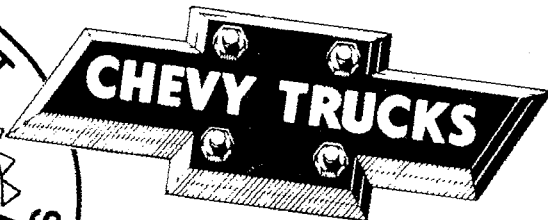
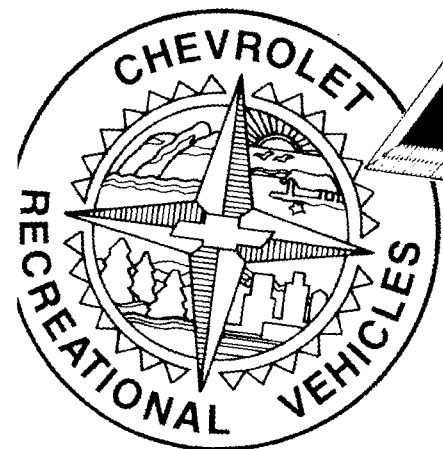


CHEVROLET MOTOR HOME CHASSIS SERVICE GUIDE



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FOREWORD

This manual has been developed to provide the owner and operator with service information for the Chevrolet motor home chassis. Major components and systems are described and maintenance and inspection procedures are given. In addition to providing information for proper maintenance of the motor home chassis, some inspection and diagnosis procedures are included to help detect and identify common problem conditions which may occur.

In a section at the end of this manual are appendixes containing additional information helpful in maintaining the motor home. This includes information on drive belts, storage of the motor home, identification for bolts and nuts, and formulas for converting to metric measurements.

The organization of the Chevrolet Motor Home Chassis Service Guide is similar to that of the Chevrolet Light Duty Truck 10-30 Series Shop Manual. While the information contained in this Service Guide is intended to establish proper maintenance and inspection procedures, there may be times when more detailed diagnostic and repair procedures contained in the Shop Manual may be required. The similarity in organization can make reference to the Shop Manual easier.

Specific references to Chevrolet Service Bulletins have been included within the text and Appendixes of various sections of this manual. Chevrolet bulletins are intended for use by professional technicians, NOT a "do-it-yourselfer." They are written to inform these technicians of conditions that may occur on some vehicles, or to provide information that could assist in the proper service of a vehicle. Properly trained technicians have the equipment, tools, safety instructions, and know-how to do a job properly and safely. If a condition is described, DO NOT assume that the bulletin applies to your vehicle, or that your vehicle will have that condition. See your Chevrolet dealer for information on whether your vehicle may benefit from that information.

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SECTION 1 — INTRODUCTION

GENERAL INFORMATION

Chevrolet chassis are available in two series for motor home use. These are the G-Series and the P-Series.

These are:

G-SERIES MOTOR HOME CHASSIS

The G-Series, or cutaway van, as it is commonly referred to before the addition of the motor home body, is a chassis which includes a full floor, frame, front cab (less back) and engine as shown in Figure 1-1. Many of the components including the front end sheet metal, instrumentation, driving controls and seats are common with the Chevrolet Van.

Model Number	Wheelbase Length (inches)
CP 30832	125
CP 31132	137
CP 31432	158.5
CP 31832	178

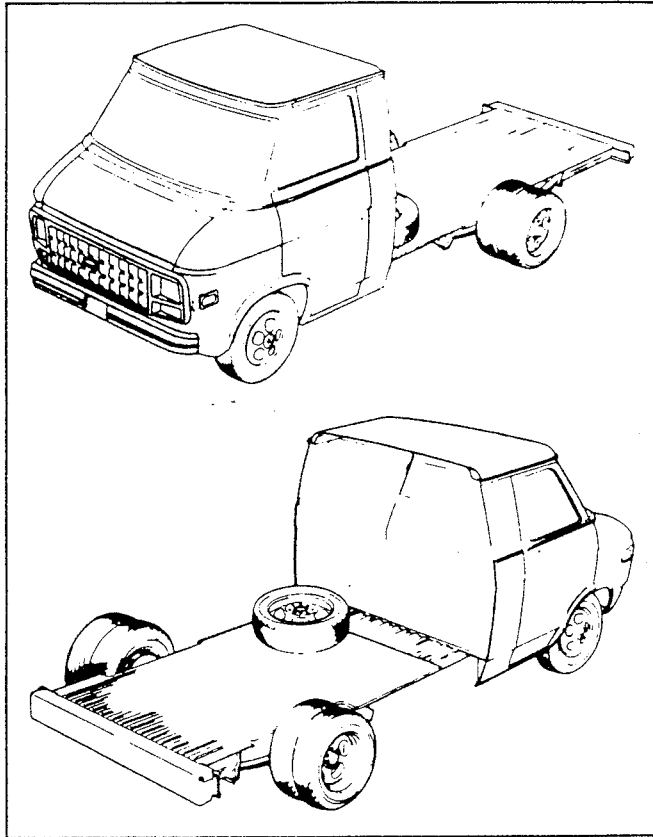


Figure 1-1 — G-Series Motor Home Chassis

P-SERIES MOTOR HOME CHASSIS

The P-Series motor home chassis is an engine and frame unit which includes the driving controls, as shown in Figure 1-2. The P-Series (P30 is the series and size class used for motor homes) is available in four wheelbase lengths.

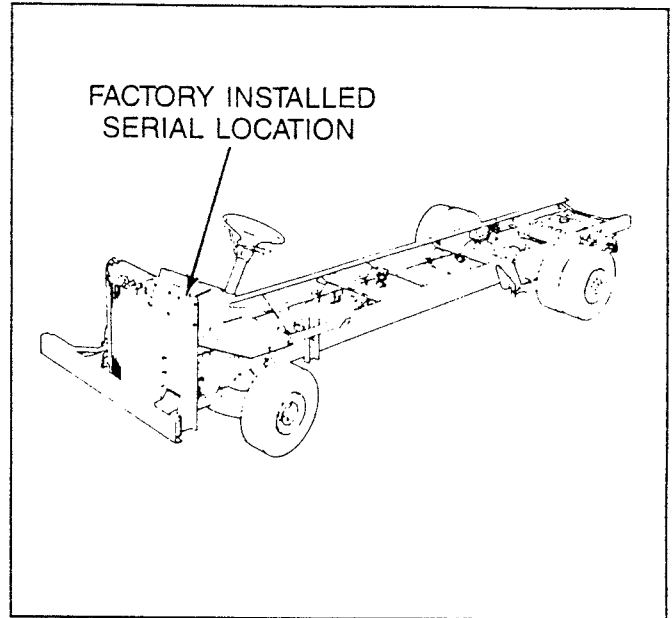


Figure 1-2 — P-Series Motor Home Chassis

IDENTIFICATION NUMBERS

There are several numbers which are important in identifying the vehicle and components used on the vehicle. These are as follows:

VEHICLE IDENTIFICATION NUMBER (V.I.N.)

This is the legal identification of the vehicle. It appears on a plate which is attached to the top left of the instrument panel on the G-Series chassis and can be easily seen through the windshield from outside the vehicle (Figure 1-3). On the P-Series chassis, the V.I.N. Rating Plate is attached to the front of the dash and toe panel to the left of the steering column. The V.I.N. also appears on the Vehicle Certificates of Title and Registration.

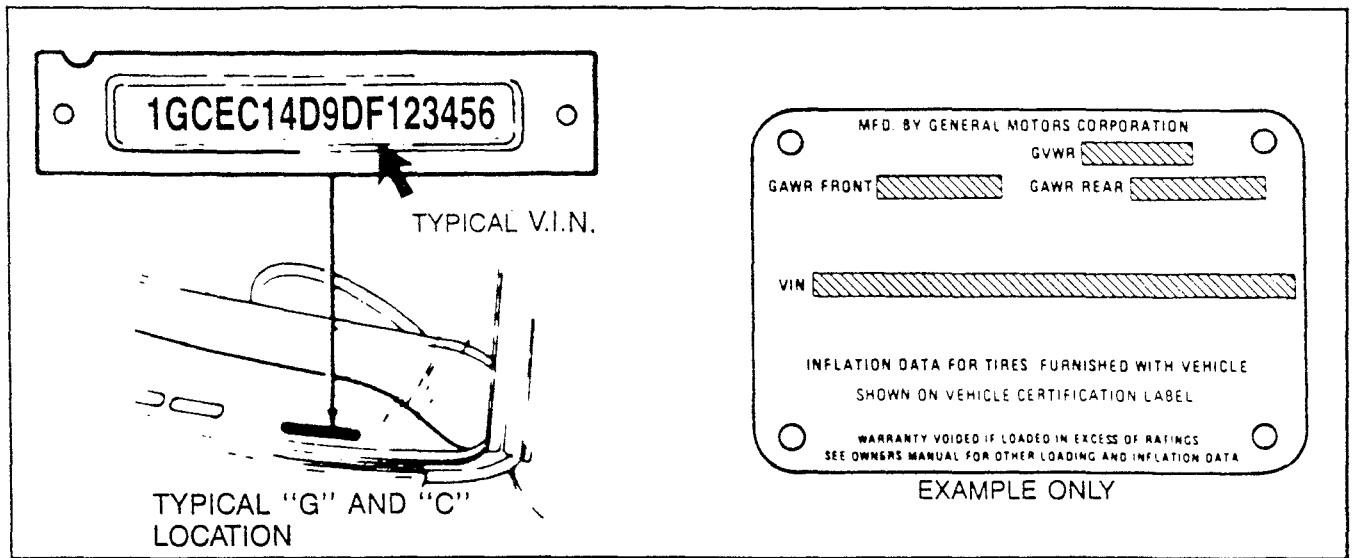


Figure 1-3 — Vehicle Identification Number

SERVICE PARTS IDENTIFICATION STICKER

The Service Parts Identification Sticker (Figure 1-4) is provided on both G- and P-Series vehicles. On the G-Series vehicle, the sticker is located on an inner hood panel surface. On the P-Series vehicle, the sticker is located on an inner body panel.

The sticker lists the vehicle identification number, wheelbase, and all production options or special equipment on the chassis when it was shipped from the factory including paint information. ALWAYS REFER TO THIS INFORMATION WHEN ORDERING PARTS.

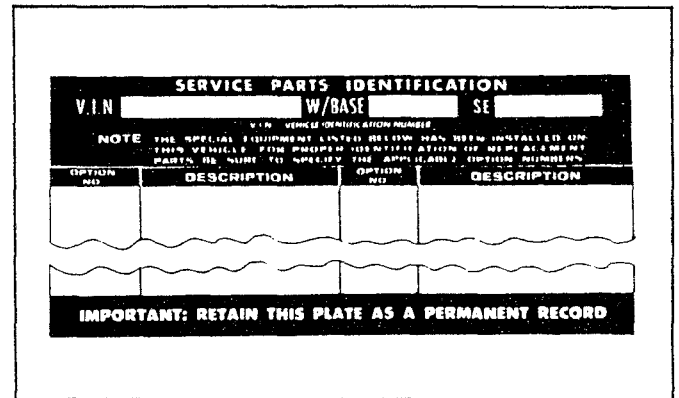


Figure 1-4 — Service Parts Identification Sticker

SECTION 1 — INTRODUCTION

LUBRICATION

Various components of the motor home chassis must have the proper lubrication to operate as designed. This lubrication must be done in accordance with the intervals specified in the appropriate Maintenance Schedule for the vehicle.

Following are charts which list the recommended fluids and lubricants, component fluid capacities and lubrication points.

RECOMMENDED FLUIDS AND LUBRICANTS

USAGE	FLUID/LUBRICANT
Power steering system and pump reservoir	Power steering fluid, GM Part No. 1050017 or equivalent
Manual steering gear	Lubricant, GM Part No. 1052182 or equivalent
Differential — Standard or Locking Spiral Bevel Axle Gearing. Pinion enters ring gear at centerline	SAE-80W GL-5 or SAE-80W-90 GL-5 gear lubricant (SAE-80W — GL-5 in Canada) Do not use additive with Eaton locking differential
Differential — Rockwell model C-103-12 ¹ / ₄ ", Commercial P model, Hypod gearing. Pinion enters ring gear below centerline.	SAE-85W-140 GL-5 above 10 °F SAE-80W-90 GL-5 below 15 °F Military spec 2105C
Brake system and master cylinder	Delco Supreme 11 fluid or DOT-3
Propeller shaft slip joint	Chassis Grease, GM Part No. 1051344 or equivalent
Hood Latch Assembly a. Pivots and spring anchor b. Release pawl	a. Engine Oil b. Chassis Grease
Hood and Door Hinges	Engine Oil
Automatic Transmission Shift Linkage	Engine Oil
Chassis Lubrication	Chassis grease, GM Part No. 1051344 or equivalent
Engine Oil (Gasoline)	"SF" or "SF/CC" or "SF/CD" Engine Oil
Engine Oil (Diesel)	"SF/CC" or "SF/CD" Engine Oil
Automatic Transmission	DEXRON II Auto. Trans. Fluid, GM P/N 1051855
Parking Brake Cables	Chassis Grease, or GM Part No. 1052182 or equivalent
Front Wheel Bearings	Wheel bearing lubricant, GM Part No. 1051344 (One Pound) or Exxon Ronex MP Grease or equivalent
Body door hinge pins, tailgate hinge and linkage, folding seat, fuel door hinge	Engine Oil
Windshield Washer Solvent	GM Optikleen washer solvent, Part No. 1051515 or equivalent
Engine Coolant	Mixture of water and high quality Ethylene Glycol base type antifreeze, GM Part No. 1052753 or equivalent
Key Lock Cylinder	Lockeze or GM Part No. 1052276

Figure 1-5 — Recommended Fluids and Lubricants

LUBRICANT CAPACITIES

USAGE		U.S. MEASURE
Differential		
8-1/2 In. Ring Gear		4-1 4 pts.
8-7/8 In. Ring Gear		3-1 2 pts.
10-1 2 In. Ring Gear (Chev.)		6-1 2 pts.
10-1.2 In. Ring Gear (Dana)		7.2 pts.
9-3/4 In. Ring Gear (Dana)		6.0 pts.
12-1.4 In. Ring Gear (Rockwell - Commercial Model Only)		6-1/2 pts.
Engine Crankcase		
Code F-H L-M-P	5.7L V-8 — Drain & Refill — w Filter Change	4 qts. 5 qts.
Code W	7.4L V-8 — Drain & Refill — w Filter Change	6 qts. 7 qts.
Code C-J	6.2L V-8 Diesel Including Filter	7 qts.
Transmission Automatic		
350C — Total		10 qts.
— Refill		3 qts.
475 — Total		11 qts.
— Refill		3.5 qts.

Figure 1-6 — Lubricant Capacities

NOTE: With any side fill gear case, regardless of specifications, fill the case until fluid runs back out the fill hole (Figure 1-7). DO NOT CONSIDER FILL ADEQUATE BECAUSE YOU CAN REACH IT WITH YOUR FINGER.

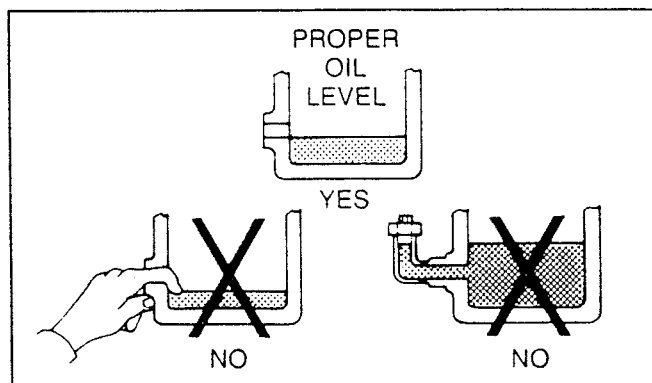


Figure 1-7 — Side Fill Gear Case Capacity

LUBRICATION POINTS

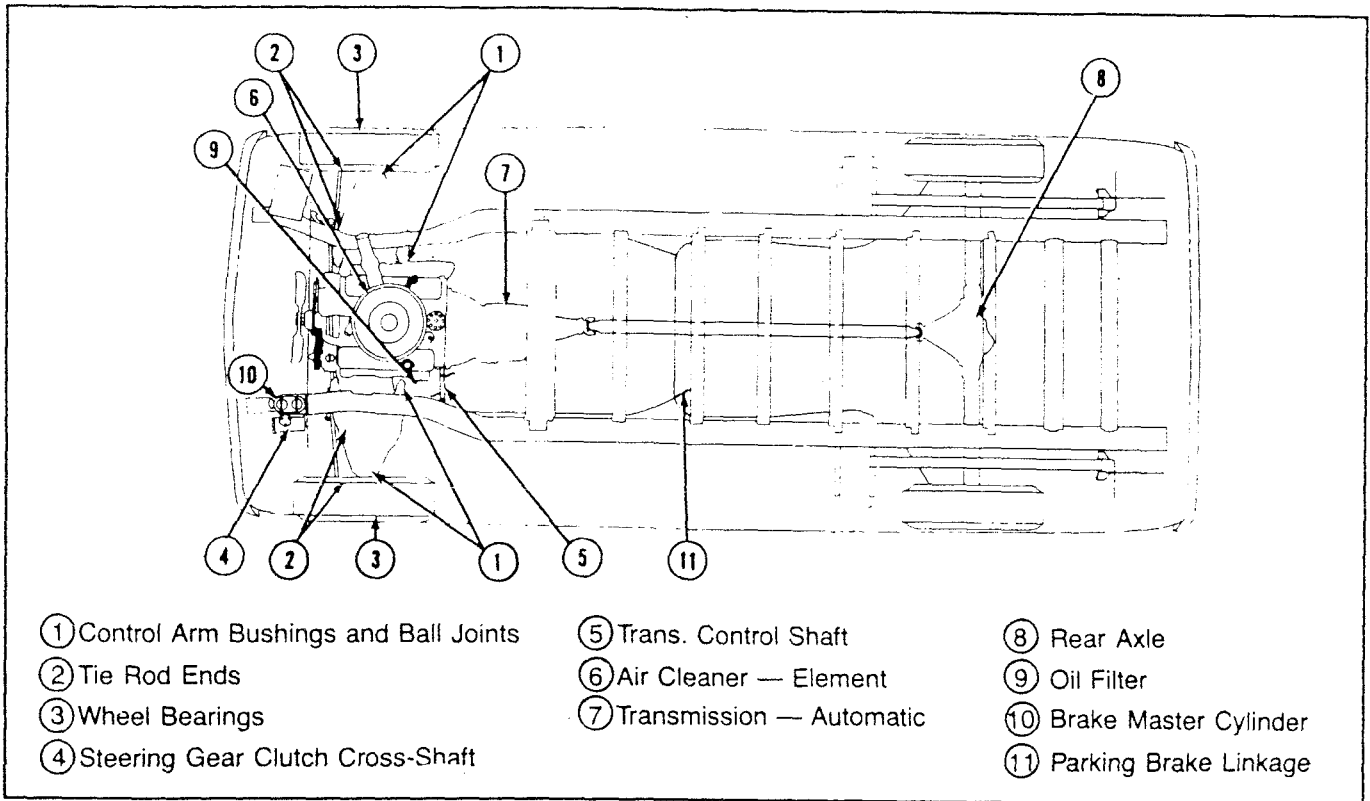


Figure 1-8 — Lubrication Points—G-Series

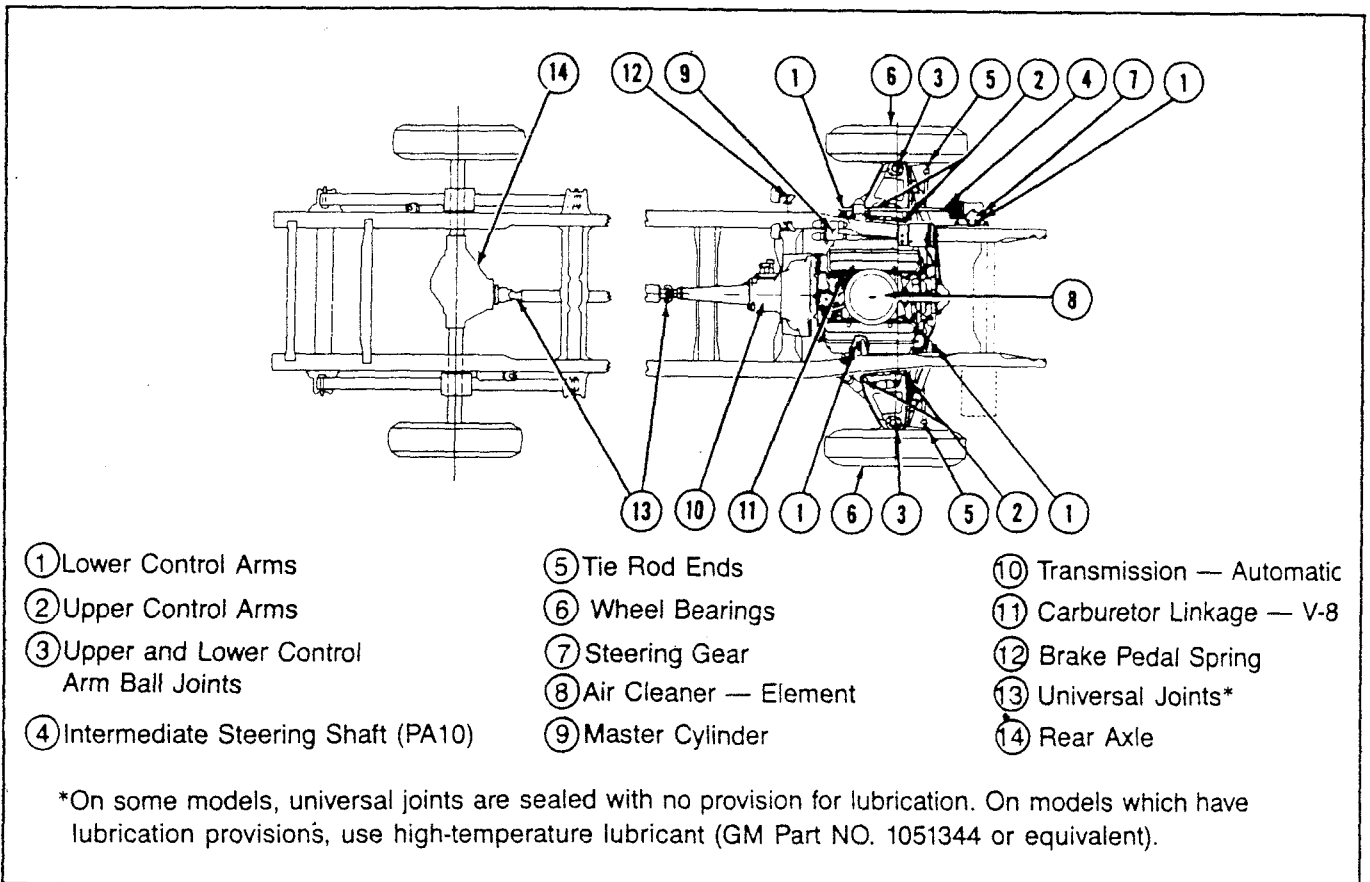


Figure 1-9 — Lubrication Points—P-Series

NOTE: THERE ARE EIGHT LUBRICATION FITTINGS
TYPICAL ON THE I-BEAM AXLE.

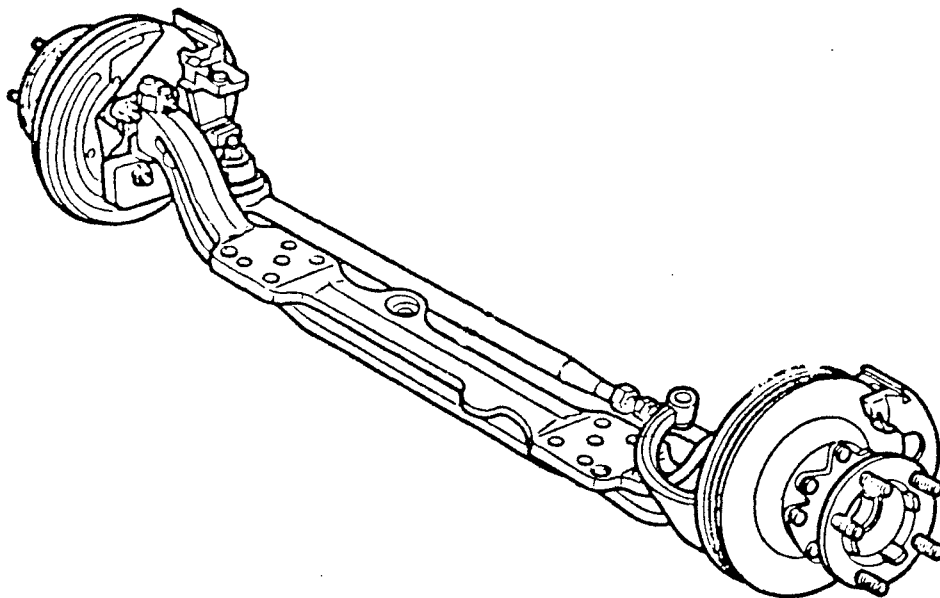


Figure 1-10 — Lubrication Points—P-Series with I-Beam Axle (Option #FS3)

SECTION 2 — HEATING AND AIR CONDITIONING HEATER SYSTEM

GENERAL DESCRIPTION

The heater system consists of a heater core housed in a case which, typically, includes an air inlet, blower motor assembly, air distribution ducts and doors to control the flow of air through the case. The configuration of G-Series and P-Series assemblies differ.

TROUBLESHOOTING THE SYSTEM

Problems of too little or no heat, poor air circulation, or inadequate defrosting action are sometimes encountered with a heater system.

The diagnosis chart (Figure 2-1) lists typical trouble symptoms, the probable causes, and what can be done to correct the conditions.

TROUBLE	CAUSE AND CORRECTION
Temperature of heater air at outlets too low to heat up passenger compartment.	1. Refer to Chevrolet 10-30 Series Shop Manual.
Temperature of heater air at outlets adequate but the vehicle will not build up sufficient heat.	Check for body leaks such as: 1. Floor side kick pad ventilators partially open. 2. Leaking grommets in dash. 3. Leaking welded seams along rocker panel and windshield. 4. Leaks through access holes and screw holes. 5. Leaking rubber molding around door and windows. 6. Leaks between sealing edge of blower and air inlet assembly and dash, and between sealing edge of heater distributor assembly and dash.
Inadequate defrosting action.	1. Check that DEFROST lever completely opens defroster door in DEF position — Adjust if necessary. 2. Assure that temperature and air doors open fully - Adjust. 3. Look for obstructions in defroster ducts - Remove any obstructions. 4. Check for air leak in duct between defroster outlet on heater assembly and defroster duct under instrument panel — Seal area as necessary. 5. Check position of bottom of nozzle to heater locating tab — Adjust. 6. Check position of defroster nozzle openings relative to instrument panel openings. Mounting tabs provide positive position if properly installed.
Inadequate circulation of heated air through vehicle.	1. Check heater air outlet for correct installation — Reinstall. 2. Inspect floor carpet to ensure that carpet lies flat under front seat and does not obstruct air flow under seat, and also inspect around outlet ducts to ensure that carpet is well fastened to floor to prevent cupping of air flow — Correct as necessary.
Erratic heater operation.	1. Check coolant level — Fill to proper level. 2. Check for kinked heater hoses — relieve kinks or replace hoses. 3. Check operation of all bowden cables and doors — Adjust as necessary. 4. Sediment in heater lines and radiator causing engine thermostat to stick open — flush system and clean or replace thermostat as necessary. 5. Partially plugged heater core — backflush core as necessary.
Hard-operating or broken controls.	1. Check for loose bowden cable tab screws or misadjusted bowden cables — Correct as required. 2. Check for sticking heater system door(s) — lubricate as required, using a silicone spray.

Figure 2-1 — Heater System Diagnosis

SECTION 2 — HEATING AND AIR CONDITIONING

AIR CONDITIONING

GENERAL DESCRIPTION

Two types of air conditioning systems are used in Chevrolet Motor Homes. For the G-Series, a blend-air system is used. This system combines both the heating and cooling functions in one unit. Cooling only is provided with the system used on the P-Series. The P-Series system is installed by the body manufacturer.

Both systems operate on the same basic principles of refrigeration. That is, a liquid refrigerant absorbs heat as it vaporizes, and loses heat as it condenses from a vapor back to a liquid. By varying the pressures within an air conditioning system, the refrigerant can be vaporized to absorb heat from inside the vehicle, and then condensed to release the heat to the outside atmosphere. System components include a compressor, condenser, expansion tube (G-Series) or a thermostatic expansion valve (P-Series), evaporator, and an accumulator or a receiver-dehydrator. In operation, the compressor produces the pressure which moves refrigerant through the system. Liquid refrigerant passing through the restriction of the expansion tube or valve changes into a vapor as it enters the low-pressure environment of the evaporator. (See Figure 2-1.)

