beating vibration can produce the familiar droning noise heard in some vehicles.

Beating occurs when two vibrating forces are adding to each other's amplitude. However, two vibrating forces can also subtract from each other's amplitude. The adding and subtracting of amplitudes in similar frequencies is called beating. In many cases, eliminating either one of the disturbances can correct the condition.

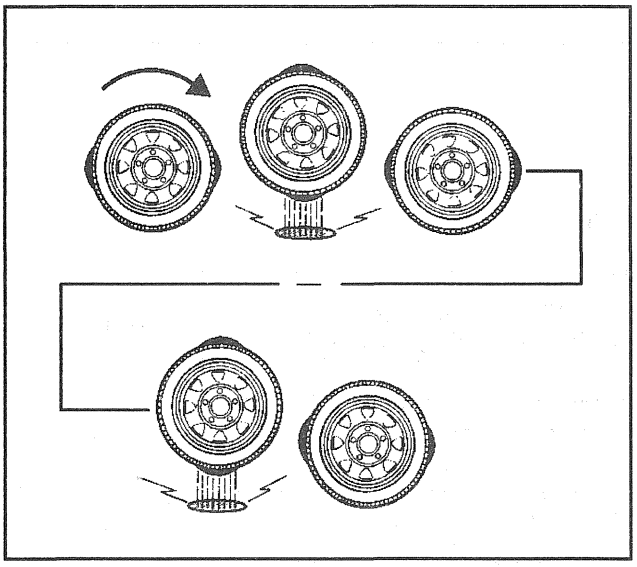
Order

Order refers to how many times an event occurs during one revolution of a rotating component.



95600

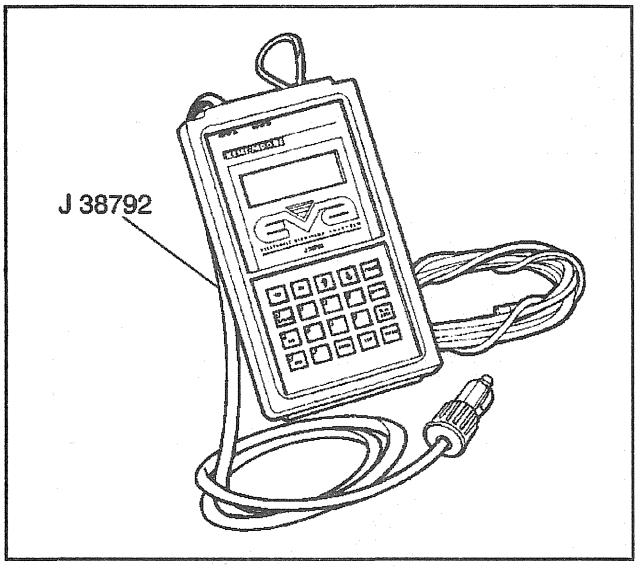
For example, a tire with one high spot would create a disturbance once for every revolution of the tire. This is called first-order vibration.



95601

An oval-shaped tire with two high spots would create a disturbance twice for every revolution. This is called second-order vibration. Three high spots would be third-order, and so forth. Two first-order vibrations may add or subtract from the overall amplitude of the disturbance, but that is all. Two first-order vibrations do not equal a second-order. Due to centrifugal force, an unbalanced component will always create at least a first-order vibration.

Electronic Vibration Analyzer (EVA)



95602

The *J 38792* Electronic Vibration Analyzer (EVA) is specifically designed to diagnose vibrations. This hand-held device is similar to a scan tool. A standard 12-volt power feed supplies the power. The vibration sensor, or the accelerometer, is at the end of a 6 m (20 ft) cord. The vibration sensor can be mounted virtually anywhere on the vehicle where a vibration is felt.

EVA Basic Hookup

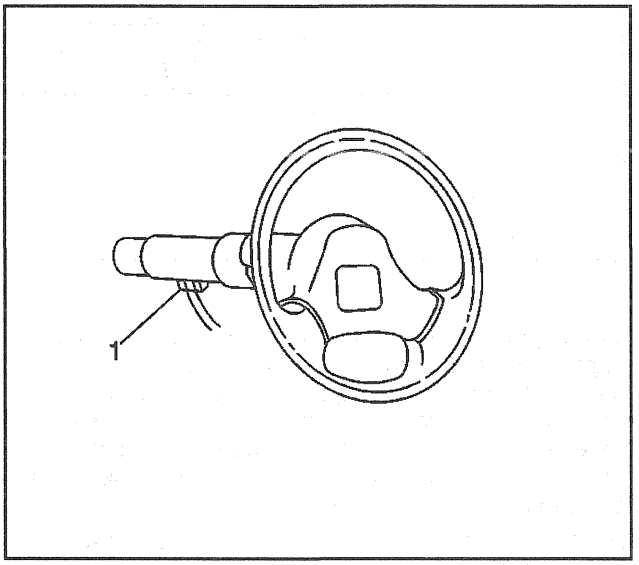
1. Inspect that the software cartridge is correctly inserted at the bottom of the unit. (The cartridge usually remains there at all times.)
2. Connect the vibration sensor cord into either input A or B.
3. Line up the connector so that the release button is at the bottom.