As it changes to a vapor, it absorbs heat from the air being circulated around the evaporator. Suction created by the compressor draws the refrigerant vapor through the line from the evaporator. The vapor, which has been under low pressure, is pumped out of the compressor under high pressure. The high pressure in this part of the system is due to the expansion tube (or thermostatic expansion valve) which places a restriction in the line. As the high-pressure refrigerant vapor flows into the condenser, it changes to a liquid as it loses heat to the air flowing around the condenser. The liquid refrigerant flows through the line from the condenser to the expansion tube (or thermostatic expansion valve) to repeat the cycle.

System temperature is controlled by running the compressor intermittently, automatically turning it on and off as necessary to maintain proper temperatures. The compressor is started and stopped through the use of an electromagnetic clutch on the compressor pulley. The clutch is operated by a pressure-sensing switch (Pressure Cycling Switch—G-Series) or a temperature-sensing switch (Thermostatic Switch—P-Series).

In addition to the components described above, the air conditioning system is also equipped with either an accumulator (G-Series), or a receiver-dehydrator (P-Series).

RECEIVER-DEHYDRATOR

The receiver-dehydrator, mounted near the condenser, serves as a reservoir for storage of high-pressure liquid produced in the condenser. It incorporates a screen sack filled with the dehydrating agent.

The receiver-dehydrator, used primarily as a liquid storage tank, also functions to trap minute quantities of moisture and foreign material which may have remained in the system after installation or service operations. A refrigerant sight glass is built into the receiver-dehydrator to be used as a quick check of the state and condition of charge of the entire system.

ACCUMULATOR

The accumulator is located at the evaporator outlet. Its most important function is not to "accumulate" although this too is important. Its primary function is to separate any liquid retained in the vapor from the evaporator, retain the liquid and release the vapor to the compressor.

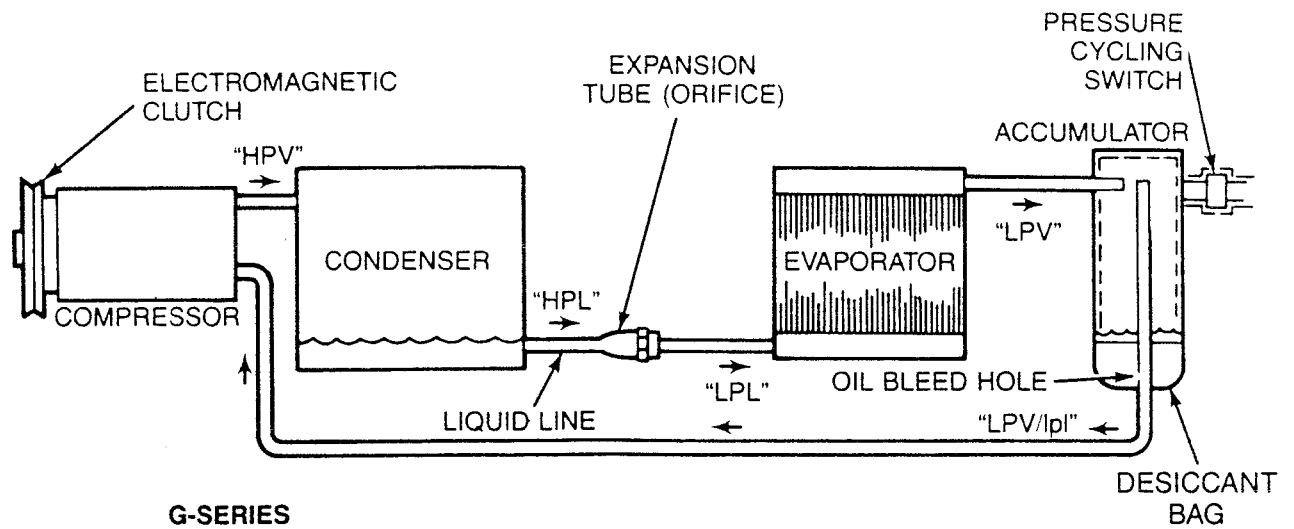
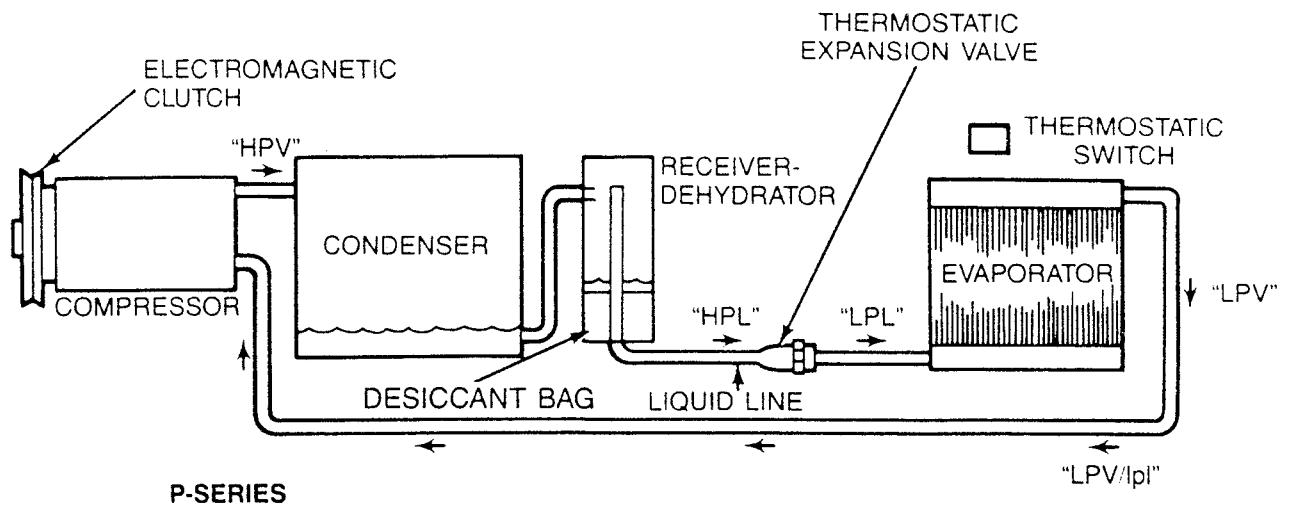
A bag of desiccant (dehydrating agent) is also located in the accumulator as a moisture-collecting device.

NOTE: If the refrigerant system has been opened—that is, exposed to the atmosphere—the desiccant may have absorbed a considerable amount of moisture. In such instances, the system must be evacuated before recharging. This process removes moisture from the system.

G-SERIES SYSTEM

Air, either outside air or recirculated air, enters the system and is forced through the system by the blower. As the air passes through the evaporator core, it receives maximum cooling if the air conditioning controls are calling for cooling. After leaving the evaporator, the air enters the heater and air conditioner selector duct assembly where, by means of diverter doors, it is caused to pass through or to bypass the heater core in the proportions necessary to provide the desired outlet temperature. Then conditioned air enters the vehicle through either the floor distributor duct or the dash outlets. During cooling operations, the air is cooled by the evaporator to below comfort level, it is then warmed by the heater to the desired temperature. During "heating only" operations, the evaporator will not be in operation and ambient air will be warmed to the desired level in the same manner.

The diverter doors which direct the air flow through this system are operated by the vacuum motors. The A/C control unit is positioned between the vacuum source and the motors to direct the application of vacuum as required.



HPV — HIGH-PRESSURE VAPOR
 HPL — HIGH-PRESSURE LIQUID
 LPV — LOW-PRESSURE VAPOR
 LPL — LOW-PRESSURE LIQUID

Figure 2-2 — Basic Air Conditioning System—Refrigeration Schematic

P-SERIES SYSTEM

This system performs the cooling functions only. When heating (above ambient temperatures) is desired, the vehicle heater must be used. When air conditioning is desired, the heater should be completely shut OFF.

This self-contained unit is bracket mounted to the dash by the motor home manufacturer. It operates on inside (recirculated) air only. Air is drawn into the unit, passed through the evaporator core (receiving maximum cooling) and then directed into the vehicle through adjustable outlets.

A thermostatic switch, located on the face plate is used to control compressor operation by sensing air temperature as it leaves the evaporator core.

MAINTENANCE AND INSPECTION

There are two sections to the air conditioning system. The first section includes the refrigeration components—compressor, condenser, evaporator, etc. The second section includes the air distribution components such as the blower, case assembly, diverter doors, vacuum lines and motors, etc.

Maintenance and inspection procedures are directed to each of these sections. Of course, for the P-Series, the air distribution section is quite simple and does not include the many components used in the G-Series.

REFRIGERATION SECTION

CAUTION: BECAUSE OF THE NATURE OF REFRIGERANT-12 AND THE HIGH PRESSURES WHICH ARE PRESENT IN THE REFRIGERANT SECTION OF THE SYSTEM, PERSONAL INJURY CAN RESULT IF ESTABLISHED DIAGNOSTIC AND SERVICE PROCEDURES ARE NOT FOLLOWED. THEREFORE, ALL SUCH WORK REQUIRED ON THE SYSTEM SHOULD BE REFERRED TO A QUALIFIED SHOP WITH THE NECESSARY TRAINED PERSONNEL AND EQUIPMENT.

THE FOLLOWING PROCEDURES ARE INTENDED TO IDENTIFY OR AVOID POTENTIAL PROBLEM CONDITIONS.

Inspection

Perform the following checks regularly:

1. Check outer surfaces of radiator and condenser cores to be sure they are not plugged with dirt, leaves or other foreign material. Be sure to check between the condenser and radiator as well as the outer surfaces.
2. Check the metal tubing lines to be sure they are free of dents or kinks which can cause a loss of system capacity due to a line restriction.
3. Check the flexible hose lines for brittleness or deterioration which could cause a system leak.
4. Check for proper drive-belt tension.

Operational Quick Checks

The following checks may indicate if the amount of refrigerant (charge) in the system is low. The ambient temperature must be above 70 °F.

NOTE: Engagement of the compressor clutch in both of the tests below indicates that the clutch electrical circuit is O.K. If the clutch does not engage, then check for a blown fuse, loose connections or damaged or deteriorated wires. If these checks are O.K., then the problem may be in the compressor clutch or switch. Take the vehicle to a qualified shop for further testing.

G-SERIES

1. Prepare the motor homes as follows:
 - Engine must be warm (CHOKE OPEN and OFF FAST IDLE SPEED CAM) and at normal idle speed.
 - Hood and body doors open.
 - Selector (mode) lever set at NORM.
 - Temperature lever at COLD.
 - Blower on HI.
2. With the compressor engaged, place your hand first on the evaporator inlet pipe (between the expansion orifice and evaporator), and then on the accumulator can surface (Figure 2-3).
 - The temperature should feel the same for both and somewhat cooler than the ambient temperature.
 - If the inlet pipe feels cooler than the accumulator surface, the system's refrigerant charge is probably low.

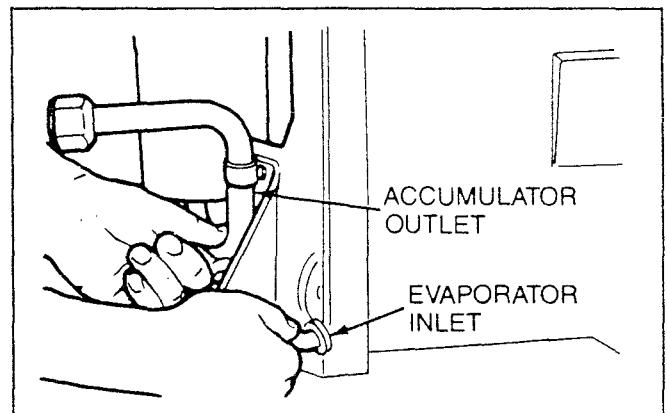


Figure 2-3 — Checking Evaporator Inlet and Accumulator Temperatures (G-Series)

P-SERIES (WITH SIGHT GLASS)

At temperatures higher than 70 °F, the sight glass may indicate whether the refrigerant charge is sufficient. A shortage of liquid refrigerant is indicated after about five minutes of compressor operation by the appearance of slow-moving bubbles (vapor) or a broken column of refrigerant under the glass. Continuous bubbles may appear in a properly charged system on a cool day. This is a normal situation. If the sight glass is generally clear and performance is satisfactory, occasional bubbles do not indicate a refrigerant shortage.

If the sight glass consistently shows foaming or a broken liquid column, it should be observed after partially blocking the air to the condenser. If under this condition the sight glass clears and the performance is otherwise satisfactory, the charge shall be considered adequate.

NOTE: The sight glass is located on or near the receiver-dehydrator.

AIR DISTRIBUTION SECTION

Electrical Circuit Diagnosis

The blower electrical circuit and motor are O.K. if the blower operates at all of the designated speeds. If the blower does not work at all, then check for a blown fuse, loose connections, and for damaged or deteriorated wires.

If these checks are O.K. and/or the blower does not operate at all speeds, then the problem may be in the switch, relay or motor. Take the vehicle to a qualified shop for further testing.

Vacuum System Diagnosis (G-Series)

If the air is not flowing through the proper outlets (floors, dash, or defroster), then there may be a problem in the vacuum system, or with the diverter doors. Check the doors to see that they operate properly and do not bind.

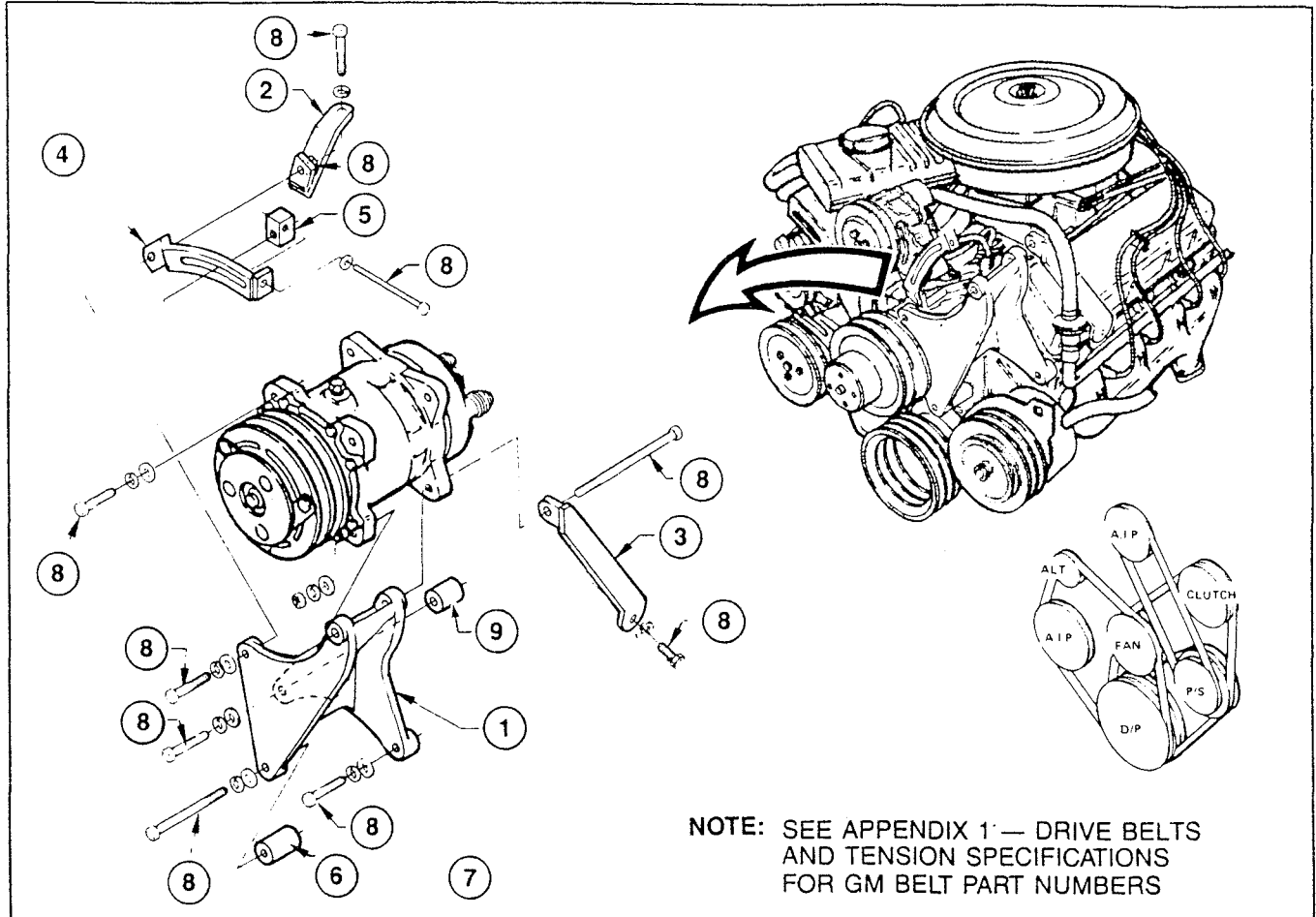
Next, check all vacuum hoses and connections between the vacuum source, A/C control and vacuum motors for leaks. If any hoses are damaged or deteriorated, they should be replaced. If the hoses are O.K., the problem may be in the control assembly or vacuum motor(s). Take the vehicle to a qualified shop for further testing.

HEATING AND AIR CONDITIONING

APPENDIX 2-1 — OPTIONAL AIR CONDITIONING SYSTEM

For 1986, at the request of several RV manufacturers, GM has made available the underhood portion of the air conditioning system as an available option — Number 7N4. GM can, as ordered, produce the engine mechanical air conditioning parts, as furnished by ARA Manufacturing Company, Grand Prairie, Texas.

The following illustrations and part number listings (both GM part numbers and corresponding ARA part numbers) are provided as an aid to the motor home owner concerning the installation and/or repair/replacement of air conditioning system option No. 7N4.



NOTE: SEE APPENDIX 1 — DRIVE BELTS AND TENSION SPECIFICATIONS FOR GM BELT PART NUMBERS

MOUNT AND DRIVE ASSEMBLY PARTS LIST

No.	ARA PART #	DESCRIPTION	QUANTITY	GM PART #
1	7045871	Compressor Mount	1	(14100871)
2	7045872	Compressor Mount Support	1	(14100872)
3	7045873	Compressor Brace	1	(14100873)
4	7045833	Compressor Adjusting Arm	1	(14100874)
5	7045824	Compressor Adjusting Block	1	(14100875)
6	5004112	Idler Spacer, 1-3/8" Long	1	(14100875)
7	1502902	Carton	1	
8	7004312	Bolt Kit. Consisting of: (1) 1/4" x 4" NC (All Thread) Bolt (2) 3/8" x 7/8" NC Bolt (3) 3/8" x 1-1/2" NC Bolt (3) 3/8" x 1-3/4" NC Bolt (1) 3/8" x 4-1/4" NC Bolt (1) 3/8" x 5-1/4" NC Bolt (1) 1/4" Flatwasher (8) 3/8" Lockwasher (6) 3/8" (SAE) Flatwasher (1) 3/8" NC Hex Nut	1	(14100875)
9	5001018	Idler Spacer, 9/16" Long (Required on vehicles with single Air Injection Pump)		

Compressor - #510 "Sanden" 0529165 (GM Part #15545619)
Clutch - 5-1/4" Diameter

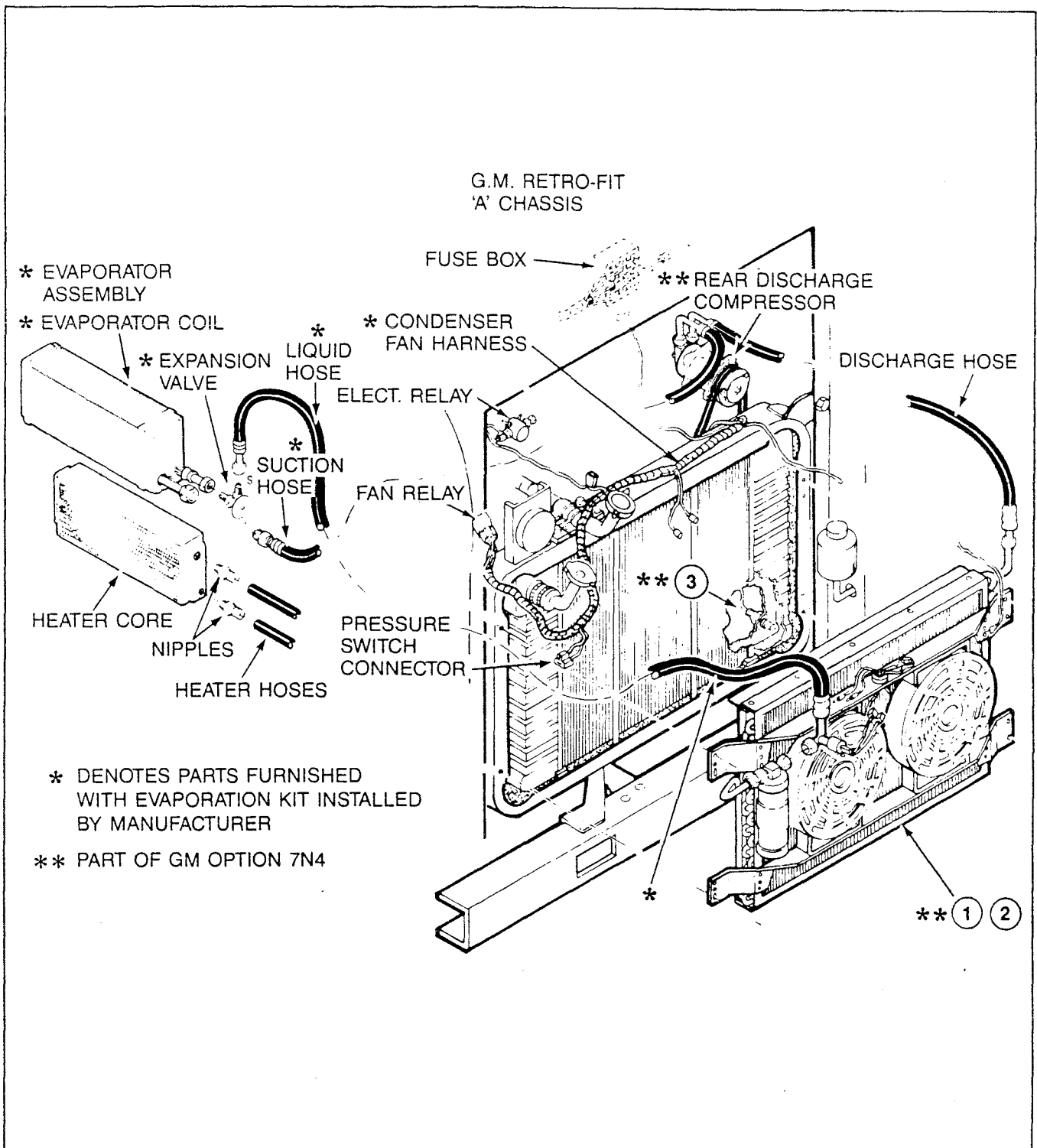
NOTE: The following parts are all listed under the GM Part #14100875:

Compressor Adjusting block
Idler Spacer, 1-2/8" Long

Bolt Kit, Consisting of:
(See Above Listing)

Figure A2-1-1 — Chevrolet Motor Home Chassis Compressor Assembly

APPENDIX 2-1 — OPTIONAL AIR CONDITIONING SYSTEM (CONT'D)

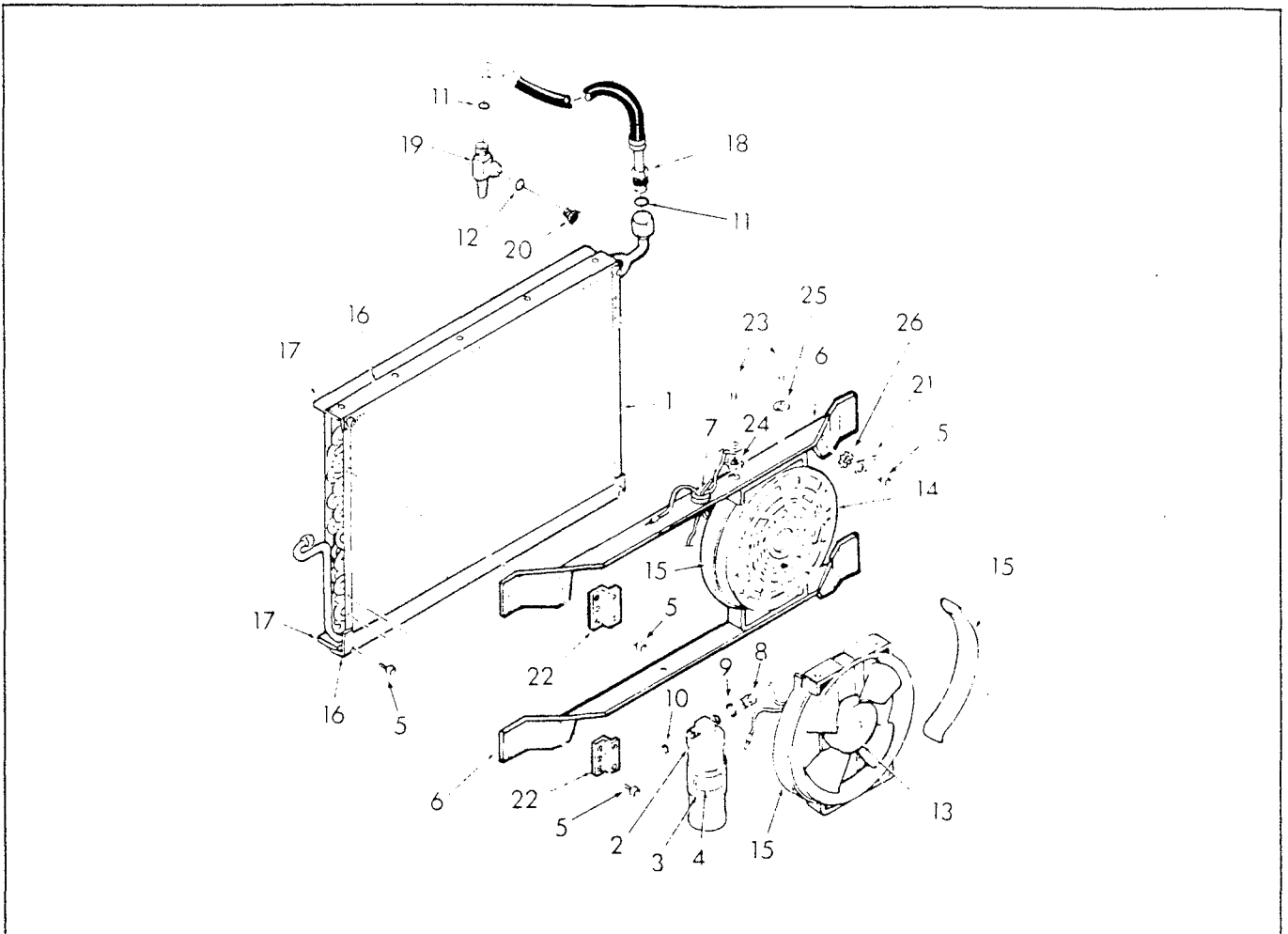


CONDENSER ASSEMBLY PARTS LIST

No.	ARA PART #	DESCRIPTION	QUANTITY	GM PART #
1	0519336	Condenser Assembly	1	(15545620)
2	0570689	Mounting Hardware, Consisting of:		
	0021202	Screw, #14 x 3/4 HWH Z/P D/P	10	
3	0884940	Switch, Coolant Temperature	1	(15545621)

Figure A2-1-2 Chevrolet Motor Home Chassis Condenser Assembly

APPENDIX 2-1 — OPTIONAL AIR CONDITIONING SYSTEM (CONT'D)



CONDENSER KIT PARTS LIST

No.	ARA PART #	DESCRIPTION	QUANTITY	GM PART #
1	0519369	Coil Condenser	1	(15547181)
2	1273235	Receiver-Drier	1	(15547182)
3	0319606	Bracket, Mounting Receiver-Drier	1	(15547188)
4	1900157	Sticker, Caution	1	(N.S.)
5	0039851	Screw, #8 x 1/2 HWH	20	
6	0319647	Bracket, Condenser Mounting	2	(15547189)
7	0996400	Grommet-Condenser Mt Brkt Ground Wire	1	(15547190)
8	0058337	Coupling-Receiver Drier	1	(15547183)
9	0543513	'O' Ring-Receiver Drier Outlet	1	(15547184)
10	0059605	'O' Ring #6-Receiver Drier Inlet	1	(15547185)
11	0059606	'O' Ring #8-Discharge Valve Hose	2	(15547186)
12	0059706	'O' Ring #10-Discharge Valve Cap	1	(15547187)
13	0964045	Condenser Fan Assy.	2	(15547191)
14	1701620	Guard, Fan	2	(15547193)
15	1016434	Seal, Condenser Fan	4	(15547194)
16	0319387	Bracket, Condenser Seal Mounting	2	(15547195)
17	1016433	Seal, Condenser to Radiator	2	(15547196)
18	0986195	Hose, Discharge #8	1	(15547198)
19	0548325	Service Valve, Discharge	1	(15547199)
20	0049849	Cap, Aluminum	1	(15547200)
21	0876802	Terminal, Adapter	1	(15547197)
22	0319563	Bracket, Adapter	2	(15547669)
23	0039852	Bolt, 1/4-20 x 5/8" HH Z/P	8	
24	0039853	Lockwasher, Star 1/4" Z/P	1	
25	0039855	Lockwasher, 1/4" Z/P	7	
26	0039854	Starwasher #10	1	

Figure A2-1-3 Condenser Kit

SECTION 3 — STEERING, SUSPENSION, WHEELS AND TIRES

FRONT ALIGNMENT

GENERAL DESCRIPTION

The term "front alignment" refers to the angular relationships between the front wheels, the front suspension attaching parts and the ground.

The pointing in or "toe-in" of the front wheels, the tilt of the front wheels from vertical (when viewed from the front of the vehicle) and the tilt of the suspension members from vertical (when viewed from the side of the vehicle), are all involved in front alignment.

CASTER

Caster is the tilting of the front steering axis either forward or backward from the vertical (when viewed from the side of the vehicle). A backward tilt is said to be positive (+) and a forward tilt is said to be negative (-). (See Figure 3-1.)

CAMBER

Camber is the tilting of the front wheels from the vertical

when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is said to be positive (+). When the wheels tilt inward at the top, the camber is said to be negative (-). The amount of tilt is measured in degrees from the vertical and this measurement is called the camber angle. (See Figure 3-1.)

TOE-IN

Toe-in is the turning in of the front wheels. The actual amount of toe-in is normally only a fraction of an inch. The purpose of a toe specification is to ensure parallel rolling of the front wheels. (See Figure 3-1.)

Toe-in also serves to offset the small deflections of the wheel support system which occur when the vehicle is rolling forward. In other words, even when the wheels are set to toe-in slightly when the vehicle is standing still, they tend to roll parallel on the road when the vehicle is moving. It should be noted that excessive toe-in or toe-out will cause tire wear.

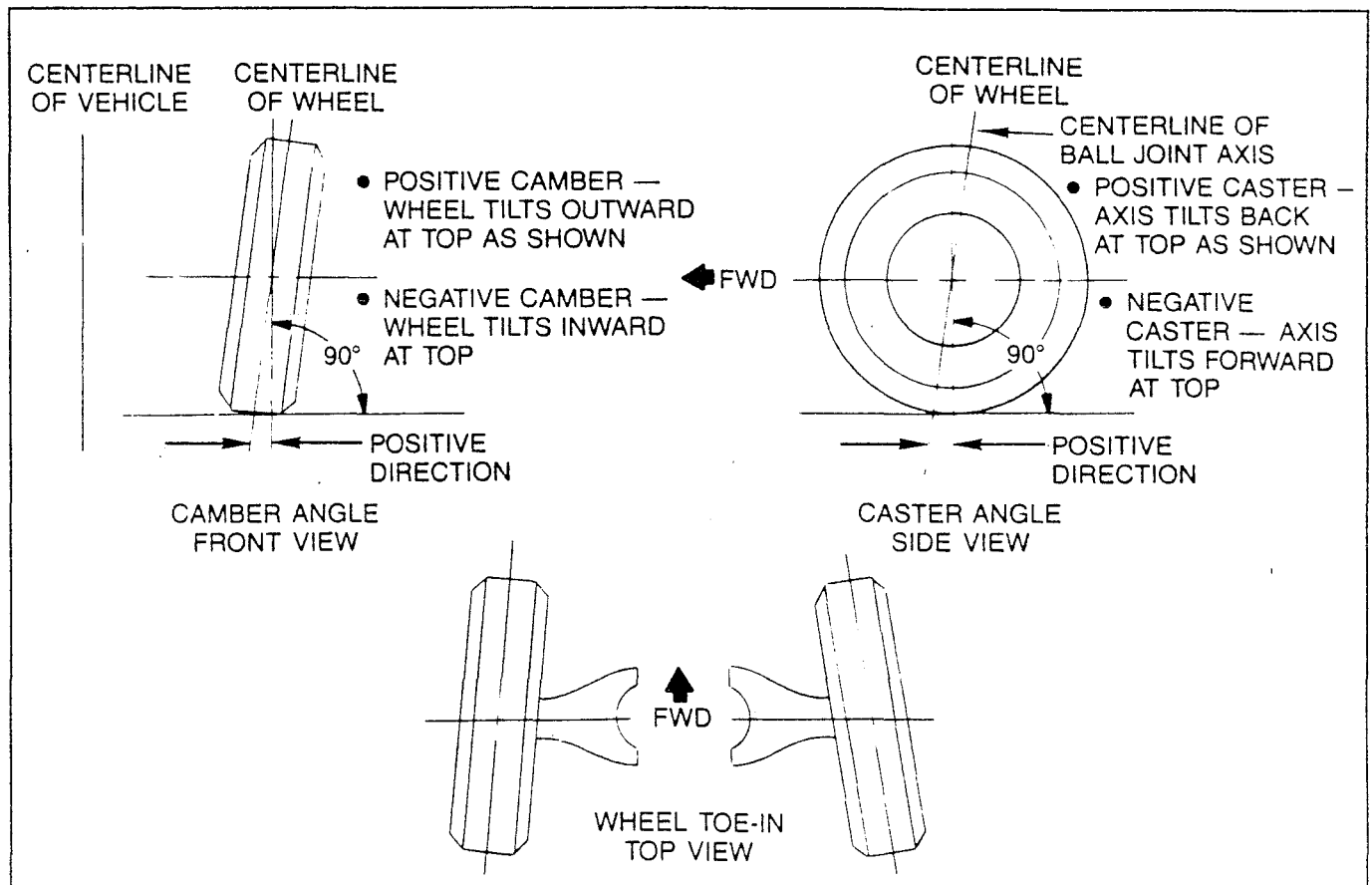


Figure 3-1 — Caster, Camber and Toe-in

MAINTENANCE AND INSPECTION

There are several factors which can affect front alignment. These factors include tire inflation pressures, the condition of wheel bearings, steering and suspension components. They are the basis for the following checks which can indicate problems that should be corrected.

1. Check all tires for proper inflation pressures and approximately the same tread wear.
2. Check front wheel bearings for looseness.
3. Check for looseness of ball joints, tie rod ends and steering relay rods and damper.
4. Check for excessive run-out of wheels and tires.
5. Check for a difference in the ride height between right and left sides of the vehicle. (See Figure 3-2.)

NOTE: Excessive or unevenly distributed loads also affect ride height and alignment. This should be taken into consideration when making the check. Also, if the motor home is equipped with air bag cylinders, it is important that the cylinders be inflated to the proper pressure for the load being carried, in order to maintain adequate ride height. (See Air Bag Cylinder Inspection information in the Suspension section of this manual.)

6. Check for steering gear looseness at frame.
7. Check for improperly operating shock absorbers. There may be evidence of a leaking shock(s).
8. Check for loose control arms.

CHECK RIDE HEIGHT MEASUREMENT (DIMENSION A) BETWEEN BRACKET AND CROSS MEMBER FLANGE. MEASUREMENT MUST BE PERPENDICULAR TO CROSS MEMBER FLANGE. MEASUREMENT IS "IRON TO IRON". RUBBER BUMPER IS NOT INCLUDED.

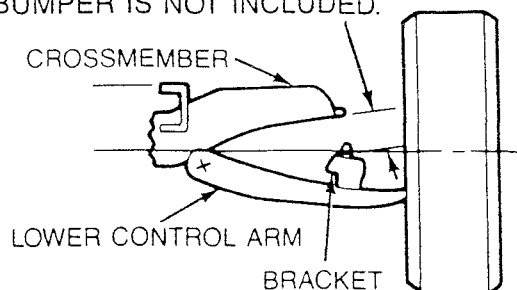


Figure 3-2 — Ride Height Measurement

9. Check for loose or missing stabilizer bar attachments.
10. Steering and vibration complaints are not always the result of improper alignment. An additional item to be checked is the possibility of tire lead due to worn or improperly manufactured tires. "Lead" is the deviation of the vehicle from a straight path on a level road without hand pressure on the steering wheel.

ALIGNMENT CHECK

The caster, camber and toe-in specifications for both the G- and P-Series chassis are shown in Figure 3-3. The caster specifications will vary depending on the ride height measurement (Dimension "A") shown in Figure 3-2. Dimension "A" is also affected by rear axle imbalance of weight (left to right). See Rear Suspension section of this manual for further information.

WHEEL ALIGNMENT SPECIFICATIONS — CASTER

DIMENSION "A"

(IN.)	1-1/2	1-3/4	2	2-1/4	2-1/2	2-3/4	3	3-1/4	3-1/2	3-3/4	4	4-1/4	4-1/2	4-3/4	5
G-10, 20	3-1/2°	3-1/4°	3°	3°	2-3/4°		2-1/2°	2-1/4°	2°	2°	1-3/4°	1-1/2°			
G-30	2-3/4°	2-1/2°	2-1/4°	2°	1-1/2°		1°	3/4°	1/2°	1/4°	0°	-1/4°			
P-20, 30			3°	2-1/2°	2-1/4°	2°	1-3/4°	1-1/2°	1-1/4°	1°	1/2°	1/2°	1/4°	0°	
MOTOR HOME (32)					5-1/2°	5-1/4°	5°	4-3/4°	4-1/2°	4°	3-3/4°	3-1/2°	3-1/4°	3°	3°

MODEL	CAMBER	TOE-IN (IN.)
G10, 20	.5°	3/16
G30	.2°	3/16
MOTORHOME (32)	.2°	5/16

Figure 3-3 — Alignment Specifications

I-BEAM AXLE (OPTION FS3)

TOE-IN (IN.)	3/16 ± 1/16
CASTER*	+2-1/2° ± 1/2°
CAMBER	+1-1/2° ± 1/2°
KING PIN INCLINATION (NOT ADJUSTABLE)	7° 10"

* Refer to Frame Angle Measurement Information in this section of the manual for correction to caster procedure.

Another factor which will affect the caster measurement is the frame angle (Figure 3-4). Frame angle should be taken into account when determining the proper caster setting.

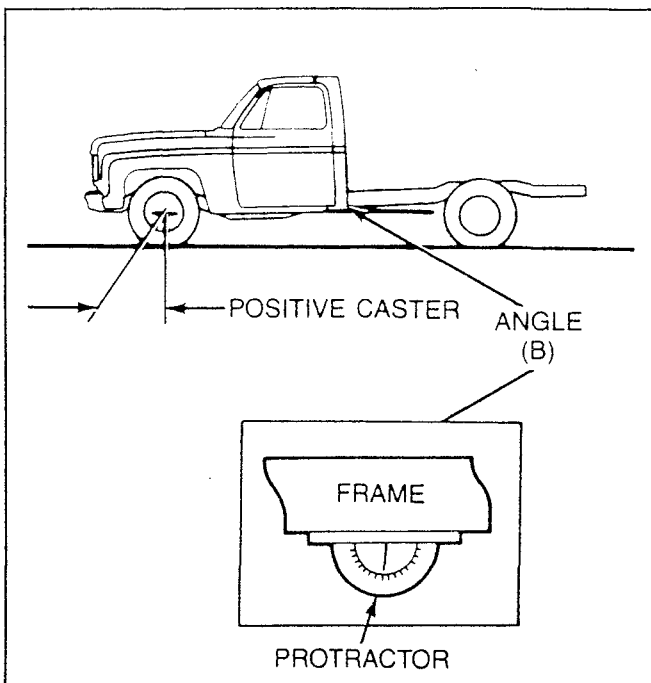


Figure 3-4 — Frame Angle Measurement

FRAME ANGLE MEASUREMENT

To determine the frame angle:

1. Park the motor home on a level surface.
2. Place a protractor with a level gage against the bottom of a straight section of the frame rail near the chassis midpoint.
3. Determine the angle the frame rail slopes from level.

NOTE: Determine if the truck has either an up-in-rear measurement or down-in-rear measurement.

4. Determine the caster setting following the procedures in the appropriate shop manual.
5. Compute the actual caster setting from the frame angle and caster measurement taken as follows:

- (a) A **down-in-rear** frame angle must be added to a **positive** caster specification.
- (b) An **up-in-rear** frame angle must be subtracted from a **positive** caster specification.
- (c) A **down-in-rear** frame angle must be subtracted from a **negative** caster specification.
- (d) An **up-in-rear** frame angle must be added to a **negative** caster specification.

LOWER BALL JOINT INSPECTION

Lower ball joints are a loose fit when not connected to the steering knuckle. Wear may be checked without disassembling the ball stud, as follows:

1. Support weight of control arms at wheel hub and drum.
2. Accurately measure distance between tip of ball stud and tip of grease fitting below ball joint.
3. Move support to control arm to allow wheel hub and drum to hang free. Measure distance as in Step 2. If the difference in measurements exceeds 2.38 mm (.094 or 3/32 inch) for all models, the ball joint is worn and should be replaced. (See Figure 3-5.)

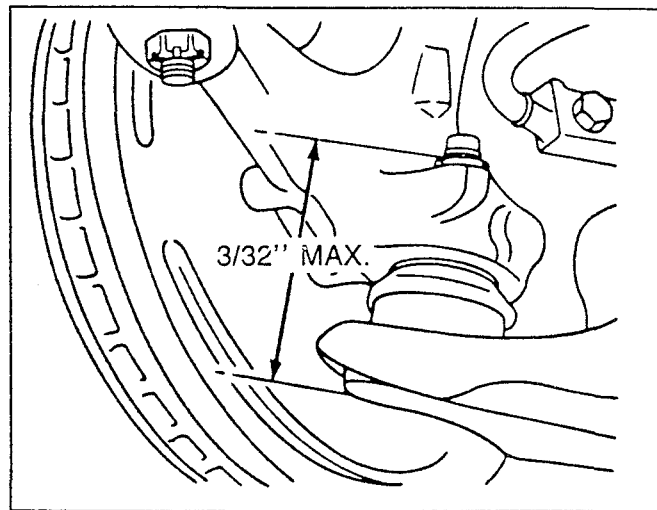


Figure 3-5 — Lower Ball Joint Check

SECTION 3—STEERING, SUSPENSION, WHEELS AND TIRES

STEERING SYSTEM

The steering system consists of the steering linkage, steering gear, and the steering column and wheels. Vehicle direction is controlled from the steering wheel. Rotating the steering wheel rotates the input shaft (wormshaft) on the steering gear by means of a shaft in the steering column. Rotation of the wormshaft transfers this motion to the output shaft of the steering gear. The output shaft of the gear controls the directional position of the front wheels (right or left depending on input) through a series of arms or levers referred to as the steering linkage. A damper incorporated into the linkage helps to control the road shock transmitted to the linkage from the wheels.

STEERING LINKAGE GENERAL DESCRIPTION

The steering linkage is located forward of the front crossmember. The P-Series linkage is illustrated in Figure 3-6. Steering effort is transmitted to left- and right-hand adjustable tie rods through a relay rod. The relay rod is connected to an idler arm on the right and to the pitman arm on the left.

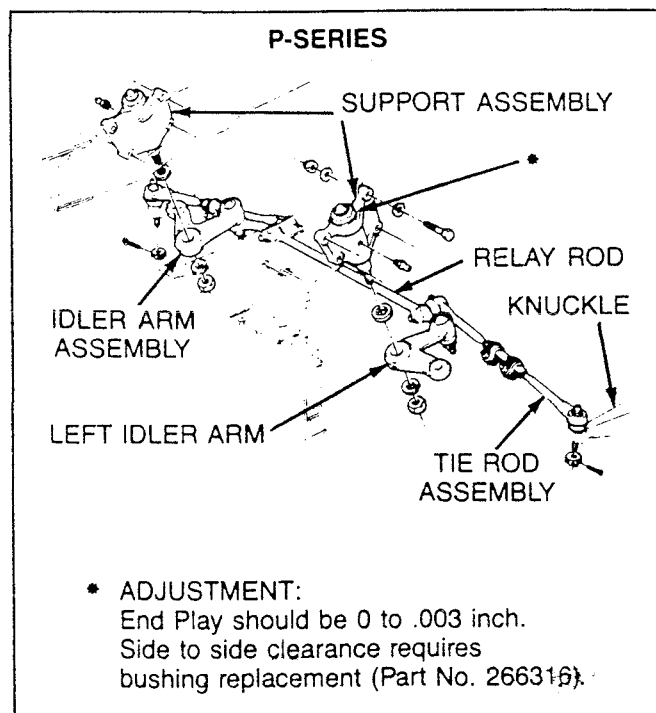


Figure 3-6—Steering Linkage

MAINTENANCE AND INSPECTION LUBRICATION OF STEERING LINKAGE

The steering linkage under normal conditions should be lubricated with any water-resistant EP-type chassis lubricant every 7,500 miles or six months, whichever occurs first. Lubricate every 3,000 miles or two months whichever occurs first when operating in dusty or muddy conditions, or if the vehicle is used "off-road."

STEERING LINKAGE, SUPPORT ASSEMBLIES (P-SERIES)

The fit of the shafts in the linkage support assemblies (Figure 3-6) should be tight with end play not exceeding .003 inch. Check the end play. If the end play exceeds .003 inch in either assembly, adjust it to within 0 to .003 inch. If there is side play, replace the bushings (GM Part No. 266316) in the affected assembly.

STEERING DAMPER CHECK

The type of steering damper shown in Figure 3-7 is nonadjustable, nonrefillable and is not repairable. At each lubrication interval, perform Check No. 1 and No. 2 on the steering damper system.

Check 1

Check the damper attachments to be sure they are properly and securely installed. (Tighten, if loose.) The damper assembly should be replaced if the rubber bushings are badly worn.

Check 2

Inspect the damper for evidence of fluid leakage. A light film of fluid is permissible on the body of the damper near the shaft seal. A dripping damper should be replaced.

Check 3

Turn the steering wheel so as to extend the piston rod from the damper body. If the piston rod is rusted badly, replace the damper. If rust is light, clean the rod. Use care so that the rod surface is not damaged.

NOTE: On vehicles left in long-term storage, the piston rod may become quite rusted. The rod must be cleaned before the vehicle is moved. Failure to clean the rod will destroy the seals with the first inward movement of the rod—making replacement of the damper a certainty.

If the damper is not functioning properly, and/or is noisy, refer to a qualified service shop.

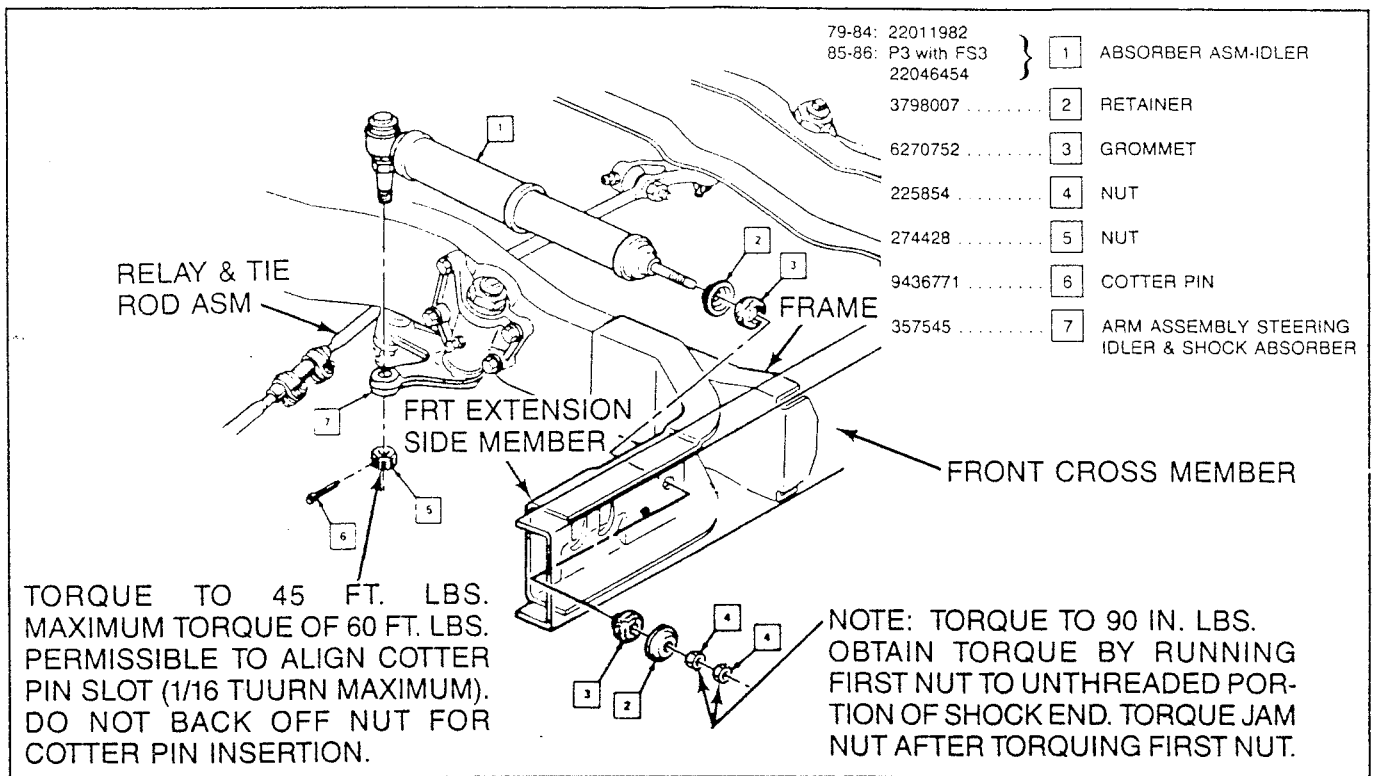


Figure 3-7 — Steering Damper

POWER STEERING SYSTEM GENERAL DESCRIPTION

The optional power-assist steering utilizes the steering column and linkage previously described. However, the steering gear is different. It combines hydraulic pressure with the mechanical force of a manual steering system to reduce the steering effort required. In addition to a redesigned steering gear, the system requires a pump with pressure and return hoses connecting it to the steering gear. The pump, driven by a belt from the crankshaft, circulates the hydraulic fluid through the steering gear. Valves in the steering gear which are controlled by the steering wheel direct the flow of fluid as appropriate for right or left vehicle turns.

The steering gear is of the recirculating-ball-type. This gear provides for ease of handling by transmitting forces from the wormshaft to the pitman shaft through the use of ball bearings in the same way as the manual steering gear.

MAINTENANCE AND INSPECTION

Complaints of faulty steering are frequently the result of problems other than the steering gear or pump. Those areas of the steering system which can be easily checked and quickly corrected without disassembly and overhaul of any major components should be attempted first.

Conditions such as hard or loose steering, road shock or vibrations are not always due to the steering gear or pump, but are often related instead to such factors as low tire pressure and front-end alignment. These factors should be checked and corrected before any adjustment or

disassembly of the power steering gear or pump is attempted.

Many factors affect power operation of the steering system of which the most common are:

1. Fluid level and condition.
2. Drive belt tension.
3. Loose component mountings.
4. Loose pump pulley.
5. Excess front axle weight

These factors must be checked and corrected before making any further diagnosis of the steering system.

After the source of the problem has been found, determine the cause. For example, if the oil level in the reservoir is found to be low, refill and check the entire hydraulic system for oil leaks. Refilling the reservoir will not necessarily correct the problem.

HARD STEERING AT ENGINE IDLE

The P-Series motor home power steering assist system is designed for good response up to the 5,000-lb. suspension capacity. GM cannot endorse overloading. To avoid problems concerning overloading, move some load rearward to remove some of the weight from the front axle. Axle weight should never exceed tire or axle capacity. Refer to the proper shop manual for the power steering pump pressure checking procedures.

NOTE: Typical P-Series—Commercial power steering pump pressure is 1,200-1,300 PSI. Typical P-Series—Motor home power steering pump pressure is 1,350-1,450 PSI.

LEAKAGE CHECK

If you suspect leakage in the power steering system, follow the guidelines listed below. In some cases you will be able to locate the leak easily, but seepage leaks may be more difficult.

1. With the vehicle's engine off, wipe the complete power steering system dry (gear, pump, hoses, and connections).

2. Check oil level in pump's reservoir and adjust as required.
3. Start engine and turn steering wheel from stop to stop several times. Do not hold in corner for any length of time as this can damage the power steering pump. It is easier if someone else operates the steering wheel while you search for the seepage.
4. Find the exact area of leakage. Potential leak points are shown in Figure 3-8.

Some leaks can be corrected easily (see Quick Fixes). Refer the problem of more extensive leaks to a qualified serviceman for repair.

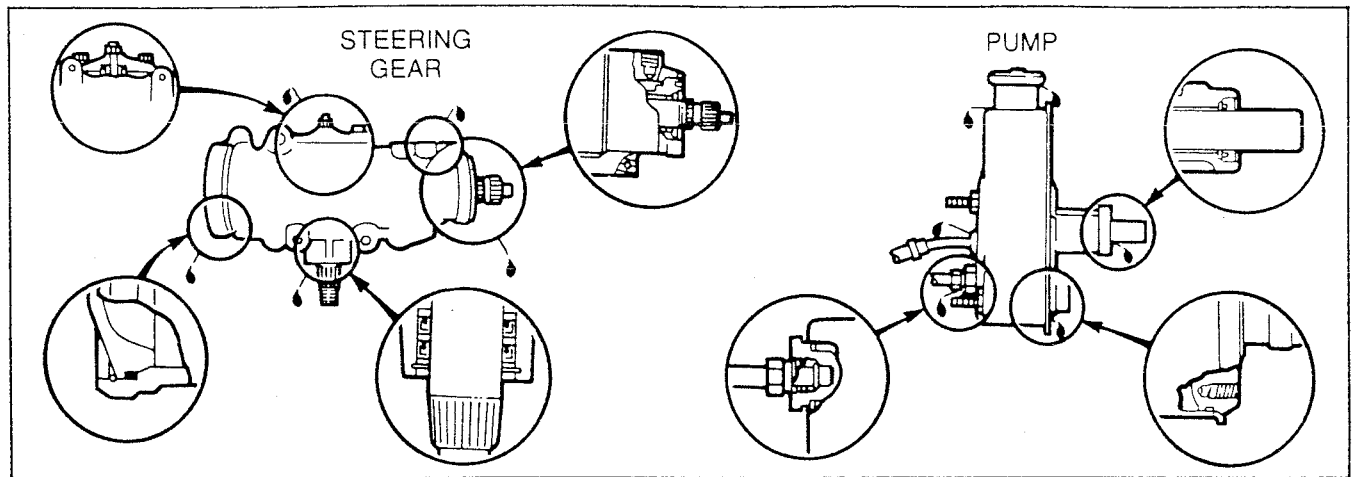


Figure 3-8 — Power Steering Pump Gear Box Leak Points

QUICK FIXES

The purpose of this section is to acquaint you with the types of leakage which can be repaired very easily. It contains information on reservoir oil level, the hoses and the hose connections.

An overfilled pump reservoir can be a cause for leakage complaint. The oil in the steering system expands as heated during normal usage. If overfilled, the excess is forced through the breather cap hole and may be sprayed over the engine by air blast. Operate the engine and steering system until normal operating temperature is obtained. Remove the reservoir cap and check the graduated level on the dipstick. Adjust the oil level as required.

Seepage at the hose connections can be a cause for leakage complaint and can be due to loose connection nuts. If leakage is observed at the hose connections, and the nut is not cross threaded, tighten the nuts at the gear to 30 ft. lbs. of torque.

The nut at the power steering pump should be tightened to 40 ft. lbs. of torque. If tightening to this torque does not stop the leak, refer to the diagnostic chart.

If either the return hose or pressure hose leaks, replace the hose.

After the source of a leak has been found and corrected,

refill the system with GM Power Steering Fluid (GM Part No. 1050017—quart size) or equivalent. Avoid the use of automatic transmission fluid in the power steering system since it does not contain the additives necessary for good seal life. In an emergency situation, automatic transmission fluid can be used to "get home." However, it should be replaced with power steering fluid as soon as is practical.