Important: Do not twist the connector. The sensor should remain plugged into the unit at all times.

4. Push the connector into the input until the connector clicks and locks in place.
5. Plug the power cord into a 12-volt power feed in order to turn the EVA on. (There is no ON-OFF switch.)

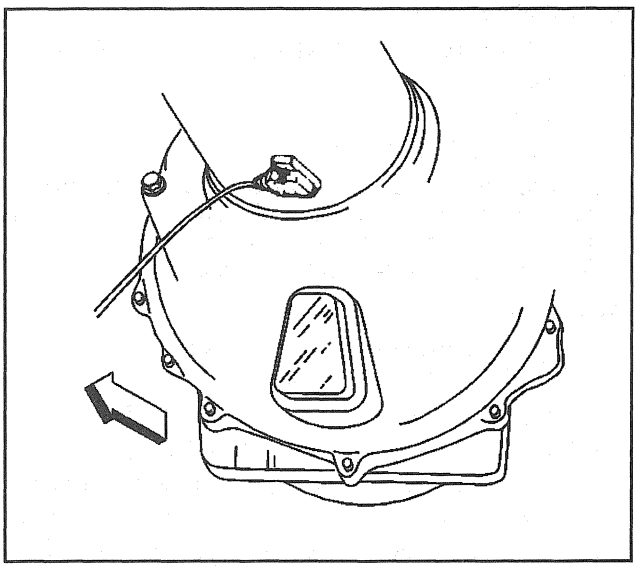
To Disconnect the sensor, press the release button and gently pull the connector straight out.

EVA Sensor Placement



95603

Proper EVA sensor placement is critical in order to take proper vibration readings. The sensor can be placed anywhere on the vehicle where vibrations are felt. Use putty or a hook and loop fastener in order to hold the sensor in place on non-ferrous surfaces, such as the surface of the steering column.

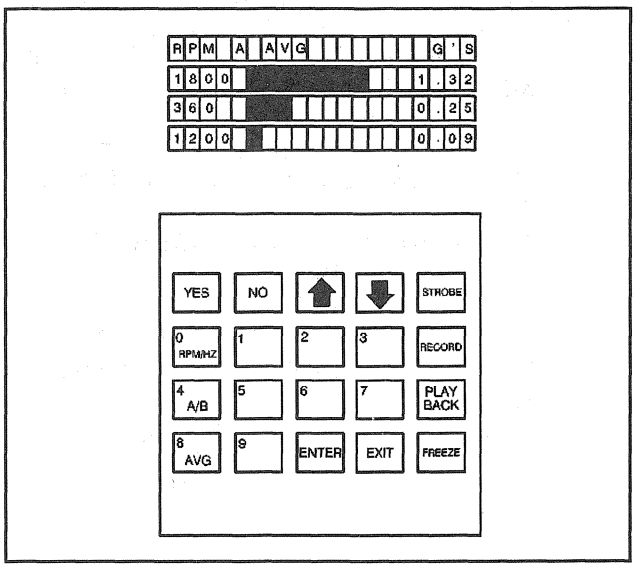


95604

A magnet is supplied in order to hold the sensor to ferrous surfaces.

Vibrations are typically felt in an up-and-down direction. The sensor is directionally sensitive. Therefore, place the sensor as flat as possible with the side marked UP facing upward. Place the UP side of the sensor in the exact position every time for consistent results when repeating the tests or making a comparison.

EVA Display



95605

The EVA offers the following main display features, all of which are described below:

- Freeze
- Record/Playback
- Averaging/Non-averaging modes
- Strobe Balancing

Freeze

Pressing the FREEZE button on the keypad activates the freeze function, which locks the display of data. The display shows FRZ at the top. The freeze function is useful when conducting an acceleration/deceleration test in which the significant amount of vibration registers only for a very short time. Pressing EXIT or the FREEZE button again deactivates the freeze function.

Record/Playback

The displayed vibration information can be recorded for later playback. The EVA retains stored data for about 70 hours after the unit has been unplugged from a power source. Data is recorded as SNAPSHOTS of vibration information. Each snapshot consists of 10 different frames. Up to 10 of these snapshots can be recorded.

Press RECORD in order to record a snapshot. The screen will display R? in order to request a tag number between 0 and 9. These tag numbers are the individual frames of the snapshot recording. New data will replace the existing data when a number is chosen that has already been used in order to tag a snapshot.