Component Replacement

Lip seals, which seal rotating shafts, require special treatment. This type of seal is used on the steering gear at the pitman shaft, at the stud shaft, and on the drive shaft of the pump. When leakage occurs in one of these areas, refer the problem to a qualified serviceman for repair.

PUMP BELT TENSION ADJUSTMENT

1. Loosen pivot bolt and pump brace adjusting nuts. (See Figure 3-9.)

NOTE: Do not move pump by prying against reservoir or by pulling on filler neck, or damage to the pump could occur.

2. Move pump, with belt in place until belt is tensioned to the specifications. (See Appendix 1—Drive Belts and Tension Specifications at the back of this manual.)
3. Tighten the pump brace adjusting nut. Then tighten the pivot bolt nuts.

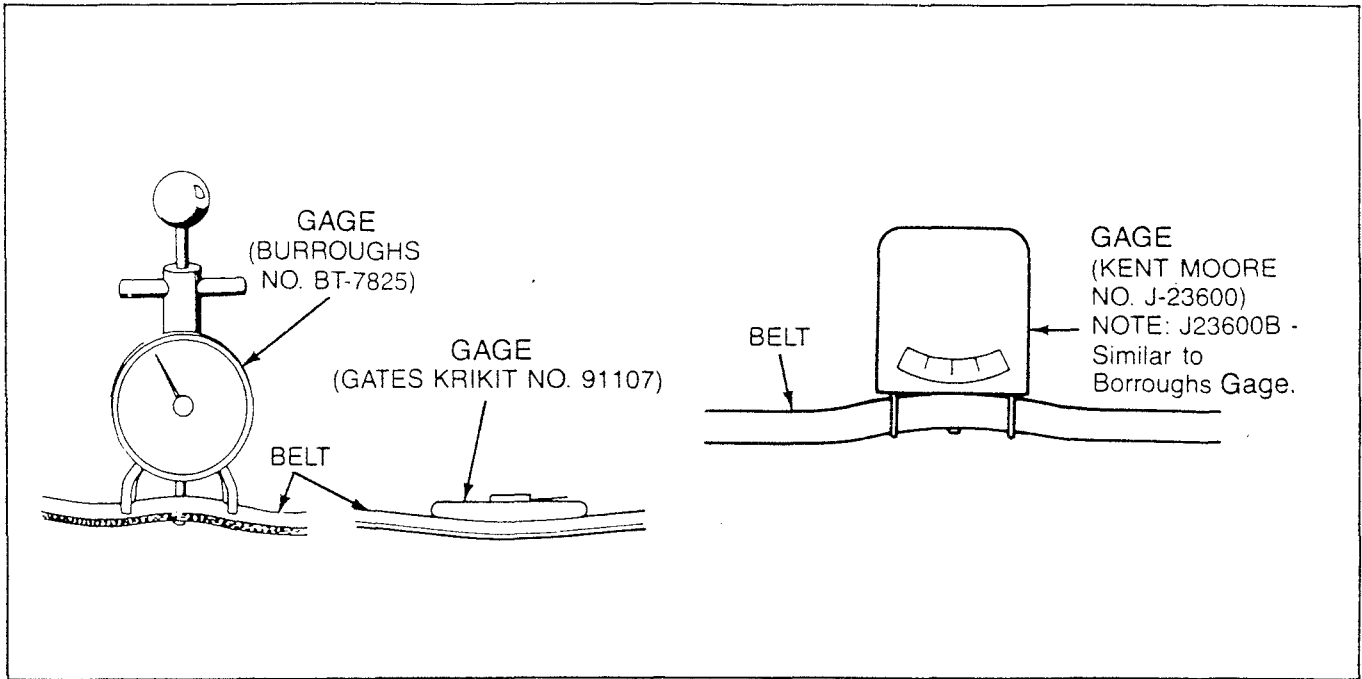


Figure 3-9 — Belt Tension Adjustment

SECTION 3 — STEERING, SUSPENSION, WHEELS AND TIRES

SUSPENSION SYSTEM

The function of the suspension system is to support the vehicle body and chassis over the tires and wheels, and to absorb and cushion road shock. The springs in the suspension cushion the ride while the shock absorbers dampen or control the excess motion (up-and-down bounce) caused by variations in the road surface. The designs of the front and rear suspensions are different, but their function is the same.

FRONT SUSPENSION GENERAL DESCRIPTION

The G- and P-Series vehicles incorporate an independent coil spring front suspension system, as shown in Figure 3-10. The control arms are of unequal length (S.L.A. Type).

This suspension system consists of upper and lower control arms pivoting on steel threaded or rubber bushings on upper and lower control arm shafts. The lower control arms are attached to the crossmember. The upper control arms are attached to a frame bracket. These control arms are connected to the steering knuckle through pivoting ball joints.

A coil spring is located between the lower control arm and a formed seat in the suspension crossmember, thus the lower control arm is the load-carrying member. Double-acting shock absorbers are also attached to the lower control arms and connect with the frame to the rear on the upper end. The front wheel bearings are tapered roller type and are used on all models.

Some P-Series motor homes may be equipped with air bag cylinders to increase the load-carrying capacity of the front suspension. These cylinders are positioned in the center of the coil springs.

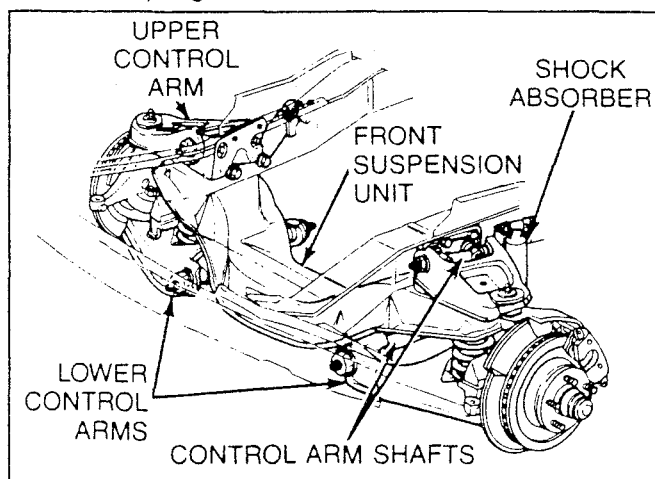


Figure 3-10 — Independent Front Suspension—Typical

MAINTENANCE AND INSPECTION

The front suspension must be lubricated periodically in accordance with the Maintenance Schedule. Grease fittings are indicated in the Lubrication section of this manual.

When the suspension is being lubricated, the components should also be checked for obvious signs of damage or wear. Leakage from the shock absorbers may indicate a need for replacement.

WHEEL BEARING LUBRICATION

As a part of normal service, the front wheel bearings should be removed, cleaned, inspected and lubricated each 12,000 miles. Repack the wheel bearings with high-temperature melting grease — approximately 500 °F (GM Part No. 1051344 or equivalent). Refer to the appropriate Chevrolet Light-Duty Truck Shop Manual for the procedure.

WHEEL BEARING ADJUSTMENT CHECK

NOTE: Tapered roller bearings are used on all series vehicles and they have a slightly loose feel when properly adjusted. A design feature of front-wheel tapered roller bearings is that they must NEVER be preloaded. Damage can result by the steady thrust on roller ends which comes from preloading.

1. Raise the vehicle and support it at the front lower control arm.
2. Spin the wheel to check for any unusual noise or roughness.
3. If the bearings are noisy, tight, or excessively loose, they should be removed, cleaned, inspected and lubricated prior to adjustment. If it is necessary to inspect bearings, refer to the appropriate Chevrolet Light-Duty Truck Shop Manual.

To check for tight or loose bearings, grip the tire at the top and bottom and move the wheel assembly in and out on the spindle. Measure movement of hub assembly, if movement is less than .001 inch or greater than .005 inch, adjust bearings per the following adjustment procedure.

WHEEL BEARING ADJUSTMENT

1. Remove the hub cap or wheel disc from the wheel.
2. Remove the dust cap from the hub.
3. Remove the cotter pin from the spindle and spindle nut.

4. Tighten the spindle nut to 12 ft. lbs. while turning the wheel assembly forward by hand to fully seat the bearings. This will remove any grease which could cause excessive wheel bearing play later. Refer to Figure 3-11.
5. Back off the nut to the "just loose" position.
6. Hand tighten the spindle nut. Loosen the spindle nut until either hole in the spindle lines up with a slot in the nut (not more than 1/2 flat).
7. Install the new cotter pin. Bend the ends of the cotter pin against the nut. Cut off the extra length to ensure that the ends will not interfere with the dust cap.
8. Measure the looseness in the hub assembly. There will be from .001 to .005 inch end play when properly adjusted.
9. Install the dust cap on the hub.
10. Replace the wheel cover or hub cap.
11. Lower the vehicle to the ground.

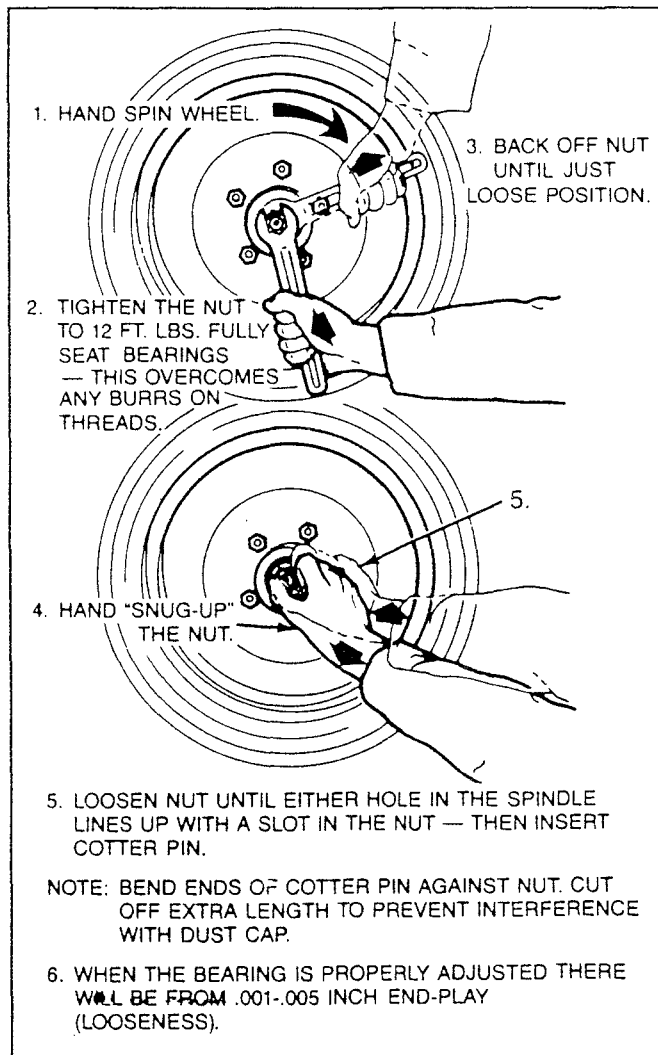


Figure 3-11 — Wheel Bearing Adjustment

12. Perform the same operation for each front wheel.

AIR BAG CYLINDER INSPECTION

The air bag cylinders (Replacement Part No. 367762) should be inspected periodically for signs of deterioration or damage. Inflation pressures should be maintained at 10 PSI minimum to avoid chafing. Under load, 40-50 PSI is recommended for a 4,300-lb. suspension, and 50 PSI for a 5,000-lb. suspension.

SERVICE TIP— (For units that appear somewhat low in front due to operating at near front suspension capacity)

1. Jack up the motor home by the middle of the front crossmember and allow the wheels to hang.
2. Remove the air from the airbag and reinflate the airbag to 50 PSI.
3. Lower the unit and bleed off air (as necessary) to maintain airbag pressure of 50 PSI.

This may provide some ride height improvement as the airbag tends to stretch lengthwise slightly with this procedure.

SHOCK ABSORBER DIAGNOSIS

(Follow the Procedures Outlined Below in the Order Indicated.)

Inspection and Ride Test:

TIRE PRESSURE—Check the tire pressure and compare it to the recommended specification. Adjust the pressure to specification as required. Poor vehicle control and ride complaint are caused in many cases by improper tire inflation.

SPECIAL SUSPENSION EQUIPMENT—Check the Service Parts Identification Sticker for any special suspension equipment, such as a heavy-duty suspension. Vehicles equipped with this type of option have a somewhat stiffer or harsh ride, and this should be kept in mind during the following test. Stiffness may occur while vehicle is still new (under 5,000 miles). The ride should improve somewhat after 7,000 to 8,000 miles.

VEHICLE LOAD CONDITIONS—Unusual load conditions can affect the ride and handling of the vehicle. If unusual loading is apparent, check the distribution of this weight. Note if it is all toward one side of the vehicle or at the extreme rear of the vehicle. Reposition load as required to obtain a more uniform weight distribution.

The importance of a near equal Rear Axle-to-Frame/Side-to-Side Measurement cannot be overstressed. This near equal measurement has a direct effect on desirable vehicle handling and on the front-end alignment "A" dimension (with independent suspension). Generally, a near equal "D" dimension (see Figure 3-12) at the rear axle is needed in order to obtain an acceptable front-end alignment. If vehicle weights cannot be shifted due to vehicle build, consideration should be given to adding spring leaves or spacer blocks.

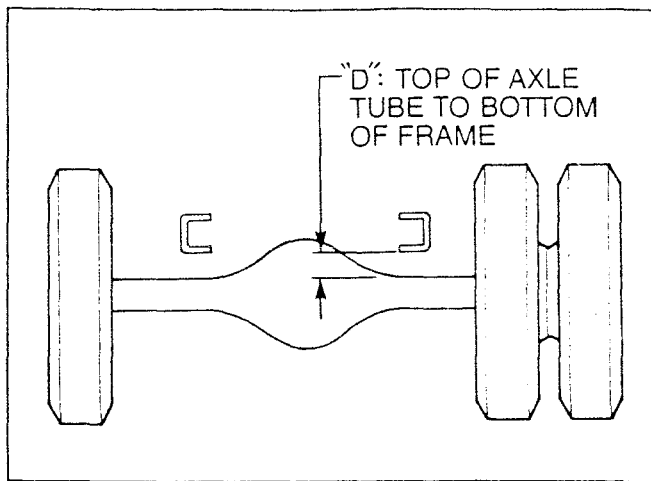


Figure 3-12 — Rear Axle-to-Frame/Side-to-Side Measurement

If the vehicle is within the rear spring rating but heavier on one side (tending to lean toward the generator or some other heavy appliance), you might consider adding a spacer block of sufficient thickness to equalize the left/right axle-to-frame measurement.

NOTE: The addition of spacer blocks can actually improve overall ride quality while the addition of spring leaves tends to reduce the ride quality of the vehicle.

Spacer blocks can be added to either side or both sides of the vehicle and be of different thicknesses to equalize or "open up" the "D" dimension shown in Figure 3-12.

Spacer blocks are generally 2½-inches wide by 6-inches long and are installed between the spring pack and spring seat (see Figure 3-13). The thickness of the spacer block

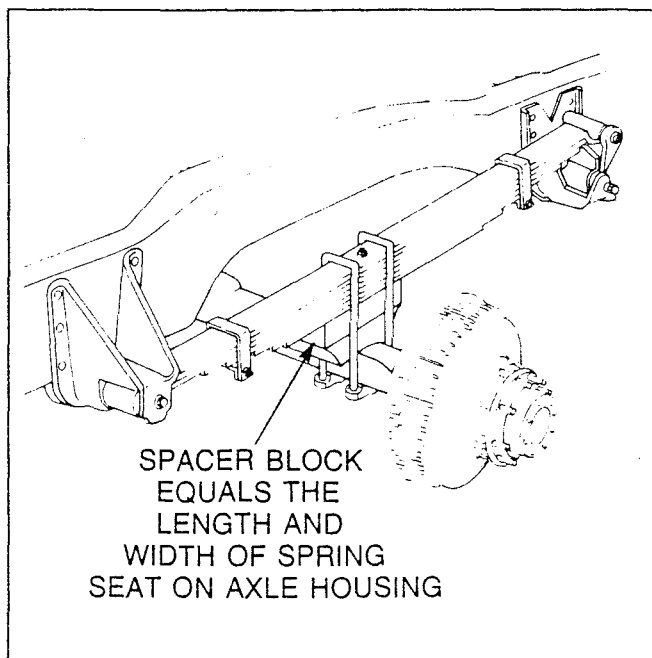


Figure 3-13 — Spacer Block

(to equalize left/right side dimensions) is determined by measuring the "D" dimension on each side and then subtracting one side's dimension from the other. The result is the thickness of the spacer block required for the low side of the vehicle.

Raising the back of the vehicle is generally trial and error. This is accomplished by driving the vehicle over stacked pieces of plywood ½-inch to 1-inch thick (in a level area) and checking that the side trim of the vehicle is level with each height increase. When the side trim is level and eye appealing to the owner, measure the height of the pieces of wood and add spacer blocks to equal that measurement. With most motor homes, you can add a spacer block of approximately ¾ inch without replacement of the U-bolts.

CAUTION: As the back of the vehicle is raised, the rear hydraulic flexible brake hose (running from frame midpoint to the axle) is effectively shortened. Damage can result to the rear hose when the axle drops away from the vehicle to the lower end of the wheel travel (when the vehicle encounters a chuck hole). Check to make sure that the rear hose is long enough to avoid damage in such a situation. If there is any doubt, replace the rear hose with a longer hose and then bleed the brakes.

The spacer block has a ¾-inch hole drilled in the center. A slip-fit dowel, as long as the thickness of the spacer block, is inserted into the hole of the block (see Figure 3-14). The center bolt head of the spring pushes the dowel down into the pocket in the spring seat and extends into the axle housing seat hole, as shown in Figure 3-14.

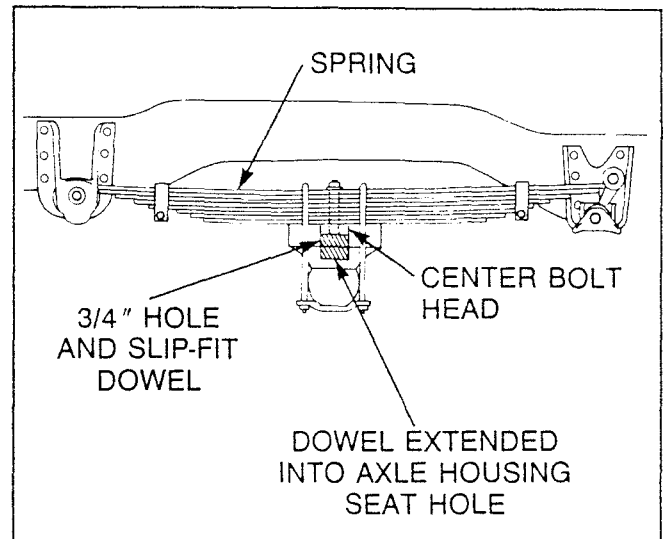


Figure 3-14 — Spacer Block Positioning

NOTE: There are several different spring center bolt head sizes available. The P-Series motor home chassis requires a ¾-inch spring center bolt head size.

VEHICLE RIDE AND HANDLING CHECK—After completing the previous checks, drive the vehicle to determine if problem has been corrected or to definitely establish the type of problem that still exists. If the problem still exists (poor handling, bottoming, noise, ride sway, etc.), the shock

absorbers may be the cause. Refer to the appropriate Chevrolet Light-Duty Truck Shop Manual for more extensive test procedures.

REAR SUSPENSION GENERAL DESCRIPTION

Both the G- and P-Series vehicles use a leaf-spring/solid-rear-axle suspension system.

The rear axle assembly is attached to multi-leaf springs by U-bolts. The spring front eyes are attached to the frame at the front hangers, through rubber bushings. The rear ends of the springs are attached to the frame by the use of shackles which allow the spring to "change its length" while the vehicle is in motion. Control arms are not required with leaf springs. (See Figure 3-15.)

Ride control is provided by two identical direct double-acting shock absorbers angle-mounted between the frame and brackets attached to the axle tubes.

On the G-Series, the shock absorbers are mounted to the front of the axle on the right side, and to the rear of the axle on the left side. For P-Series vehicles, both right and left shock absorbers are mounted to the front of the axle.

MAINTENANCE AND INSPECTION

Since the rear springs and shock absorbers use rubber bushings in the mounts, no lubrication is required. However, inspect the suspension periodically for worn or damaged components such as weak or broken spring leaves, leaking shock absorbers, and loose or broken mounting bolts, etc. Check for uniformity of ride height between right and left sides. Replace any worn or damaged parts.

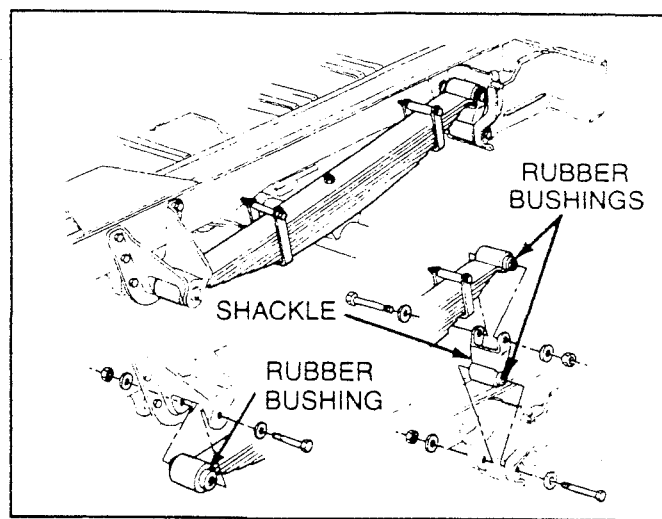


Figure 3-15 — Rear Spring Installation—G-Series Typical

Rear shock absorbers should be inspected and their operation checked following the same procedures for shock absorbers listed in this section under Front Suspension.

The U-bolts attaching the rear axle to the leaf springs should be checked and retightened to the specified torque after the first 500 miles of vehicle operation. Recheck the U-bolt torque each 10,000 miles thereafter. Torque specifications are listed in the chart which follows:

U-BOLT TORQUES — REAR

Model	Bolt Diameter	Torque
G-10,20	9/16 in.	115-130 ft.-lbs.
G/P-20,30	5/8 in.	125-175 ft.-lbs.
P-30	3/4 in.	200 ft. lbs.

SECTION 3 — STEERING, SUSPENSION, WHEELS AND TIRES

WHEELS AND TIRES

Use the proper size torque wrench when installing wheels. Hand tightening without a torque wrench or the use of a power impact tool can result in installation torques which are too high or too low. It will help prevent loosening of the wheel stud nuts and excessive stress placed on the stud bolts.

GENERAL DESCRIPTION

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

Correct tire pressures and driving techniques have an important influence on tire life. Heavy cornering, excessively rapid acceleration, and unnecessarily sharp braking increase tire wear.

MAINTENANCE AND INSPECTION

TIRE INSPECTION AND ROTATION

Front and rear tires perform different jobs and can wear differently depending on the type of roads driven, individual driving habits, etc. To obtain maximum tire life, tires should be inspected at intervals shown in the Maintenance Schedule. For the longest tire life, anytime irregular wear is noticed, the tires should be inspected and rotated and the cause of the uneven wear corrected. Be certain to check wheel nut tightness (using a torque wrench) and to adjust the tire pressures, front and rear, after rotation to agree with the recommended pressures. Recheck the torque (Figure 3-18) at 100 and 1,000 miles of operation after wheel installation, then, once every 6,000 miles thereafter.

The outer tire on a dual wheel will skid or drag on a turn because of the difference in the turning radii of the inner and outer tires. This results in faster wear of the outer tire. In general, the tire with the largest diameter or least wear should be positioned at the outside of each dual wheel. In addition, when vehicles are operated continuously on high-crown roads an increase in air pressure of from 5 to 10 PSI in the outside tire of each dual produces maximum tire life.

The "X Method" of rotation is allowed with radial tires if necessary. Due to their design, radial tires tend to wear faster in the shoulder area particularly in the front positions. This makes regular rotation especially necessary.

With dual wheel installations, it is recommended that the circumference of each tire that is to be installed on the rear axle be measured with a steel tape. If all tires do not measure the same, the two larger tires should be installed on one side and the two smaller tires on the opposite side.

INFLATION PRESSURE

The maximum cold inflation pressures for the factory-installed tires are listed on the Certification Label. (See Figure 3-16.) Tires must be inflated to these pressures when the Gross Vehicle Weight Rating (GVWR) or a Gross Axle Weight Rating (GAWR) is reached. For partial or uneven load distributions (front to rear), proper tire inflation pressure can be determined from the procedure under Determining Wheel/Tire Loads in this section. Improper tire inflation pressures for the load the vehicle is carrying can adversely affect tire life and vehicle performance.

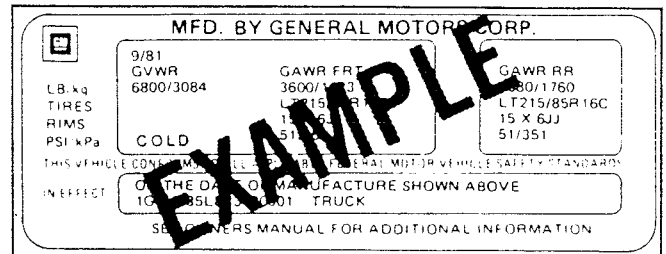


Figure 3-16 — Certification Label

For improved ride comfort in vehicles rated at 8,600 lbs. GVWR, it is permissible to use the lower tire pressure values shown on the label located on the rear edge of the driver's door provided there is a maximum of 200 lbs. cargo, no slide-in camper, and there are three or less occupants. The lower GVWR and GAWR (rear) reflect the maximum load-carrying capacity of the tires at lower pressure.

Too low an air pressure can result in tire overloading, abnormal tire wear, adverse vehicle handling, and reduced fuel economy. The tire flexes more and can build up excessive heat, weakening the tire and increasing susceptibility to damage or failure. Too high an air pressure can result in abnormal wear, harsh vehicle ride, and increased susceptibility to damage from road hazards. Lower inflation pressures should be used only with reduced vehicle loads and the rear tire pressure should be equal to or greater than the front pressure on single wheel application. After determining the load on each tire by weighing the vehicle on a scale, the correct cold inflation pressures for the actual tire loads can be obtained from the Tire/Wheel Load and Inflation Pressure Charts shown in Figure 3-17. Refer to the owner's and driver's manual for additional information on inflation pressure.

DETERMINING WHEEL/TIRE LOADS

To determine the load carried by each wheel and tire, weigh the motor home in two stages. First, position the vehicle with the front wheels on the scale, and take a weight

reading. Divide this reading by two to determine the load carried by each tire/wheel. Next, position the vehicle with the rear wheels on the scale, and take the second weight reading. Divide this reading by two (single rear wheels) or four (dual rear wheels) to determine the tire/wheel loads. Then, inflate tires to the proper pressure as determined by load. (See Figure 3-17.)

WHEEL AND TIRE BALANCING

It is desirable from the standpoints of tire wear, vehicle ride and handling ease to maintain proper balance of wheel and tire assemblies on all models. This may be accomplished by either of the two types of balancing systems in current use which balance wheels either on the vehicle or off. The "on the vehicle" type, however, is the more desirable in that all rolling components (brake drums, bearings, seals, etc.) are included in the balancing procedure and thereby have any existing unbalance corrected. Because of the specializ-

ed equipment required, wheel and tire balancing should be performed by a qualified service shop

TIRE REPLACEMENT

When replacing tires, be sure to consult your owner's and driver's manual for information regarding the proper tire selection. Use of the incorrect size or type of tire may affect load-carrying capacity, ride, handling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to the body and chassis. If replacing only a single tire, it should be paired on the same axle with the least worn tire of the others.

CAUTION: DO NOT MIX DIFFERENT TYPES OF TIRES ON THE SAME VEHICLE SUCH AS RADIAL, BIAS, AND BIAS-BELTED TIRES EXCEPT IN EMERGENCIES, BECAUSE VEHICLE HANDLING MAY BE SERIOUSLY AFFECTED AND MAY RESULT IN LOSS OF CONTROL.

G-SERIES

TIRE AND WHEEL LOAD LIMIT CHARTS

(TIRE AND WHEEL LOAD LIMITS ARE SHOWN BELOW. VEHICLE LOADING MUST BE LIMITED SUCH THAT NEITHER THE WHEEL LOAD LIMITS NOR TIRE INFLATION ARE EXCEEDED.)

TIRE SIZE AND LOAD LIMITS — LBS.

TIRE SIZE	TIRE REV. PER MILE	LOAD RANGE	INFLATION PRESSURE — PSI										
			30	35	40	45	50	55	60	65	70	75	80
BIAS TIRES USED AS SINGLES													
8.00-16.5	734	C	1360	1490	1610	1730							
8.00-16.5	734	D	1360	1490	1610	1730	1840	1945	2045				
8.75-16.5	712	D	1570	1720	1850	1990	2110	2240	2350				
8.75-16.5	712	E	1570	1720	1850	1990	2110	2240	2350	2470	2570	2680	
BIAS TIRES USED AS DUALS													
8.00-16.5	734	C	1195	1310	1415	1520							
8.00-16.5	734	D	1195	1310	1415	1520	1620	1710	1800				
RADIAL TIRES USED AS DUALS													
8.75R16.5	712	E		1570	1720	1850	1990	2110	2240	2350	2470	2570	2680

G-SERIES

WHEEL CODE AND LIMITS

CODE	WHEEL SIZE	MAX. LOAD LBS.	MAX. PRESSURE PSI
BR	15x7 JJ	1690	40
CD	15x6.5 JJ	1690	40
XH	15x6 JJ	1585	40
XW	15x6 JJ	1910	70

CODE	WHEEL SIZE	MAX. LOAD LBS.	MAX. PRESSURE PSI
YD	16.5x6	2680	85
YH	16.5x6	2680	85
YJ	16.5x6.75	2680	85
NO CODE	15x6.5 JJ	1690	40

Figure 3-17 — Tire/Wheel Load and Inflation Pressure Charts

P-SERIES

(TIRE AND WHEEL LOAD LIMITS ARE SHOWN BELOW. VEHICLE LOADING MUST BE LIMITED SUCH THAT NEITHER THE WHEEL LOAD LIMITS NOR TIRE INFLATION PRESSURE ARE EXCEEDED.)

RADIAL TIRE SIZE AND LOAD LIMITS — LBS.

TIRE SIZE	TIRE REV. PER MILE	LOAD RANGE	INFLATION PRESSURE — PSI							
			36	44	51	58	65	73	80	
METRIC RADIAL TIRES USED AS SINGLES										
LT215 85R16	682	C	1532	1742	1940					
LT215 85R16	682	D	1532	1742	1940	2127	2315			
LT235 85R16	653	D	1742	1984	2205	2425	2623			
LT235 85R16	653	E	1742	1984	2205	2425	2623	2844	3042	
METRIC RADIAL TIRES USED AS DUALS										
LT215 85R16	682	C	1389	1587	1764					
LT215 85R16	682	D	1389	1587	1764	1918	2105			

TIRE SIZE	TIRE REV. PER MILE	LOAD RANGE	INFLATION PRESSURE — PSI							
			45	50	55	60	65	70	75	80
RADIAL TIRES USED AS SINGLES										
8R19.5	616	D			2110	2270	2410	2540	2680	2800
RADIAL TIRES USED AS DUALS										
8R19.5	616	D	1850	1990	2110	2230	2350	2460		

BIAS TIRE SIZE AND LOAD LIMITS — LBS.

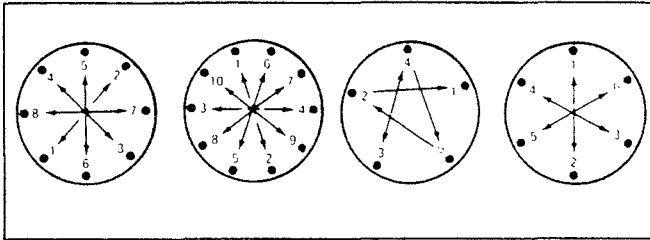
TIRE SIZE	TIRE REV. PER MILE	LOAD RANGE	INFLATION PRESSURE — PSI									
			30	35	40	45	50	55	60	65	70	75
BIAS TIRES USED AS SINGLES												
7.50-16	652	C	1620	1770	1930	2060						
7.50-16	652	D	1620	1770	1930	2060	2190	2310	2440			
7.50-16	652	E	1620	1770	1930	2060	2190	2310	2440	2560	2670	2780
8-19.5	652	D, E					2110	2270	2410	2540	2680	2800
BIAS TIRES USED AS DUALS												
7.50-16	652	C	1430	1565	1690	1815						
7.50-16	652	D	1430	1565	1690	1815	1930	2040	2140			
8-19.5	613	D			1850	1990	2110	2230	2350	2460		
8-19.5	613	E			1850	1990	2110	2230	2350	2460	2570	2680

Figure 3-17 — Tire/Wheel Load and Inflation Pressure Charts (Continued)

WHEEL CODE AND LIMITS

CODE	WHEEL SIZE	MAX. LOAD LBS.	MAX. PRESSURE PSI
AA	16x6.5L	3045	90
AF	16x6K	2440	75
BF	16x6.5L	2780	85
ZT	19.5x6	2540	80
ZY	19.5x6	2780	95

Figure 3-17 — Tire/Wheel Load and Inflation Pressure Charts (Continued)



NOTE: USE A TORQUE WRENCH TO TIGHTEN LUG NUTS. TIGHTENING BY HAND OR WITH AN IMPACT WRENCH IS NOT RECOMMENDED.

SERIES	DESCRIPTION	TORQUE (FT. LBS.)
G20	1/2 In. Bolts (5)	75-100
G-30, P-20, 30 Single Wheels	9/16 In. Bolts (8)	90-120
G-, P-30 Dual Wheels	9/16 In. Bolts (8)	110-140
	Heavy Duty 5/8 In. Bolts (10)	130-180

Figure 3-18 — Wheel Nut Tightening Sequence and Torque Specifications

WHEEL STUD BOLT REPLACEMENT

When one wheel stud bolt is broken on axles using five to nine bolt wheels, all stud bolts should be replaced. When one stud bolt is broken on an axle using ten-bolt wheels, the broken bolt, plus the adjacent bolt on each side should be replaced. The additional stress placed on bolts adjacent to the broken bolt weakens them and is the reason for replacement.

TYPICAL WHEEL AND STUD BOLT FAILURES

Worn/Broken Stud Bolts

Stripped threads on the stud bolts may be the result of excessive torquing of the studs (Figure 3-19) or may be the result of damage during wheel installation (when placing the wheel over the studs).

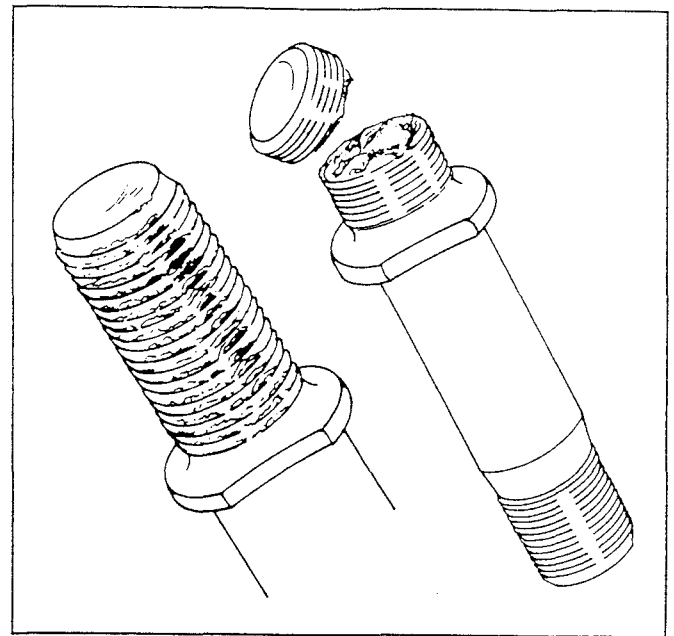


Figure 3-19 — Stripped/Broken Wheel Stud Bolts

Broken studs are a direct result of operating with loose cap nuts or improperly seated wheels.

When a broken stud is replaced, the stud on each side of it (in 10-hole mountings) should be replaced. In the case of smaller bolt circles, all of the studs should be replaced. This is because all of the other studs in the assembly have been subjected to undue strain in carrying all of the load and may have become excessively fatigued.

Worn/Cracked Wheels

Worn wheel stud holes will usually be accompanied by evidence of a bright, worn surface on the wheel face. This condition indicates that loose wheels were working against each other. As shown in Figure 3-20, the stud holes are out of shape and a build-up of metal occurs around them. This condition requires that the wheels be replaced.

Cracks running from stud hole to stud hole (Figure 3-20) on the bolt circle indicate a loose-mounting condition. Cracks running from hand hole to stud hole, hand hole to hand hole, or hand hole to rim are a direct result of overloading. If this type of failure occurs, the position of the failed wheel on the vehicle should be noted and the actual working loads of that axle should be checked.

TIRE WEAR

Proper inflation pressures for various tire loads are shown in Figure 3-17. For maximum tire life, these pressure recommendations should be followed. Both overinflation and underinflation can greatly reduce tire life. Likewise, the life of overloaded tires is shortened considerably. Greatest tire economy is achieved by selecting tires large enough to carry maximum loads without overloading, and by adjusting inflation pressures downward when less than maximum loads are carried.

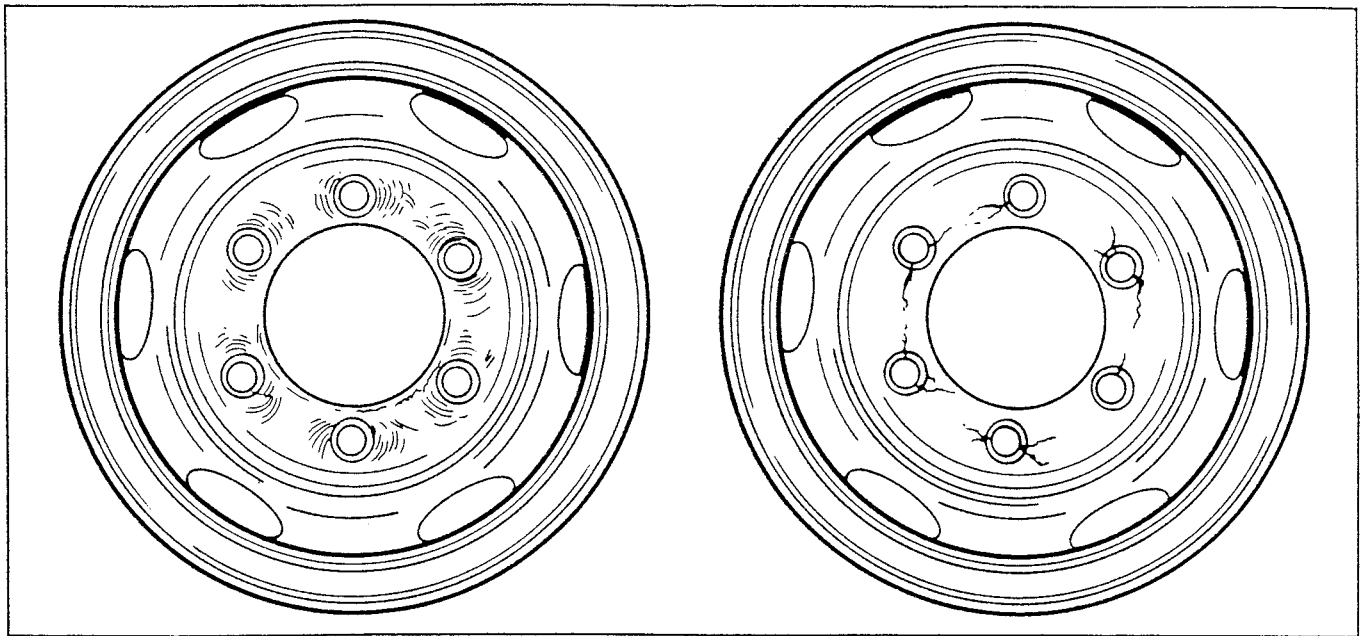


Figure 3-20 — Worn/Cracked Wheels

EFFECT OF INFLATION ON TIRE WEAR

Overinflation— This is one of the greatest causes of tire damage. Overinflation does not add strength to a tire, nor does it compensate for overloading. Instead, it weakens the tire and causes more rapid wear (Figure 3-21). Specifically, overinflation causes (1) rapid wear in center of tread, (2) greater susceptibility to impact breaks, (3) weakening of bead, (4) stresses that lead to tread separation, (5) reduced cushioning, leading to increased truck maintenance costs, (6) reduced traction and skid resistance.

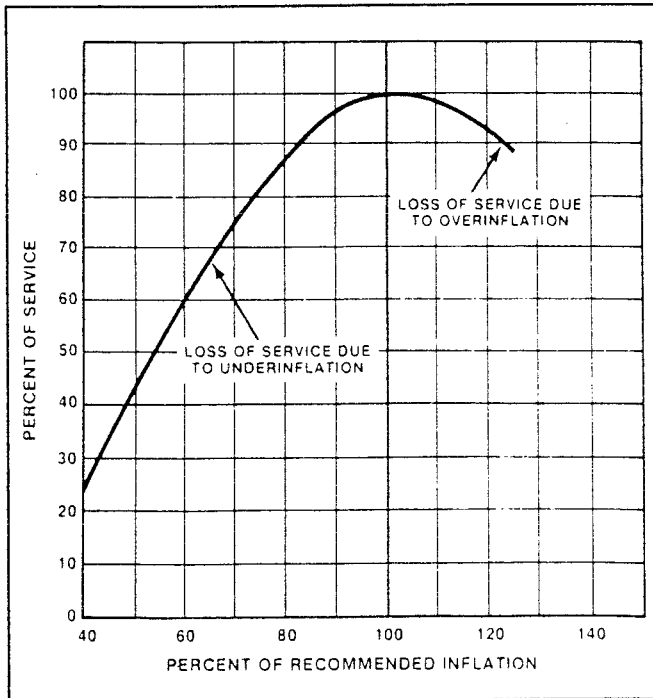


Figure 3-21 — Effect of Inflation on Tire Wear

Underinflation— This causes tires to flex excessively, causing heat build-up and increased tire wear (Figure 3-21). Underinflation leads to (1) excessive wear on shoulder of tread, (2) irregular tread wear, (3) ply separation, (4) greater susceptibility to bruising, (5) tread separation.

EFFECT OF OVERLOADING ON TIRE WEAR

Tires that are loaded beyond their maximum-rated carrying capacity will have their useful life significantly shortened. As shown in Figure 3-22, tire life decreases rapidly as overloading increases. For example, it is seen that only a 10% overload reduces tire life by about 15%. An overload of 50% reduces tire life by 60%.

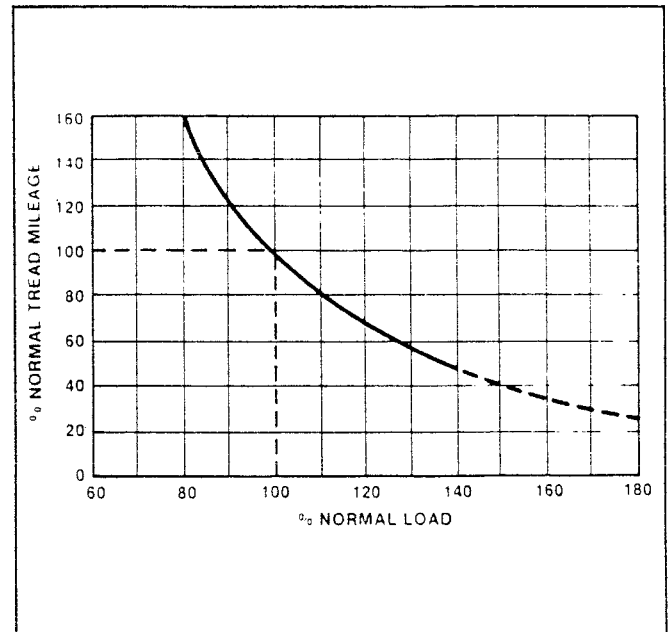


Figure 3-22 — Effect of Overloading on Tire Wear

The dotted line is a projection of the solid curve, obtained with actual tire experience over a long period of time. The extreme left end of the solid curve shows that running tires at less than rated load results in a substantial increase in tread mileage.

EFFECT OF OVERHEATING ON TIRES

When a tire gets extremely hot by operating over a considerable distance in a severely underinflated or flat condition, or with dragging brakes (these are most common causes), the internal frictional heat created may build up to a point where the tire actually bursts into flame. This usually occurs in a dual assembly where one tire is flat and the other tire continues to operate in an overloaded and/or underinflated condition. In such cases, either the completely flat tire or the tire carrying the load could build up a sufficiently high temperature to ignite, as shown in Figure 3-23. Line A of this chart shows time and tire temperature with a tire operated at proper loading and inflation pressure. Line B shows a 20% overload and/or underinflation. Note that the tire temperature has moved into the HOT area of the chart. Line C of the chart reflects a 40% overload and/or underinflation which has moved into the DANGER area.

NOTE: It is extremely difficult to extinguish a tire fire since the internal temperature causes repeated ignition. A fire extinguisher should be used to control the fire until the tire can be removed from the vehicle. The best protection against a tire fire is to avoid running on flats and to check operating pressures regularly.

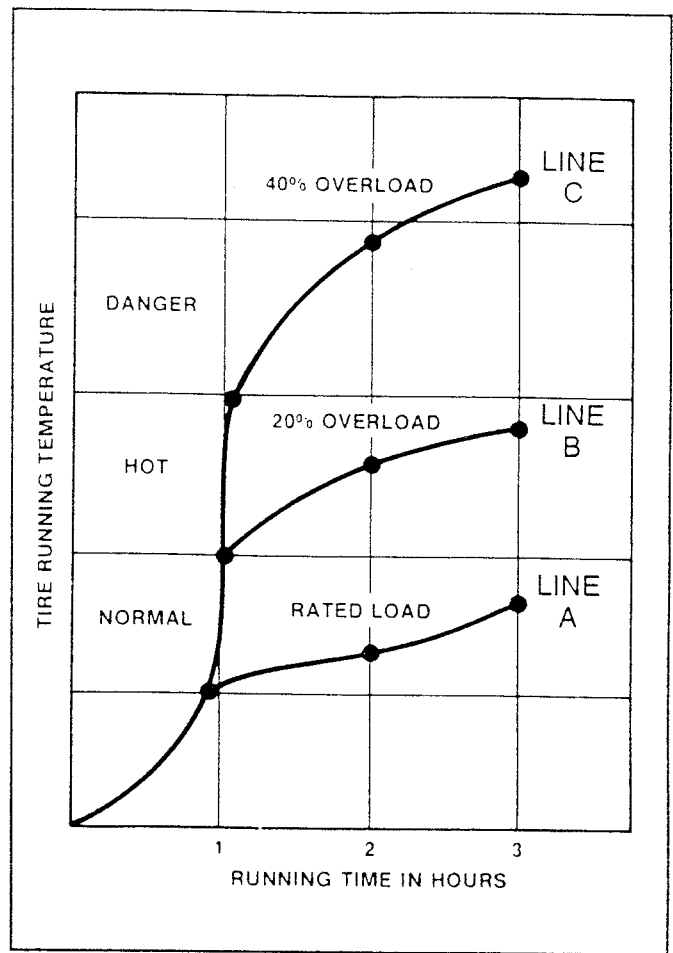


Figure 3-23 — Effects of Time, Temperature and Pressure on Tire Wear

STEERING SYSTEM

APPENDIX 3-1 — STEERING RELAY AND TIE ROD PARTS IDENTIFICATION

The following illustration has been extracted from the GM Parts Book. The typical Parts Book illustration shows group numbers of front-end parts. Major parts numbers and torque specifications have been added for reference.

(1978 AND PRIOR)

GM PART NO.
3956453

GM PART NO.
3956454

1979-84 "P(32)" STEERING LINKAGE

1.	6.870	ROD, Strg Relay	627C303	27.	N.S.	SUPPORT ASM, Strg Relay (See Items 38,39,40,41,42)	
2.	6.242	SEAL, Tie Rod Soc Ball Stud	328144	28.	8.917	NUT (7/16"-14)	
3.	8.984	FITTING, Lug Straight (1/4"-28)		29.	8.915	NUT (1/2"-20)	
4.	6.230	ROD, Inr Tie	14002550	30.	8.938	PIN, Cotter (3/32" x 1")	
5.	8.917	NUT (3/8"-16)		31.	6.525	COUPLING, W/Flange Kit, Strg Gr	7828871
6.	N.S.	CLAMP, Adj Tube (Part of #7)		32.	6.525	BOLT, Strg Shift Cplg (3/8"-24 x 1 3/16")	7807271
7.	6.232	TUBE UNIT, Tie Rod Adj (Includes Items 5,6,8)	12309226	33.	6.895	ARM, Strg Idler	14013036
8.	8.900	BOLT (3/8"-16 x 1 5/8")		34.	6.897	WASHER, Strg Idler Shk Abs Grommet	3798007
9.	6.233	ROD, Otr Tie	458201	35.	8.915	NUT (3/8"-24)	
10.	8.938	PIN, Cotter (1/8" x 1 1/4")		36.	7.244	GROMMET, Spl (1 7/32" OD 7/8" Thk)	6270752
11.	6.164	NUT, Strg Link	3983037	37.	6.895	ABSORBER, Strg Relay and Tie Rod Shk	22011982
12.	8.938	PIN, Cotter (1/8" x 1 1/4")		38.	6.896	SUPPORT, W/Bushings Strg Rly & Conn (Includes Item 39)	3941739
13.	8.917	NUT (5/8"-18)		39.	6.896	BUSHING, Strg Rly & Conn Rod Supt Shf (Included in item 38)	266316
14.	6.895	ARM, Strg Relay and Conn Rod	14013037	40.	6.896	SHAFT, Strg Rly & Conn Rod Arm Supt	3768940
15.	8.916	NUT (3/4"-16)		41.	6.897	NUT, Strg Rly & Conn Rod Arm Supt Plug	3768947
16.	8.931	WASHER (3/4")		42.	6.897	PLUG, Strg Rly & Conn Rod Arm Supt	3768945
17.	6.870	ROD, Strg Conn	6271489				
18.	6.859	ARM, Pitman	6259993				
19.	6.861	WASHER (1 1/2" OD 7/8 ID)					
20.	6.861	NUT (7/8"-14)	5667628				
21.	6.508	GEAR, Strg(*1)	7834511				
22.	6.898	SEAL, Strg Conn Rod Ball Stud	3865608				
23.	8.984	FITTING, Lug Straight (1/8"-17)					
24.	6.898	SEAL, Strg Lnk Piv Shf	3786454				
25.	8.900	BOLT (7/16"-14 x 1 3/4")					
26.	8.929	WASHER (7/16")					

NOTE 1: For information on serviceable components refer to applicable Assembly illustration.

APPENDIX 3-2 — TYPICAL LOAD HEIGHT CURVES — MOTOR HOME (CONT'D)

NOTE: This chart is for the typical P-Series Motor Home.
Additional model information is available in the
Body Builders Book.

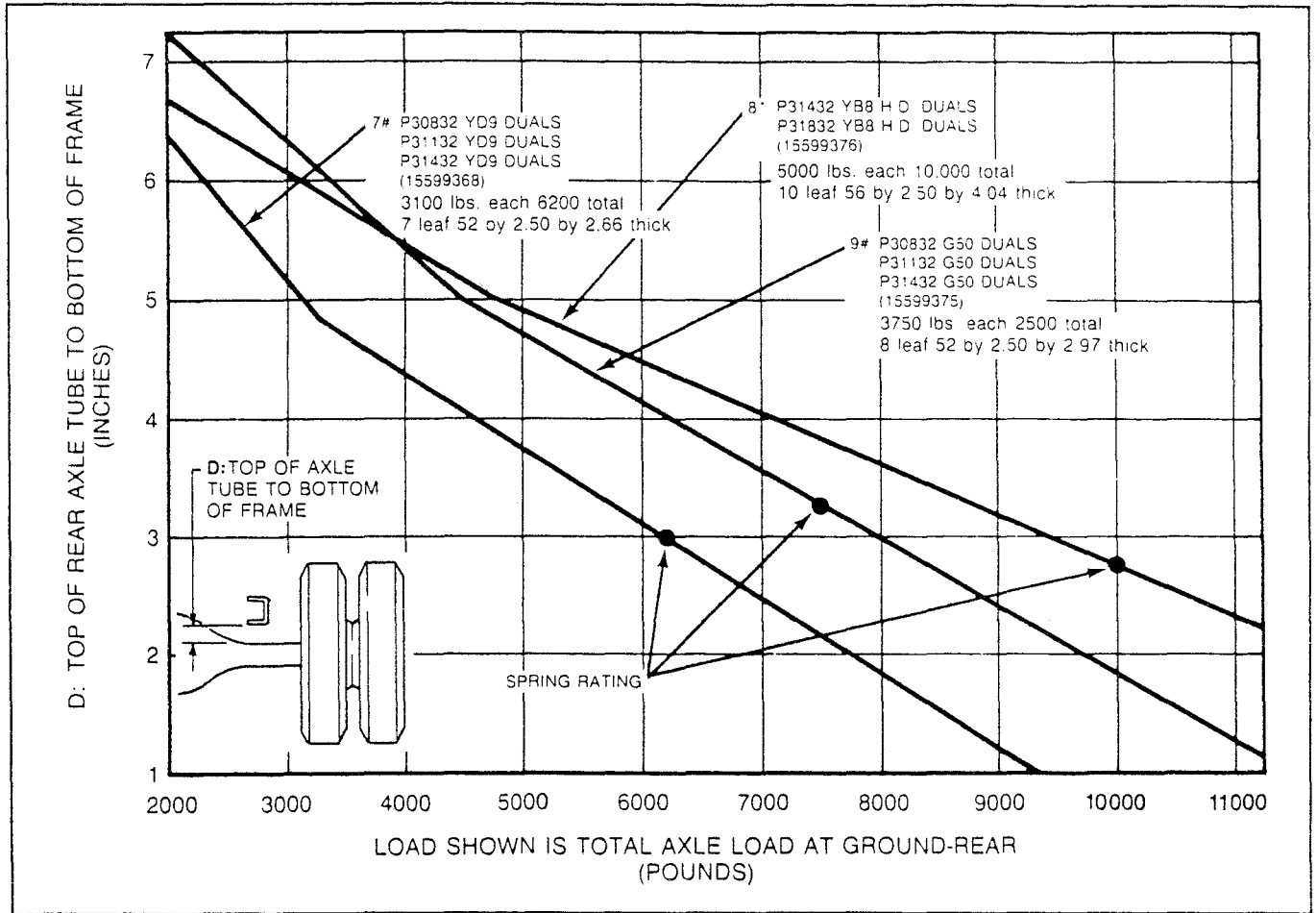


Figure A3-2-2 — Load Height Curve "D" Dimension—Motor Home

SECTION 4 — PROPELLER SHAFTS AND UNIVERSAL JOINTS

GENERAL DESCRIPTION

PROPELLER SHAFTS

The propeller shaft is a steel tube which is used to transmit power from the transmission output shaft to the differential. To accommodate various model, wheelbase and transmission combinations, drive shafts differ in length, diameter and the type of splined yoke. Each shaft is installed in the same manner. A universal joint and splined slip yoke are located at the transmission rear extension. The slip yoke permits fore and aft movement of the drive shaft as the differential assembly moves up and down. The spline is lubricated internally by transmission lubricant or grease. An oil seal at the transmission prevents leakage and protects the slip yoke from dust, dirt and other harmful materials. (See Figure 4-1.)

Since the drive shaft is a balanced unit, it should be kept completely free of undercoating and other foreign material which would upset shaft balance.

Both one-piece and two-piece propeller shafts are used depending on the model.

On models that use a two-piece shaft, the shaft is supported near its splined end in a rubber-cushioned ball bearing, commonly referred to as the center bearing,

which is mounted in a bracket attached to a frame crossmember. The center bearing is permanently lubricated and sealed.

UNIVERSAL JOINTS

The simple universal joint is basically two Y-shaped yokes connected by a crossmember called a spider. The spider is shaped like an "X," and arms that extend from it are called trunnions. (See Figure 4-2.) The spider allows the two yoke shafts to operate at an angle to each other.