Pressing PLAYBACK plays back the recorded data. The screen shows P? in order to request the tag number for the wanted snapshot. Once the number is entered, the snapshot data is displayed: P and the tag number will appear. Then, an F and a 0–9 will be displayed in order to indicate which frame of the snapshot is being displayed.

The freeze function can be used in order to freeze the display at any point in the sequence during playback. Individual frames can be viewed in a forward or backward sequence using the up and down arrow keys.

The display returns to the active screen when the recording or playback of a snapshot is finished, or when EXIT is pressed.

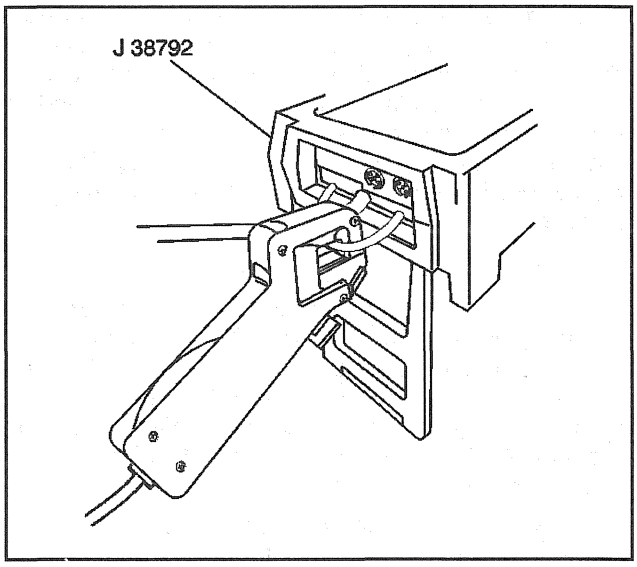
Averaging/Non-Averaging Modes

The EVA normally operates in an averaging mode that averages multiple vibration samples over a period of time. The averaging mode minimizes the effects of sudden vibration that are not related to the problem (such as form potholes or uneven road surfaces). Most tests use the averaging mode.

The EVA is more sensitive to vibrations in the non-averaging mode. The display is more instantaneous and not averaged over a period of time. The non-averaging mode is used when measuring a vibration that exists for only a short period of time, and during acceleration/deceleration tests.

Pressing the AVG button switches between the averaging and non-averaging modes. The screen will display AVG.

Strobe Balancing



95606

The EVA can strobe balance a rotating component. A trigger wire is located on the top of the EVA, which is used in conjunction with an inductive pick-up light strobe. The EVA triggers the strobe light at the same frequency as the vibration. The timing light clips on to the trigger wire. The vibration sensor must be attached to input A. Input B does not provide the strobe function.

Pressing STROBE starts the strobe balancing function. The EVA will ask a series of questions in order to determine the correct filter range: full, low, or high.

The low and high ranges prevent other vibrations from interfering with the operation of the strobe light. Use the full range as a last resort only. Press YES in order to select a range. Press NO in order to go on to the next range. The vibration/strobe frequency must fall within the selected range.

The EVA will display the strobe frequency, amplitude, and filter range. The EVA is now ready to begin the strobe balance procedure.

EVA Calibration

The EVA features the following two built in calibration procedures:

- Sensor Calibration
- Phase Shift Calibration

A replaced or added sensor must be calibrated in order to function properly with the EVA unit. The phase shift calibration is performed at the factory and should not be repeated under normal use.

Sensor Calibration

1. Lay the sensor on a flat stationary surface with the UP side facing upward.
2. Plug the sensor into either input A or B.
3. Plug the EVA into a 12-volt power supply.
4. After the display initializes, select the proper input.
5. Press the up arrow key.
6. Press the number 2 three times on the keypad. The message BURNING will appear, followed by a request to turn the sensor over.
7. Turn the sensor over.
8. Press any key in order to commence calibration:
   - Calibration will take about 20 seconds.
   - The display will return to the active mode when calibration is complete.

Phase Shift Calibration

1. Plug the EVA into a 12-volt power supply.
2. Press the down arrow key on the EVA keypad.
3. Press the number 2 three times in order to begin calibration:
   - Do not press any key until the message ANY KEY TO CONTINUE appears. Pressing a key will cancel the calibration process.
   - The display will flash numbers for 5–6 minutes. (If the numbers flash for more than 10 minutes, the EVA is defective.)
   - The message BURNING PHASE SHIFT CONSTANTS will appear for one minute.
   - The BURNING CENTER FREQUENCIES LOW=39 HIGH=48 message will appear.
   - The ANY KEY TO CONTINUE message should appear.
4. Press any key in order to return to the active mode.