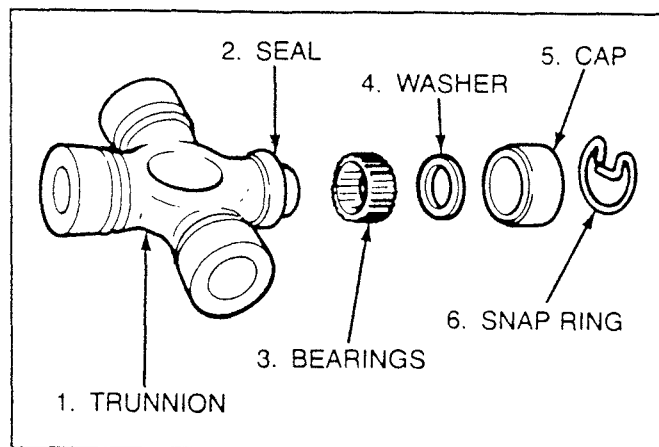


Figure 4-2 — Universal Joint—Exploded View

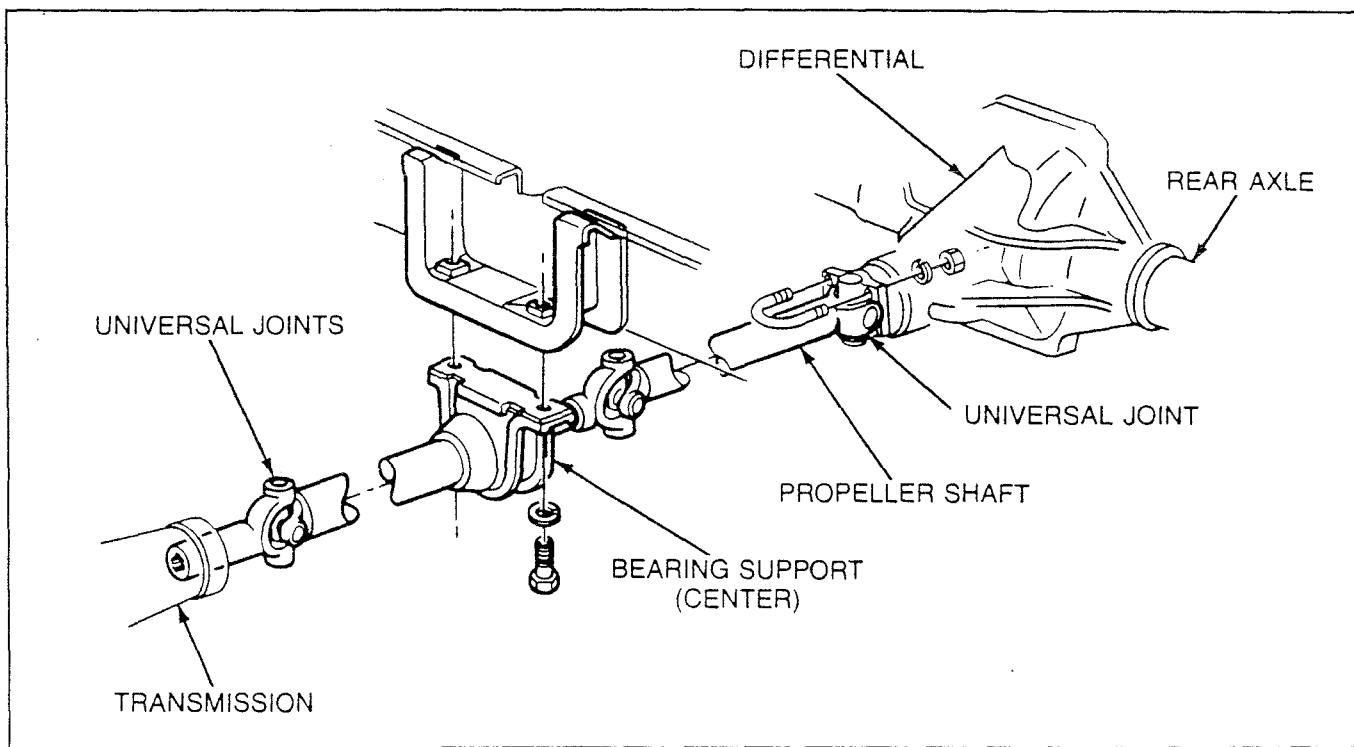


Figure 4-1 — Propeller Shaft

MAINTENANCE AND INSPECTION

Generally, the propeller shaft and universal joints require little maintenance. Periodic inspection is recommended, however, for proper propeller shaft balance and universal joint lubrication. If area around caps appears to be excessively dry, it may indicate a need for bearing relubrication or universal joint replacement. (See Figure 4-2.) A failing universal joint often squeaks on start-up or klunks with direction change.

If the center bearing is replaced, the bearing itself does not need to be packed with grease. However, chassis lubricant should be packed within the dust shields to form a dam to aid in preventing water and dirt from reaching the bearing. The dust shields are staked into position following the procedure detailed in the shop manual. (See Figure 4-3.) Typical U-Joint and slip spline failures are shown in Figure 4-4.

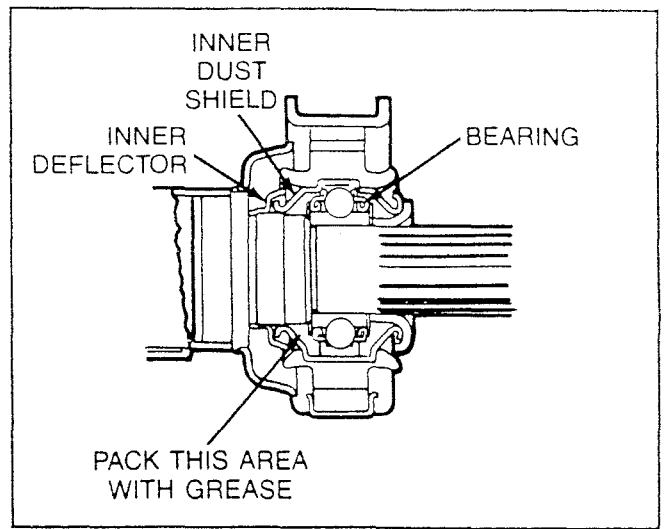


Figure 4-3 — Center Bearing

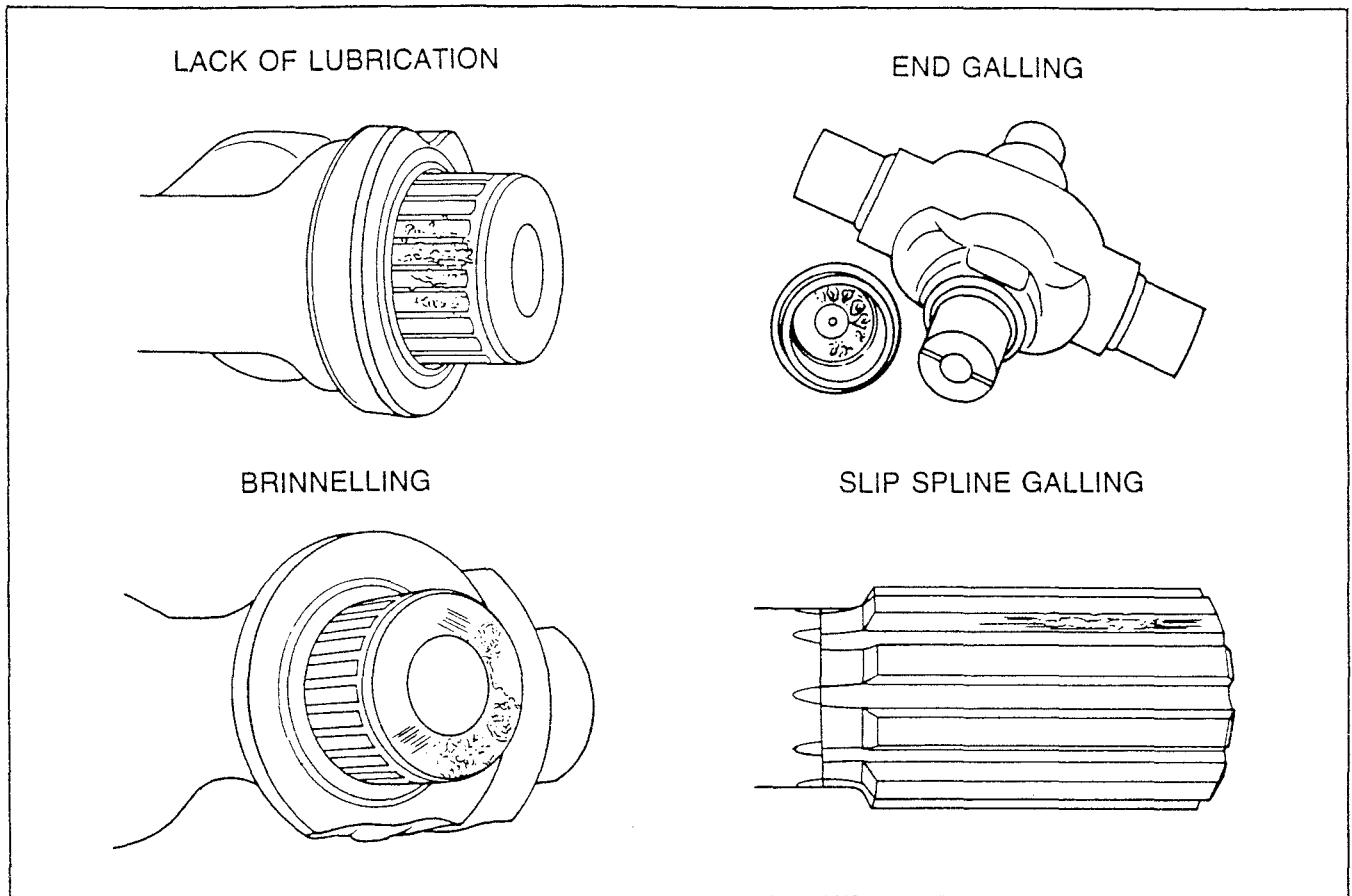


Figure 4-4 — Typical Failures—U-Joints and Slip Spline

PROPELLER SHAFTS AND UNIVERSAL JOINTS

APPENDIX 4-1 — DRIVELINE VIBRATIONS—ONE AND TWO DRIVE SHAFT SYSTEMS

The following information is directed to service personnel and is presented as an aid to the motor home owner in understanding driveline vibrations (as driveline vibration problems are often not recognized by the owner).

Driveline vibrations will generally be a high-speed vibration or a "buzz" at drive shaft speed compared to wheel and tire vibration that is a much slower speed. Standard factory units normally do not have problems unless the assembler in production has installed the incorrect length hanger bearing support or some part is off in design specification. The units most likely to have vibration problems are modified units where a wheelbase is changed, a drive shaft added or a change that has occurred when the suspension has been modified or changed (for example, a spring changed or after market suspension installed replacing production springs).

On some units that have operated in a heavy, loaded condition, the last shaft and pinion nose will change enough to require a driveline and/or pinion nose change. The following information should be read by service personnel and understood as a guideline for alignment procedures.

NOTE: 30-Series motor homes as produced by GM are built with only two drive shafts. Some RV manufacturers stretch two shaft jobs, changing driveline angles. All three-shaft motor homes have been modified by the RV manufacturers.

The following driveline rules are for one and two drive shaft systems.

Rule Number 1— The working angles of each pair of U-joints must be within one-half degree of being equal on shafts that turn at 3,200 RPM or higher, or within one degree of being equal on shafts that turn at speeds below 3,200 RPM.

Rule Number 2— (Involves a two drive shaft, three U-joint system.) With a three-joint system there is always an odd joint that cannot be paired with another joint. Since the U-joint between the transmission and the front shaft does not have a mate to cancel out its acceleration and deceleration, the front shaft should be within one-half degree of the transmission angle for high-speed shafts and within one degree for low-speed shafts. If the rear-end pinion angle is not equal to either the engine/transmission angle or front shaft angle, it should be at an angle between those two. There can be one-half degree difference between the center and rear U-joint working angles provided neither of the working angles exceeds 4 degrees on high-speed shafts, or 5 degrees on low-speed shafts.

The following is an actual driveline case study of an "S" truck. The purpose of this example is to indicate that driveline problems are not restricted to large trucks.

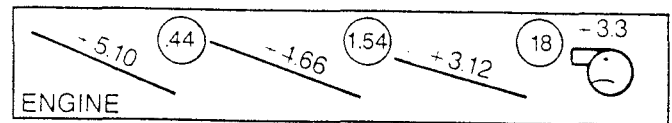


Figure A4-1-1 — Driveline Vibration—Case Study—Example No. 1

NOTE: The angles shown in Figure A4-1-1 were taken with a very accurate digital protractor and dramatically indicates an ability to work in extremely small figures.

In the example, (Figure A4-1-1) note that the working angle between the engine and first shaft of .44 degrees is well within the driveline rules. The first joint does not present any problems. With a .44-degree working angle and no mating joint, a vibration will never be felt. At the back two U-joints, the intent is to make a canceling pair within one-half degree working angle. As shown in the example, this is very poor. 1.54 degrees minus .18 degrees equals a 1.36-degree difference—clearly beyond the one-half degree rule.

However, examine what would happen if a one-degree caster wedge were installed to tip the pinion nose up to more closely follow the rule of setting the pinion to be "equal to the transmission angle or front-shaft angle or an angle between the two."

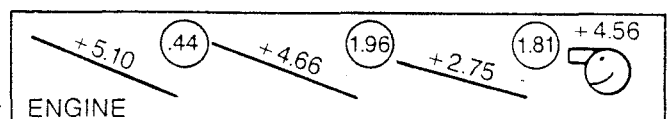


Figure A4-1-2 — Driveline Vibration—Case Study—Example No. 2

The example shows quite an improvement. Note that the two rear joints are canceling within the one-half degree rule. Another point learned in this case study concerns the use of the protractor. A one-degree shim was sent for, which was cast one degree but when installed turned out to be 1.26 degrees.

Another move that would seem to defy one of the driveline rules can sometimes be done on light-duty applications. This involves (through design considerations) keeping the pinion nose as low as possible to help reduce driveline tunnel size and the hump that is needed in the trunk floor for axle clearance.

APPENDIX 4-1 — DRIVELINE VIBRATIONS — ONE AND TWO DRIVE SHAFT SYSTEMS (CONT'D)

Note the result shown in the case study example, (see Figure A4-1-3) of reversing the shim and tipping the pinion nose down by one plus degree.

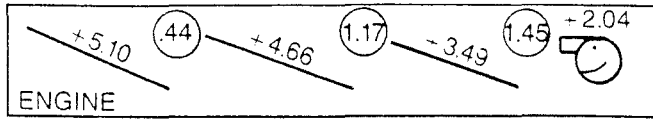


Figure A4-1-3 — Driveline Vibration—Case Study —Example No. 3

As a result, you end up with even smaller working angles but still well within the one-half degree cancellation Rule Number 1. This illustrates two very proper approaches to driveline correction (but still returning to the key point of joint working angles canceling in pairs and within one-half degree).

Before completing a discussion on two-shaft drivelines, consider the following: "Could the system be reversed and the one-half degree be placed at the pinion end?" The answer is a technical yes, but in reality, you are better off with the half degree at the engine end. With the solid-mount transmission and first shaft, you're generally better off to have your bigger working angles further from the passenger compartment at the pinion end. Noise and vibrations are further away and are somewhat absorbed in springs and suspension. Concerning this, consider what happens to the angles of the middle joint and at the pinion nose as the axle and drive shaft move through loadings and ride travel. Chances are small of maintaining proper joint relationships. Stay with the one-half degree at the engine, and equal and canceling angles as a pair at the middle joint and pinion joint. Also, remember with a two-shaft system, that the drivelines must be in proper phase at the slip yoke. If off one spline, a vibration complaint will result. The illustrations below (see Figure A4-1-4) show proper phasing and maximum drive shaft runout.

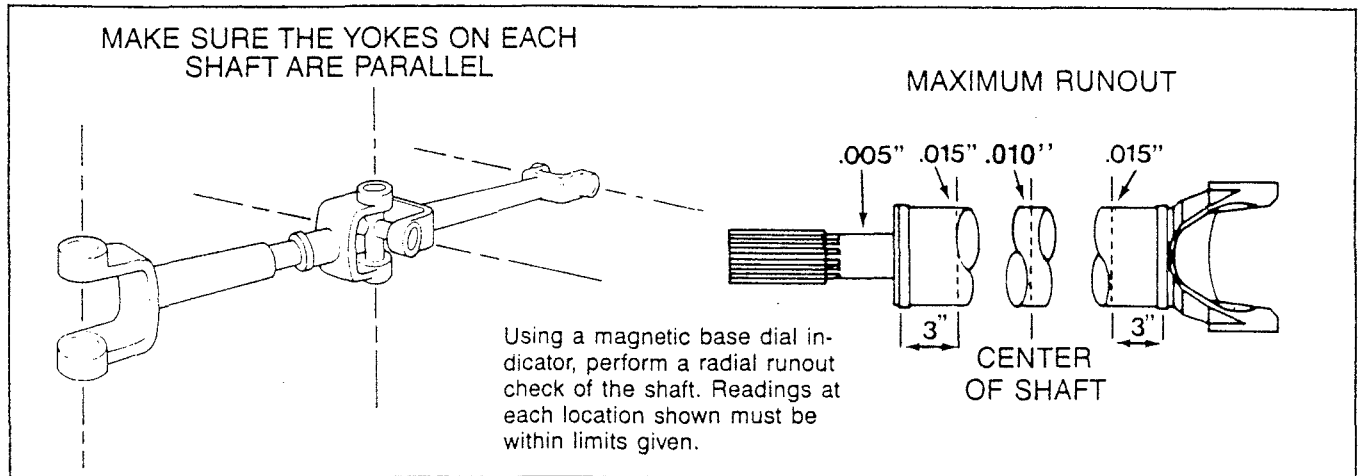


Figure A4-1-4 — Proper Phasing and Maximum Drive Shaft Runout

The following examples demonstrate acceptable driveline combinations and are presented as an aid in reemphasizing the simple single drive shaft two-joint system. Note the

one common factor among the various combinations—the joint working angles are equal as a pair and qualify under Rule Number 1.

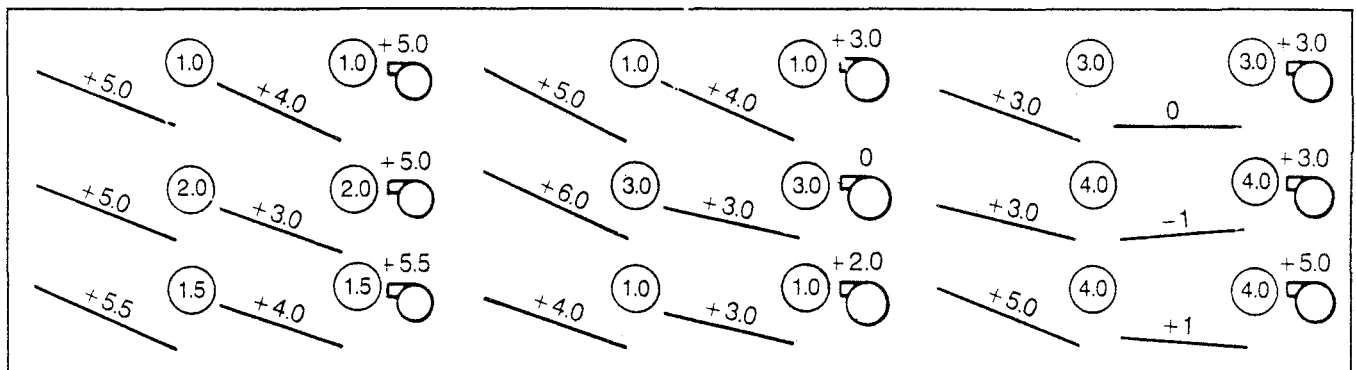


Figure A4-1-5 — Acceptable Driveline Combinations

PROPELLER SHAFTS AND UNIVERSAL JOINTS

APPENDIX 4-2 — DRIVELINE VIBRATIONS — THREE-SHAFT DRIVELINES

The following information is addressed to service personnel and is presented as an aid to the motor home owner in understanding the three-shaft drivelines typical of RV vehicles and farm trucks. Three-shaft drivelines are perhaps the simplest and most interesting of all drivelines, because of the many and varied combinations possible.

The following are several basic rules:

Rule Number 1— The working angle of each pair of U-joints must be within one-half degree of being equal on shafts that turn at 3,200 RPM or higher, or within one degree of being equal on shafts that turn at speeds below 3,200 RPM. No working angle shall exceed four degrees on high-speed shafts, or five degrees on low-speed shafts. (This is essentially the same rule as found in single and two drive shaft systems.)

Rule Number 2— (The concept of the broken back angle.) The first shaft angle plus the third angle is divided by two and equals the second shaft angle. For example: A first shaft of zero degrees plus the third shaft of 90 degrees equals 90 degrees divided by two equals 45 degrees as the proper setting for the second or middle shaft.

Rule Number 3— When computing working angles, two components that are tilted in the same direction are subtracted from each other. When connecting components are not in the same direction, such as a positive and a negative angle, the angles are added to determine the working angle.

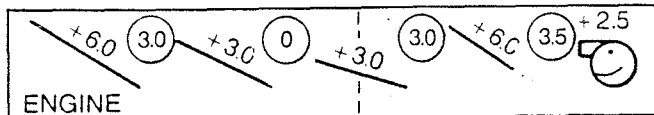


Figure A4-2-1 — Driveline Vibrations—Truck Case Study—Example No. 1

Examine the truck case study shown in Figure A4-2-1. To better understand the truck case study, draw a line vertically down through the middle drive shaft. You will find you are really working with two trucks with single drive shafts. As you apply Rule Number 1, you will notice there is not a problem with the rear pair of joints, but the front half of the truck, with three degrees of working angle and zero degrees for its mating joint, presents a problem.

With single-shaft drivelines, one method to employ would be to align the shafts so the shafts operate in parallel planes, but at different levels. (See Figure A4-2-2.) For example: Lower the second shaft to six degrees, and by installing a caster wedge, tip the pinion nose up slightly to six degrees.

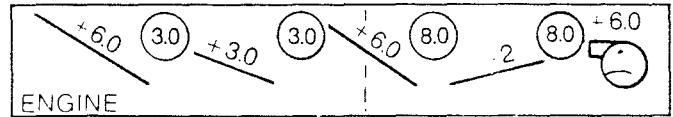


Figure A4-2-2 — Driveline Vibrations—Truck Case Study—Example No. 2

The above example shows equal canceling angles. However, the back pair exceed the four-degree maximum working angle of Rule Number 1. Note the last shaft is negative (uphill to the pinion). Negative shafts are added to positive shafts.

The following chart shows the relationship of shaft speed to maximum allowable working angle.

RPM	Max working angle	RPM	Max working angle
5000	3° 15"	3000	5° 5"
4500	3° 40"	2500	7° 0"
4000	4° 15"	2000	8° 40"
3500	5° 0"	1500	11° 30"

Figure A4-2-3 — Shaft Speed to Maximum Working Angle

In the above truck case study, the requirement was to raise the driveline system to eliminate the negative last shaft running uphill to the pinion. This situation created too large working angles. In this case study example, the broken back angle becomes an advantage and drastically reduces work in the process. (The original example shown in Figure A4-2-1 had the pinion nose at two and one-half degrees and the center shaft at three degrees.)

The following presents a case study example of a broken back angle out of the front of the truck. With the engine as the first shaft, and the middle drive shaft considered as the third shaft, determine the shaft setting for the second shaft. Use two and one-half degrees for the third shaft. Following Rule Number 2:

APPENDIX 4-2 — DRIVELINE VIBRATIONS — THREE-SHAFT DRIVELINES (CONT'D)

6	degrees as the first shaft
$2 \frac{1}{2}$	degrees as the third shaft
$8 \frac{1}{2}$	degrees divided by two equals
$4 \frac{1}{4}$	degrees second shaft

Figure A4-2-4 — Driveline Vibrations—Truck Case Study—Example No. 3

The following shows a broken back angle installed in the front half of the truck case study example.

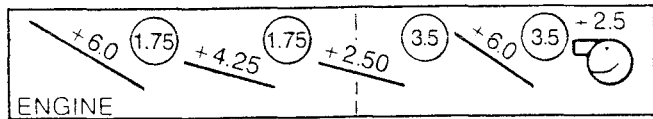


Figure A4-2-5 — Driveline Vibrations—Truck Case Study—Example No. 4

Note that by picking the middle shaft, to be the same as the pinion, you have corrected the rear of the truck to near ideal cancellation, as well as correcting the front of the truck. Changing hanger bearing length is generally a cut-and-weld as an overlap to shorten a hanger, or fabricating a spacer block. (You must locally obtain longer bolts to make a longer hanger.) Almost everything that applies to single-shaft systems applies to three-shaft trucks. Even the broken back angle can occasionally be used in some specialized single-shaft trucks, such as airport luggage toters where the rear axle is moved forward almost under the driver's seat. With a very short drive shaft, parallel alignment would make working angles too large. In the toter, the pinion becomes the third shaft and the engine is the first shaft. The manufacturer may install a broken back to obtain equal working angles at the transmission and the pinion, and reduce working angles in the process.

It is also important, as in the two drive shaft truck, to have the last drive shaft properly phased on the slip spline. Make certain, the fixed yoke and the splined yoke are in the same plane. If they are off even one spline, a vibration complaint may result. The illustrations below (Figure A4-2-6) show proper phasing and maximum drive shaft runout.

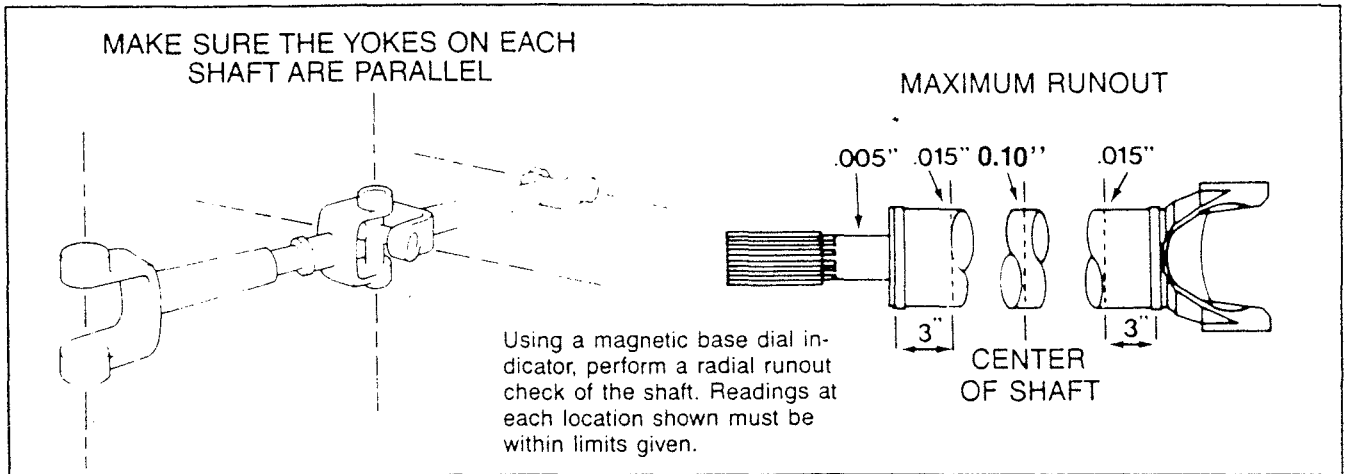


Figure A4-2-6 — Proper Phasing and Maximum Driveshaft Runout

SECTION 5 — REAR AXLE

GENERAL DESCRIPTION

The rear axle assembly consists of the drive pinion, ring gear, differential and axle shafts in one housing. The drive pinion transfers power input from the propeller shaft to the ring gear which drives the axle shafts and rear wheels. The ring gear is a reduction gear which lowers the speed (RPM) of the propeller shaft to a speed which is usable for driving the rear wheels.

MAINTENANCE AND INSPECTION

DIFFERENTIAL FLUID

The differential requires little maintenance; however, periodic fluid level checks are recommended to ensure smooth operation. In addition, the fluid should be changed in accordance with the time and mileage intervals listed in the Maintenance Schedule for the vehicle.

To check differential fluid level, remove plug. If the fluid level is sufficient, fluid will seep out of the opening. If it doesn't, add the necessary amount. Replace the plug, making sure it is properly seated. (See Figure 5-1.)

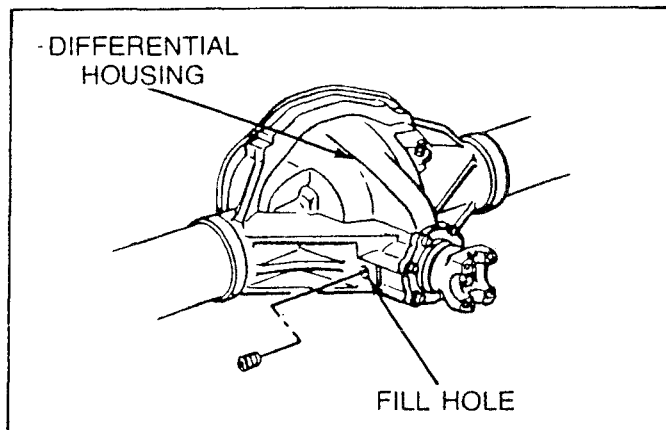


Figure 5-1 — Rear Axle Lubricant Fill Hole

WHEEL BEARING ADJUSTMENT (TAPERED BEARING)

Before checking bearing adjustment, make sure the brakes are fully released and do not drag.

Check bearing play by grasping the tire at the top and pulling back and forth, or by using a pry bar under the tire. If bearings are properly adjusted, movement of the brake drum in relation to the brake flange plate will be barely noticeable and the wheel will turn freely. If movement is excessive, adjust the bearing as follows:

1. Remove the axle shaft and raise vehicle until the wheel is free to rotate.

2. Keyways and threads on the tube and nut must be clean and free from chips, burrs and shavings.
3. Disengage tang of the retainer and remove retainer from the axle housing tube.
4. Torque the adjusting nut to 50 ft. lbs., while at the same time rotating the hub assembly and making sure the bearing cones are seated and in contact with the spindle shoulder.

Proper wheel bearing adjustment can be made using a spanner wrench (GM Tool J-2222-L or equivalent).

5. Back off nut until loose. Refer to Figure 5-2 for specifications.
6. If adjusting nut slot is in alignment with keyway in the axle spindle, insert the square key into slot. If the adjusting nut slot is not aligned, back off nut a slight amount and insert the square key into the slot. Do not back off more than one slot to align the key.
7. Assemble the snap ring at the end of the spindle to retain the key in position.

WHEEL BEARING ADJUSTMENT (BARREL-TYPE BEARING)

Before checking bearing adjustment, make sure brakes are fully released and do not drag.

Check bearing play by grasping tire at top and pulling back and forth, or by using a pry bar under tire. If bearings are properly adjusted, (installed with slight preload), there will be **no** movement of the brake rotor and the wheel will turn freely. If there is movement, adjust bearings by using the following procedure:

1. Remove axle shaft and raise vehicle until wheel is free to rotate.
2. Disengage tang of retainer from locknut and remove both locknut and retainer from axle housing tube, with GM Tool J-25510 or equivalent.
3. Tighten inner adjusting nut (using GM Tool J-25510 or equivalent) to 90 ft. lbs. torque while rotating wheel hub at the same time to make sure all bearing surfaces are in contact. Then back off inner nut 1/8 turn while rotating wheel. The wheel should turn freely.
4. Install tanged retainer against the inner adjusting nut. Align inner adjusting nut so short tang of retainer will engage nearest slot on inner adjusting nut.
5. Install outer locknut and tighten to correct specified torque (250 ft. lbs.). Then bend long tang of retainer into slot of outer nut.

MODEL	SOURCE	TYPE/CAPACITY	RING GEAR SIZE (In.)
P30	Chevrolet/Dana	Salisbury/7900# and 10,000# Motor Home Axle	10-1/2
P30 (With H22/H23)	Rockwell	Banjo/11,000#	12
G30	Chevrolet	Salisbury/5700#	10-1/2
G30 (Dual Wheel)	Dana	Salisbury/6200#	9-3/4
G30 (Dual Wheel)	Dana	Salisbury/7500#	10-1/2

REAR WHEEL BEARING ADJUSTMENT SPECIFICATION					
RING GEAR SIZE (In.)	BEARING ADJUSTING NUT TORQUE (Ft. Lbs.)*	ADJUSTING NUT BACK-OFF*	OUTER LOCKNUT TORQUE (Ft. Lbs.)	RESULTING BEARING ADJUSTMENT (In.)	TYPE OF BEARING
10-1/2	50			.001 TO .010 END PLAY	TAPERED ROLLER
9-3/4	50	**	65		
12	90	1/8*	250	SLIGHT PRELOADED	BARREL ROLLER

**Back off nut and retighten to 35 Ft. Lbs. then, back off 1/4 turn. *With wheel rotating.

Figure 5-2 — Wheel Bearing Adjustment Specifications

AXLE HOUSING

A gear set operated at its capacity rating will give 100% of rated life. Taking the same gear set and reducing the work load will give a very large gain in life. Overloading by even very small percentages causes a very serious loss in life. Overloading also tells a major story on reduced tire, wheel bearing and axle housing failures.

The graph shown in Figure 5-3 (provided by Eaton Axle

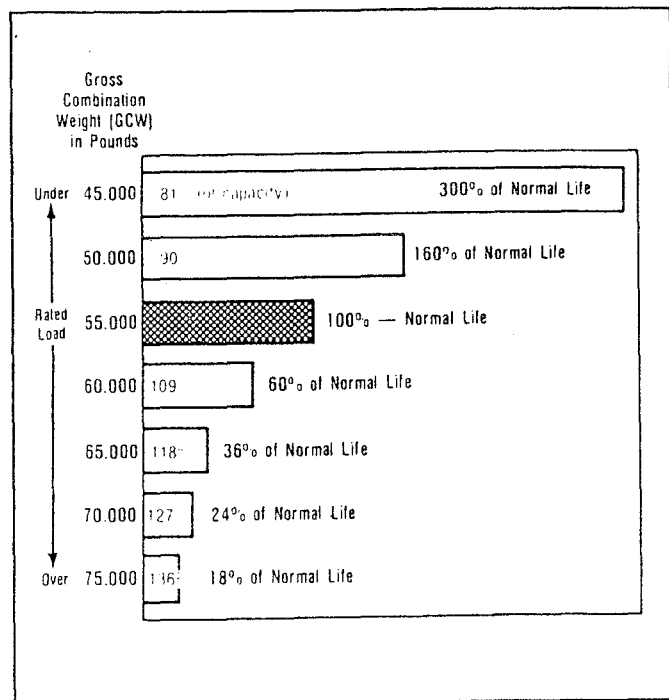


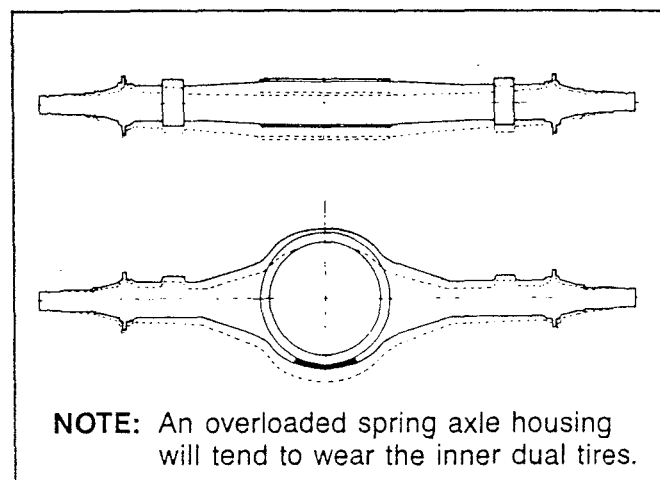
Figure 5-3 — Average Life of Overloaded and Underloaded Gears

Division) indicates the approximate percentage of life expectancy of axle gear sets and other axle parts. The figures are based upon dynamometer tests (conducted by Eaton Axle Division) and are the direct result of accurately simulated load conditions.

NOTE: A gear set operated at its capacity rating will give 100% of rated life.

BENT AXLE HOUSING

Overloads destroy axle housings and flexed housings tend to excessively load inner dual tire. Overloaded wheel bearings fail earlier than normal life. Check for any grease lube leaks at the bottom of the axle housing. A split gasket (shown as the shaded area in Figure 5-4) almost always indicates an overload, or flex and housing distortion, which destroys the gasket between the carrier and the housing.



NOTE: An overloaded spring axle housing will tend to wear the inner dual tires.

Figure 5-4 — Bent Axle Housing

SECTION 6 — BRAKES

GENERAL DESCRIPTION

There are two brake systems on the motor home, the service brakes and the parking brakes.

The service brakes use hydraulic pressure from a foot-pedal-operated master cylinder to actuate cylinders which apply the brakes at each wheel. Fluid lines and hoses connect the master cylinder with each of the wheel cylinders. When the brake pedal is depressed, force is transferred through the pushrod to the master cylinder primary piston, which moves forward. Under normal conditions, the combination of hydraulic pressure and the force of the primary piston spring moves the secondary piston forward at the same time. When the pistons have moved forward, hydraulic pressure is built up and trans-

mitted through the brake hydraulic lines to the front and rear brake assemblies. Hydraulic pressure behind the wheel cylinder cups forces the pistons outward, causing the brakes to be applied. Braking action occurs as a result of friction between the brake lining material and the metal surface of the rotor disc or the drum.

As brake pedal force is reduced, brake fluid pressure in the master cylinder is also reduced. This allows the drum brake retractor springs to retract the shoe and lining assemblies from contact with the drum which forces brake fluid out of the wheel cylinder assemblies and back into the master cylinder assembly. The reduction in fluid pressure also allows the disc brake caliper pistons to retract slightly by action of the piston seal. (See Figure 6-1.)

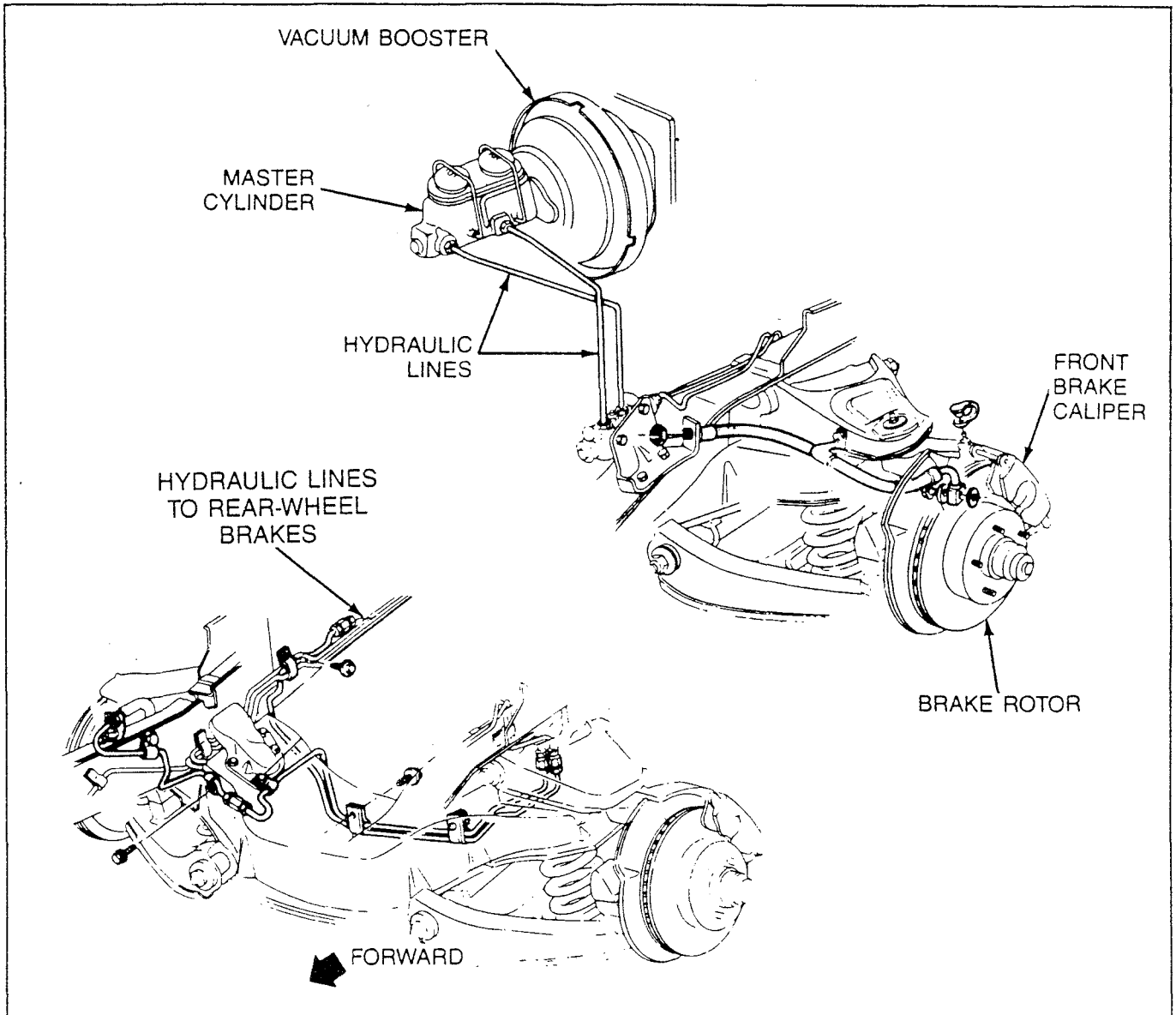


Figure 6-1 — Typical Hydraulic System

DISC BRAKES

Upon application of the brakes, fluid pressure applied to the piston(s) is transmitted to the inner shoe and lining, forcing the lining against the inner rotor surface. The pressure applied to the bottom of the piston bore(s) forces the caliper to slide or move on the mounting bolts toward the inner side, or toward the vehicle. Since the caliper is one piece, this movement toward the vehicle causes the outer section of the caliper to apply pressure against the

back of the outer shoe and lining assembly, forcing the lining against the outer rotor surface. As line pressure builds up, the shoe and lining assemblies are pressed against the rotor surfaces with increased force, bringing the vehicle to a stop. (See Figure 6-2.)

Lining wear is automatically compensated for by the outward movement of the caliper and piston. Brake fluid fills this void as lining wears.

NOTE: Oversize Support Keys are available. Refer to GM Bulletin No. 79-T-25 dated January, 1980 (Appendix 6-1 at the back of this section)

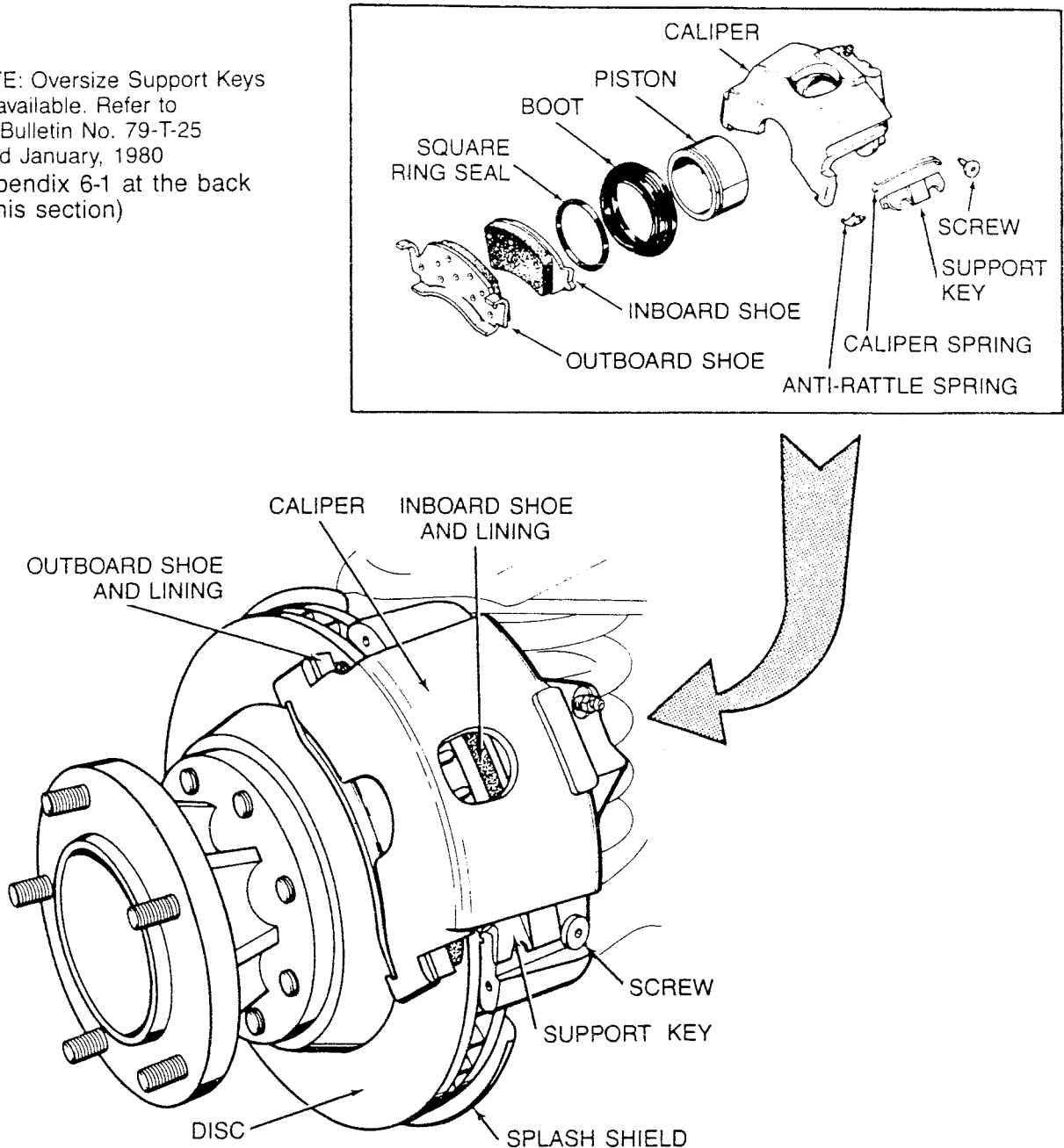


Figure 6-2 — Disc Brake

DRUM BRAKES

When the brake pedal is depressed, fluid is forced through the brake lines into the piston. The wheel cylinder links are then forced out against the brake shoes which exert braking action on the drum. When the pedal is released, the return springs pull the shoes away from the drum. (See Figure 6-3.)

POWER UNITS

Additional braking power is supplied through either a vacuum booster or a Hydro-Boost. The master cylinder is mounted on the forward end of the vacuum booster or Hydro-Boost. (See Figure 6-4.)

The Hydro-Boost utilizes hydraulic pressure supplied from the power steering pump. A spring accumulator is also included in the booster to provide reserve braking power in case pressure from the power steering pump is unavailable. At normal curb idle with 150 lbs. of pedal pressure, the Hydro-Boost could be expected to produce 1,600-1,850 lbs. of line pressure measured at any wheel cylinder bleeder port. Similar pressures could be expected of most vacuum boosters with good engine vacuum.

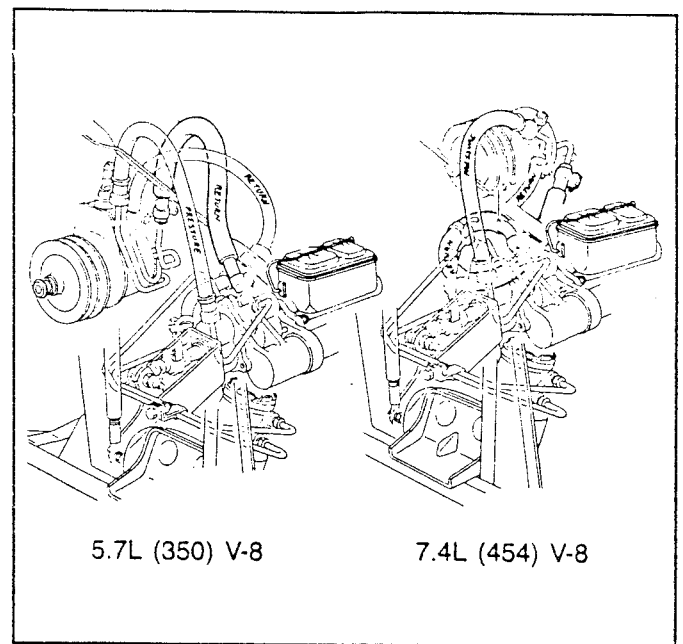


Figure 6-4 — Power Brake Hydro-Boost

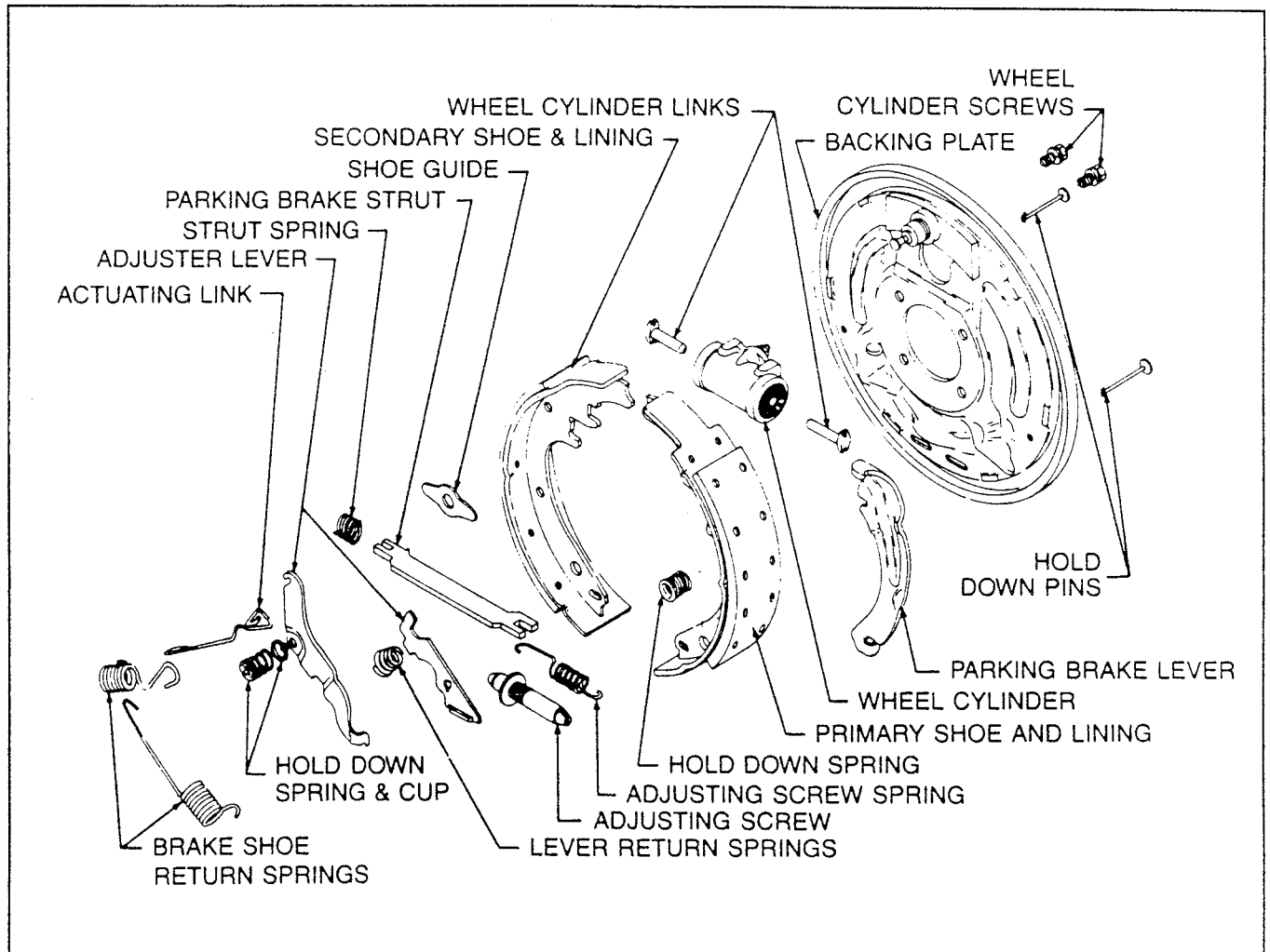


Figure 6-3 — Typical Brake Drum Assembly

PARKING BRAKE(S)

Both the G-Series and P-Series are equipped with a parking brake system. This system is mechanically operated by a lever and strut or a pedal which will activate the rear

brakes only or the propshaft drum brake unit (P-Series motor homes with a GVWR of 14,000 lbs. or more). Very little maintenance is required, but some periodic adjustment is necessary. (See Figure 6-5.)

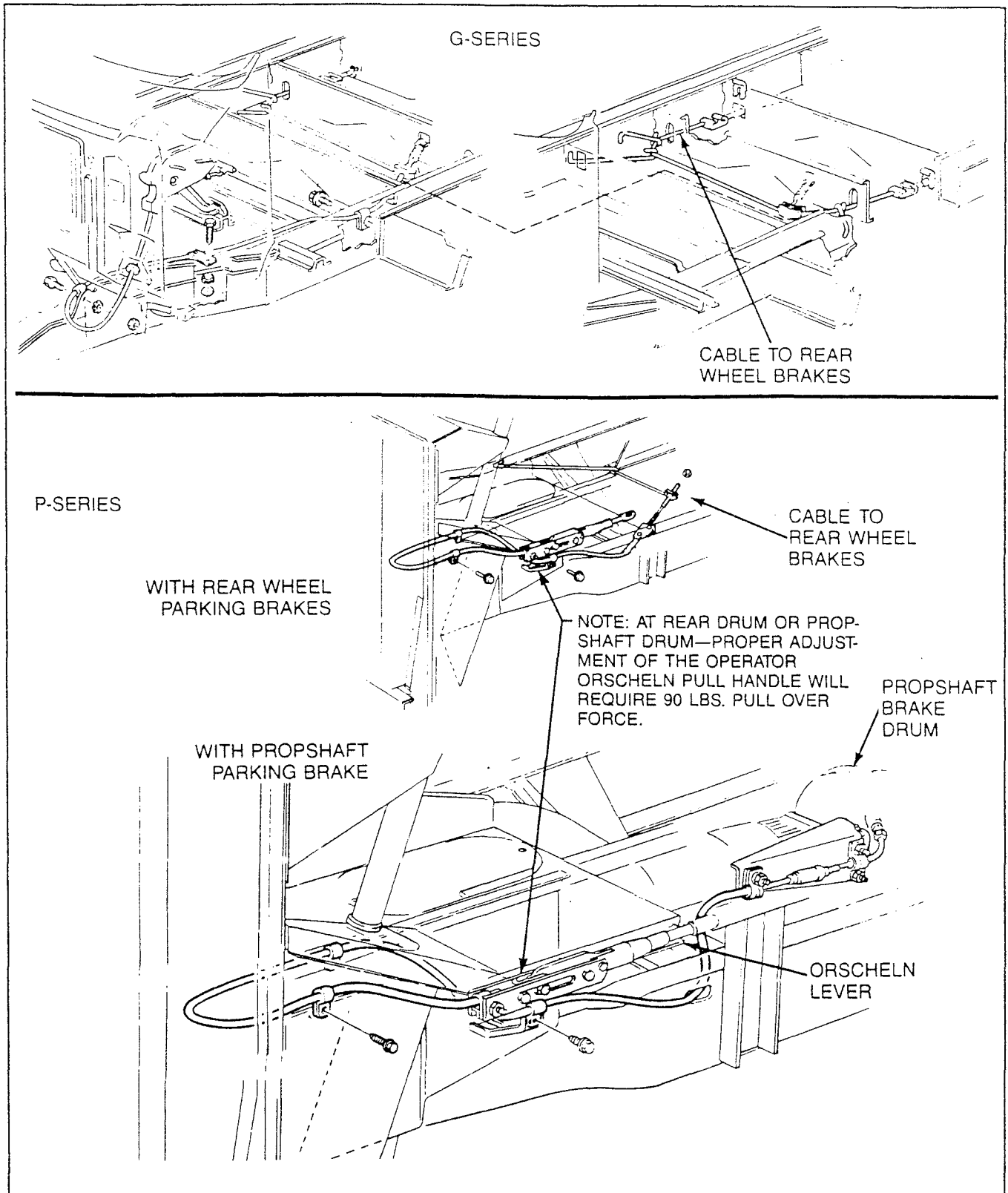


Figure 6-5 — Parking Brake System

MAINTENANCE AND INSPECTION

FILLING THE MASTER CYLINDER

The master cylinder must be kept properly filled to ensure adequate reserve and to prevent air from entering the hydraulic system. However, because of expansion due to heat absorbed from the brakes and from the engine, the master cylinder must not be overfilled.

The master cylinder is located under the floor on the driver's side of the engine (P-Series), or on the cowl (G-Series). The position of the master cylinder on the P-Series may require the use of a flashlight and mirror to check the fluid level.

Thoroughly clean the reservoir cover before removal to avoid getting dirt into the reservoir. Remove the cover and diaphragm. Add fluid as required to bring the level to 1/4 inch (plus or minus 1/8 inch) from the lowest portion of the top of each reservoir. Use Delco Supreme No. II Hydraulic Brake Fluid (DOT No. 3) or equivalent.

Do not use shock absorber fluid or any other fluid which contains mineral oil. Do not use a container which has been used for mineral oil or a container which is wet from water. Mineral oil will cause swelling and distortion of rubber parts in the hydraulic brake system and water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent water contamination.

BRAKE HOSE INSPECTION

The flexible hydraulic brake hose which transmits hydraulic pressure from the steel brake pipe on the frame to the rear axle and to the calipers should be inspected regularly in accordance with the vehicle Maintenance Schedule. The brake hose assembly should be checked for road hazard damage, for cracks and chafing of the outer cover, and for leaks and blisters. A light and mirror may be needed for an adequate inspection. If any of the above conditions are observed on the brake hose, it will be necessary to replace it.

LINING INSPECTION

Inspect the brake linings per the vehicle Maintenance Schedule and any time that the wheels are removed (tire rotation, etc.). Check both ends of the outer shoe by looking at each end of the caliper. Check the lining thickness on the inner shoe by looking down through the inspection hole in the top of the caliper housing. Whenever the lining is worn to the approximate thickness of the shoe, the shoe and lining should be removed. After removal, measure the lining thickness. The shoe and lining should be replaced at any time when the lining is worn to within 1/32 inch of a rivet or of the shoe at any point, or when wear indicator contacts the rotor. Always replace linings in sets (both right and left front).

Some front disc brakes have a wear indicator that makes a noise when the linings wear to a degree where replacement is required. (See Figure 6-6.) The spring clip is an integral part of the inboard shoe and lining. When the lining is worn, the clip contacts the rotor and produces a warning noise.

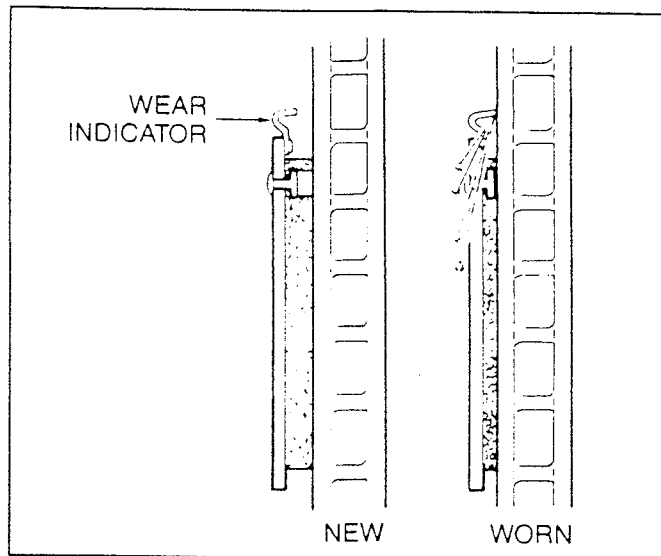


Figure 6-6 — Disc Brake Wear Indicators

Check the flatness of the brake pads. Place inboard and outboard pad surfaces together and check for a gap between the pad surfaces. If more than .005 inch gap is measured at the middle of pad (midway between attaching lugs), the pad must not be used. This applies to new or used brake pads. Whenever the front disc brakes are relined, the rear brakes should also be checked.

BRAKE DRUM INSPECTION

Whenever brake drums are removed, they should be thoroughly cleaned and inspected for cracks, scores, deep grooves and out-of-round.

A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum.

Smooth up any slight scores. Heavy or extensive scoring will cause excessive brake lining wear, and it will probably be necessary to turn the drum on a lathe in order to true up the braking surface.

If the brake linings are slightly worn and the drum is grooved, the drum should be polished with fine emery cloth but should not be turned. At this stage, eliminating the groove in the drum would necessitate removal of too much metal, while if left alone, the grooves and lining ridges match and satisfactory service can be obtained.

If brake linings are to be replaced, a grooved drum should be turned for use with new linings. A grooved drum, if used with new lining, will not only wear the lining, but will make it difficult, if not impossible, to obtain efficient brake performance.

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum can also cause severe and irregular tire tread wear as well as pulsating brake pedal. When the braking surface of a brake drum exceeds the factory specification limits in taper and/or being out-of-round, the drum should be turned to true up the braking surface.

BRAKE ROTOR INSPECTION

To prevent brake roughness, the rubbing surfaces of the rotor must be flat, parallel and with lateral runout held to a minimum. The surface finish should be smooth to avoid pulling or erratic brake performance. Light scoring which results from normal use is not detrimental to brake operation if the scoring does not exceed .015 inch in depth.

Lateral runout, the side-to-side movement of the rotor as it rotates, if excessive (over .004 inch total indicator reading), can cause vibration when the brakes are applied. It is checked using a dial indicator gage which a qualified service shop should have.

DISC BRAKE SQUEAL OR SQUEAK

A persistent amount of "squeal or squeak" is often associated with heavy-duty disc brake usage. These noises are common for both foreign and domestic disc brake systems. Heat, humidity and severity of usage seem to be contributing factors to brake noise. Changing the brake pads, or rotor refinishing as a repair, is often considered a temporary repair, or even by some technicians as useless. The recommended approach is to have an inspection to assure there is free and proper operation of all caliper parts. At this point, the owner should realize that the brake noise exists, but is not detrimental to overall brake life.

BRAKE CALIPER NOISE

Sometimes on vehicles with high mileage, a noise or rattle condition caused by wear at the brake caliper and knuckle slide surfaces may be encountered. This condition does not affect the operation of the brake system, but the noise or rattle condition can be corrected by installing an oversized key and spring available as a service replacement. GM Bulletin 79-T-25 (Jan. 1980) in Appendix 6-1 at the back of this section gives details for selecting the proper size replacement key and installing it.

BLEEDING BRAKE HYDRAULIC SYSTEM

A bleeding operation is necessary to remove air whenever it is introduced into the hydraulic brake system.

It may be necessary to bleed the hydraulic system at all four wheel cylinders if air has been introduced through low fluid level or by disconnecting brake pipes at master cylinder. If a brake pipe is disconnected at any wheel cylinder, then that wheel cylinder only needs to be bled. If pipes are disconnected at any fitting located between master cylinder and wheel cylinders, then all wheel cylinders served by the disconnected pipe must be bled.

NOTE: The following procedure is for manual bleeding of the brakes only. If possible, obtain approved commercial pressure-bleeding equipment or the GM Tools Vacuum Brake Bleeder. (See the GM Wheel Service System Brake Bleeder in Appendix 6-2 at the back of this section for further information regarding Brake Bleeder specifications, usage and ordering information.)

With power brakes, remove the vacuum reserve by applying the brakes several times with the engine off. Then, complete the following steps:

1. Fill the master cylinder reservoirs with brake fluid and keep at least one-half full of fluid during the bleeding operation. (See Figure 6-1.)
2. If the master cylinder is known or suspected to have air in the bore, then it must be bled (before bleeding any wheel cylinder or caliper) in the following manner:
 - a. Disconnect the forward (blind end) brake pipe connection at the master cylinder.
 - b. Allow brake fluid to fill the master cylinder bore until it begins to flow from the forward pipe connector port.
 - c. Connect the forward brake pipe to the master cylinder and tighten.
 - d. Depress the brake pedal slowly one time and hold. Loosen the forward brake pipe connection at the master cylinder to purge air from the bore. Tighten the connection and then release the brake pedal slowly. Wait 15 seconds. Repeat the sequence, including the 15-second wait, until all air is removed from the bore. Care must be taken to prevent brake fluid from contacting any painted surface.
 - e. After all air has been removed at the forward connection, bleed the master cylinder at the rear (cowl) connection in the same manner as the front, as in Step "d" above.
 - f. If it is known that the calipers and wheel cylinders do not contain any air, then it will not be necessary to bleed them.
3. Individual wheel cylinders or calipers are bled only after all air is removed from master cylinder.
 - a. Place a proper size box end wrench over the bleeder valve. Attach transparent tube over valve and allow tube to be hand-submerged in brake fluid in a transparent container. Depress the brake pedal slowly one time and hold. Loosen the bleeder valve to purge the air from the cylinder. Tighten bleeder screw and slowly release pedal. Wait 15 seconds. Repeat the sequence, including the 15-second wait until all air is removed. It may be necessary to repeat the sequence ten or more times to remove all the air.
4. If it is necessary to bleed all of the wheel cylinders and calipers, the following sequence should be followed:
 - 1) Right-rear wheel cylinder; 2) Left-rear wheel cylinder; 3) Right-front caliper; 4) Left-front caliper.
5. Check the brake pedal for "sponginess" and the brake warning light for indication of unbalanced pressure. Repeat entire bleeding procedure to correct either of these two conditions.

BLEEDING HYDRO-BOOST BRAKE SYSTEM

Whenever the booster is removed and reinstalled, the steering system should be bled as outlined below.

NOTE: Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.

1. Fill fluid reservoir to the proper level and let the fluid remain undisturbed for at least two minutes.
2. Start the engine and let it run momentarily.
3. Add fluid if necessary.
4. Repeat above procedure until the fluid level remains constant after running engine.
5. Raise front end of the vehicle so that the wheels are off the ground.
6. Turn the wheels (off ground) right and left, lightly contacting the wheel stops.
7. Add fluid if necessary.
8. Lower the vehicle.
9. Start engine and depress the brake pedal several times while rotating the steering wheel from stop to stop.
10. Turn engine off and then pump the brake pedal 4-5 times to deplete accumulator pressure.
11. Check the fluid level and refill as required.
12. If fluid is extremely foamy, allow vehicle to stand for a few minutes with the engine off and repeat above procedure.
 - a. Check belt tightness and check for a bent pulley. (Pulley should not wobble with engine running.)
 - b. Check to make sure hoses are not touching any other parts of the vehicle, particularly the sheet metal.
 - c. Check the reservoir fluid level, filling it to the proper level if necessary, following operations 1 through 10. This step and Step "d" are extremely important as low fluid level and/or air in the fluid are the most frequent causes of objectionable pump noises.
 - d. Check for the presence of air in the fluid. Air will show up as milky-appearing fluid. If air is present, attempt to bleed the system as described in operations 1 through 10. If it becomes obvious that the pump will not bleed after a few trials, refer to the appropriate shop manual for more detailed test procedures.

13. The presence of trapped air in the system will cause the fluid level in the pump to rise when the engine is turned off. Continue to bleed the system until this condition no longer occurs.

POWER BRAKE UNITS

The hydraulic lines connecting the power steering pump, Hydro-Boost unit and steering gear, as well as the components themselves, should be checked regularly for signs of leaks, damage or deterioration on vehicles so equipped.

For vehicles with vacuum boosters, inspect the vacuum hoses and booster chamber for damage or deterioration.

NOTE: Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.

Both the vacuum booster and Hydro-Boost should be serviced by a qualified repairman.

PARKING BRAKE

Adjustment of parking brake cable is necessary whenever holding ability is not adequate or whenever the center brake cables have been disconnected. An improperly adjusted parking brake cable may also cause the brakes to drag.

The service brakes must be properly adjusted as a base for parking brake adjustment; conversely, the parking brake must be properly adjusted for the service brake to function as intended.

Inspection

If complete release of the parking brake is not obtained, unless it is forcibly returned to its released position, or if application effort is high, check parking brake assembly for free operation. If operation is sticky or a bind is experienced, correct as follows:

1. Clean and lubricate brake cables and equalizer with Delco Brake Lube (or equivalent).
2. Inspect brake assembly for straightness and alignment (replace if necessary).
3. Clean and lubricate parking brake assembly with Delco Brake Lube (or equivalent).
4. Check routing of cables for kinks or binding.

Cable Adjustment

FOOT PEDAL TYPE (G-SERIES)—

Before adjusting parking brake, check service brake condition and adjustment.

1. Loosen the equalizer adjusting nut.
2. Apply parking brake four notches from fully released position.
3. Tighten the equalizer nut until a moderate drag is felt.

when the rear wheels are rotated forward. (See NOTE at the end of this procedure.)

4. Fully release parking brake and rotate the rear wheels. No drag should be present.

ORCHELN LEVER TYPE (P-SERIES)—

1. Turn adjusting knob on parking brake lever counterclockwise to stop.
2. Apply parking brake.
3. Loosen nut at intermediate cable equalizer and then adjust nut to give light drag at rear wheels. (See NOTE at the end of this procedure.)
4. Readjust parking brake lever knob to give a definite snap-over-center feel. Proper pull-over force is 90 pounds.

NOTE: This fastener is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one having the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design.

Propeller Shaft Drum-Type Brake Adjustment (Adjustment—Drum On)

Refer to Figure 6-8.

1. Using a jack, raise vehicle so that at least one rear wheel is off ground. Block wheels and release the hand brake.

2. Remove cotter pin and clevis pin connecting the pull rod and relay lever. This will assure freedom for full shoe release.

NOTE: It may be necessary to knock out lanced area in brake drum (or backing plate) with punch and hammer to gain entry to adjusting screw through brake drum. Be sure to remove any metal that has fallen inside the parking brake drum.

3. Rotate brake drum to bring one of the access holes in-line with adjusting screw at bottom of shoes (manual transmission), or top of shoes (automatic transmission).
4. Expand shoes by rotating adjusting screws with a screwdriver inserted through hole in the drum. Move outer end of screwdriver away from the drive shaft. Continue adjustment until shoes are tight against drum and drum cannot be rotated by hand. Back off adjustment 10 notches and check drum for free rotation.
5. Place parking brake lever in the fully released position. Take up slack in the brake linkage by pulling back on cable just enough to overcome spring tension. Adjust clevis of the pull rod or front cable to line up with hole in the relay levers.

- a. Insert clevis pin and cotter pin, then tighten clevis locknut.
- b. Install a new metal hole cover in drum to prevent contamination of the brake.
- c. Lower rear wheels. Remove jack and wheel blocks. See Note under Cable Adjustment procedure in this section.

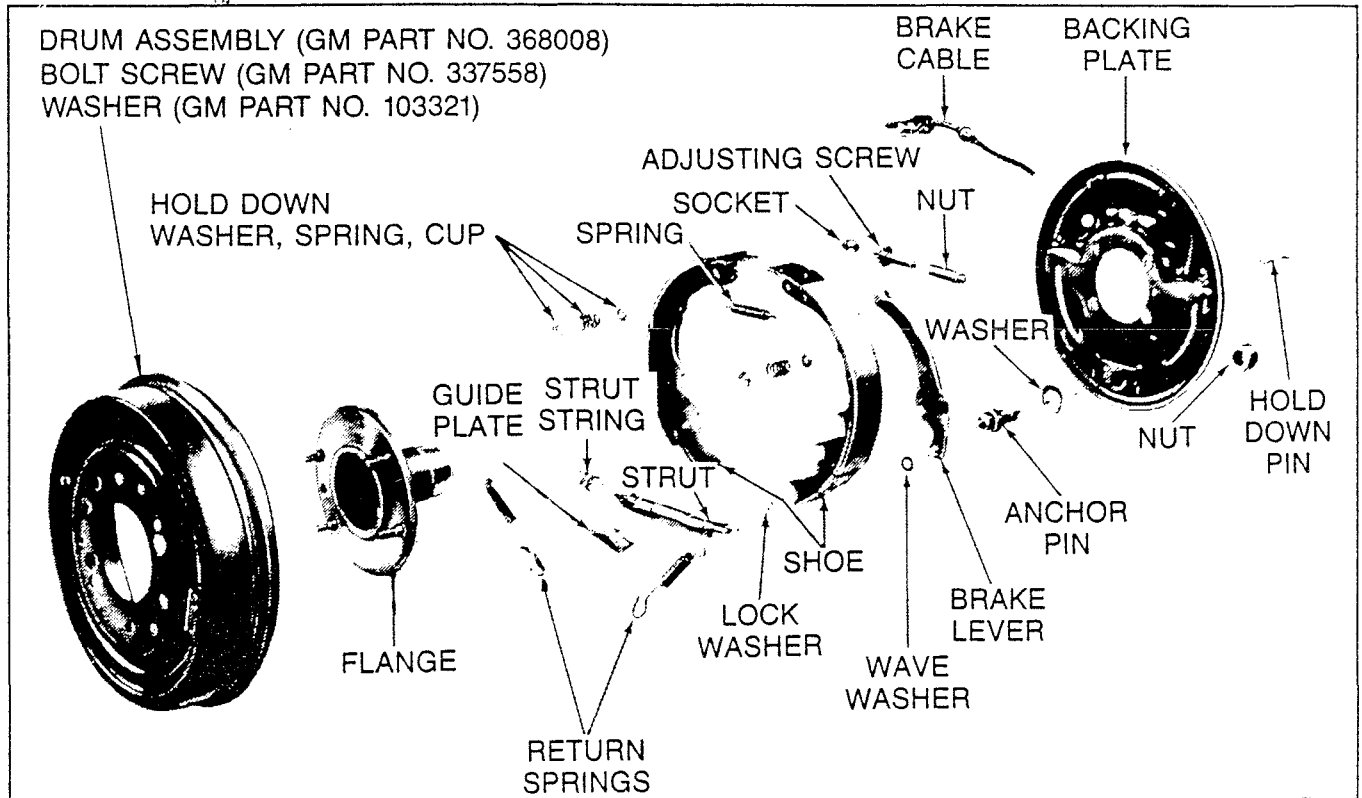


Figure 6-8 — Propeller Shaft Drum Brake

BRAKES

APPENDIX 6-1 — BRAKE CALIPER NOISE

Reference: General Motors Dealer Service Technical Bulletin No. 79-T-25 (January, 1980)

1974-1979 G-, P-30 Series Models with JB-8 or JF-9 Brake Option

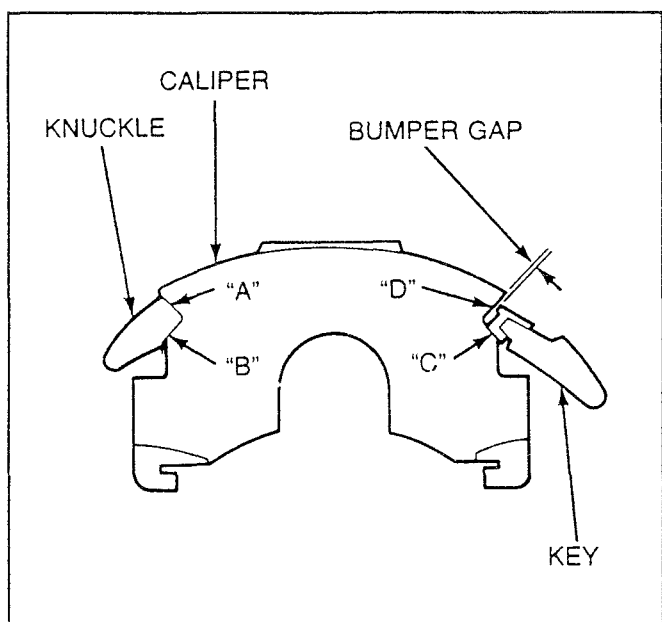
The following information has been extracted from the above referenced bulletin.

A noise or rattle condition caused by wear at the brake caliper and knuckle slide surface may be reported on some high-mileage vehicles as a loose or rattling front end on all but smooth roads. This condition does not affect the operation of the brake system. The JB-8 and JF-9 brake systems have a caliper retention design which incorporates a key and a leaf spring retained in a "V" groove.

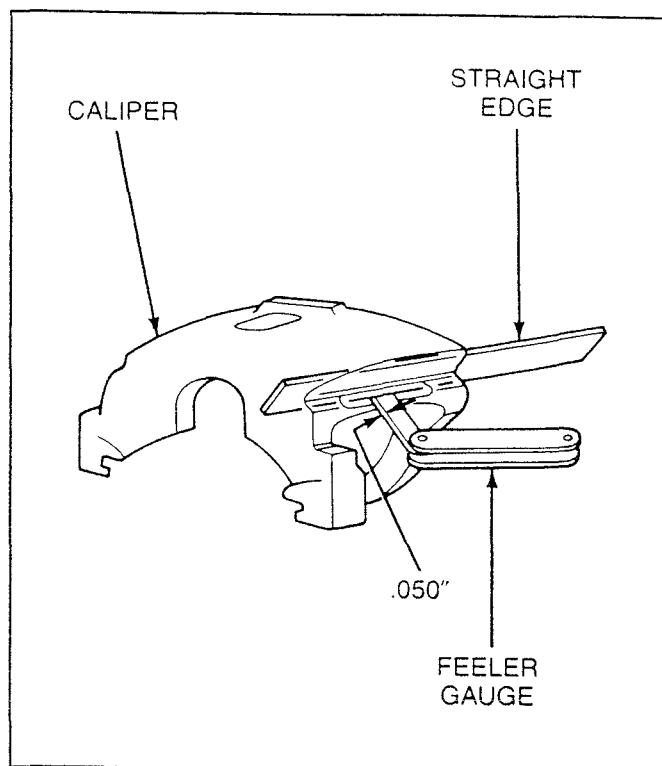
Vehicles which have the caliper rattle condition can be corrected by installing an oversized key and newly designed leaf spring available from General Motors Parts Division. The service keys will be available in five sizes (at .040 inch increments) to compensate for varying degrees of wear.

Follow the procedure given below for correction of complaint vehicles:

1. Remove caliper from knuckle by unscrewing key retention screw and tapping out key and spring.
2. Clean surfaces "A," "B," "C," and "D" (shown in the following illustration) with a wire brush, filing smooth any nicks and/or gouges.



3. Lay a straight edge across the forward caliper surfaces "C" and "D" (shown in the following illustration) and measure with a feeler gage the maximum depth of any wear on these surfaces. Calipers worn to a depth of .050 inch or more should be replaced.

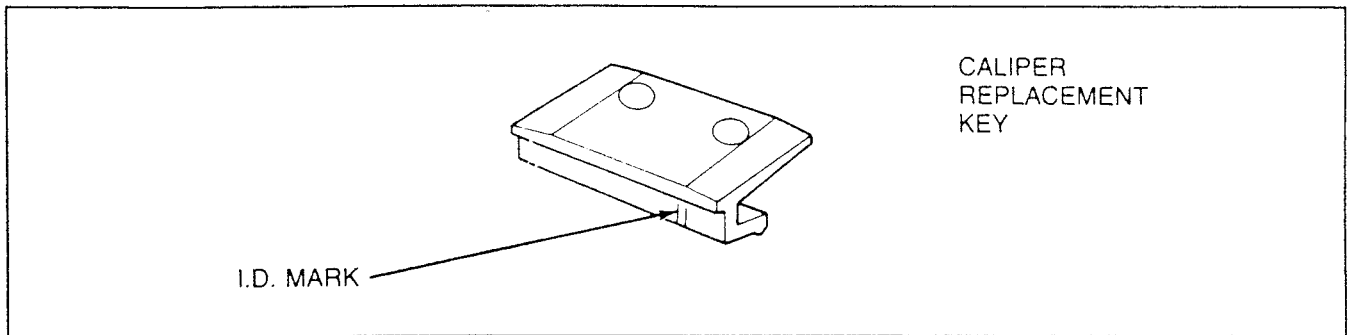


4. Reinstall the caliper back into the knuckle. Install a new standard size key and reinstall the key retention screw, but do not install the caliper support spring at this time.
5. Insert a screw driver into center of key/bumper gap and pry firmly to assure that caliper is seated against three slide surfaces— "A," "B," "C."
6. Measure bumper gap with largest feeler gage (or stack of gages) that will fit into the gap for its full length.
7. Select a replacement key according to the following table:

BRAKES

APPENDIX 6-1 — BRAKE CALIPER NOISE (CONT'D.)

BUMPER GAP (IN.)		REPLACEMENT KEY I.D.	PART NO.
MORE THAN	BUT NOT EXCEEDING		
0	.060	Standard Size 1	14026792
.060	.100	.040 Oversized 11	14026793
.100	.140	.080 Oversized 111	14026794
.140	.180	.120 Oversized 1111	14026795
.180	.220	.160 Oversized 11111	14026796
.220	—	Replace Anchor Plate-Knuckle and Caliper and use new standard size key and new spring.	

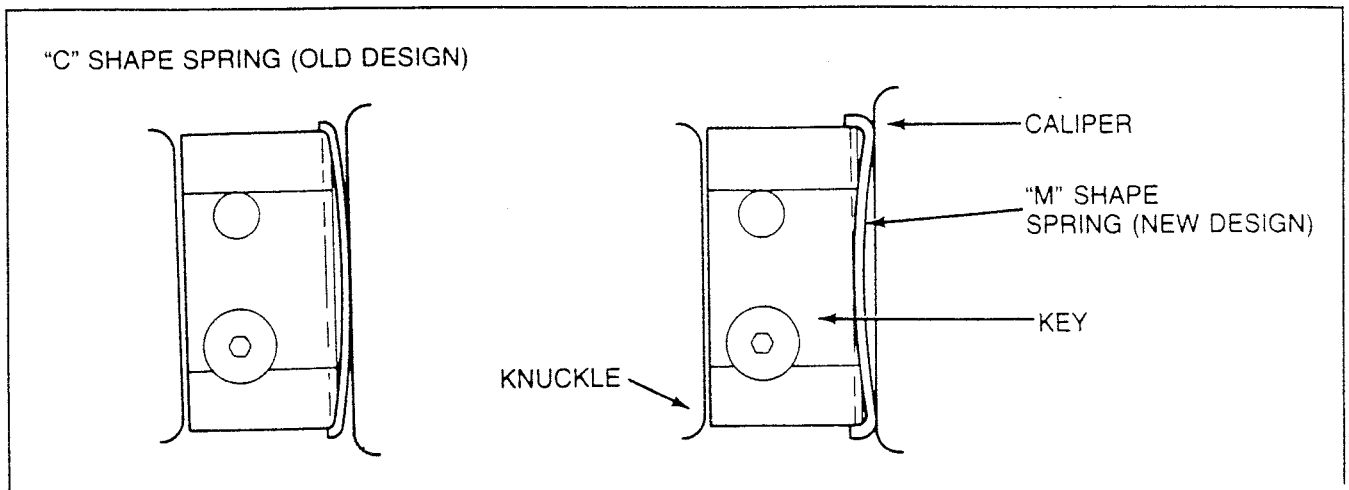


8. Install selected replacement key and new design spring, GM Part No. 14023437, and reinstall retention screw.

wear, replace with new part (GM Part No. 331478).

NOTE:

- If retention screw is damaged or shows signs of excessive wear, replace with new part (GM Part No. 331478).
- The spring has been redesigned from a "C" to an "M" shape. The "M" spring must be installed with the large radius in contact with the key.



BRAKES

APPENDIX 6-2 — VACUUM BRAKE BLEEDER

The following information has been extracted from the GM Dealer Equipment Catalog. Vacuum brake bleeder features, specifications and ordering information has been described.

FEATURES

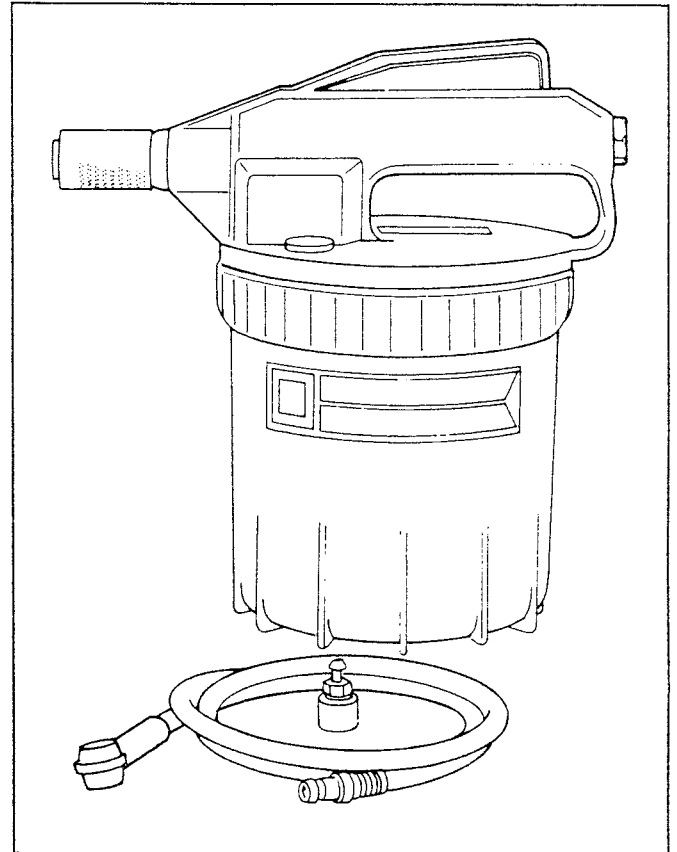
- Vacuum operation
- Can be used for all types of cars, trucks, busses and motor bikes.
- Fluid is retained in the canister, eliminating costly paint damage from splashing.
- Brake set equipped with universal rubber connector on 40-inch quick-connect tubing and GM adapter.

HOW IT WORKS

The brake bleeder is used as outlined below:

1. Connect the brake bleeder to an air supply (80 to 175 PSI) and the hose with the rubber connector end to the brake bleed screw.
2. Depress the lever on the bleeder top to create a vacuum in the canister.
3. Apply a suitable wrench to the bleed screw, and open. Air and brake fluid will now be drawn out of the system.

TO ORDER:
Call: 1-800-GM TOOLS
Part No. 039 00001

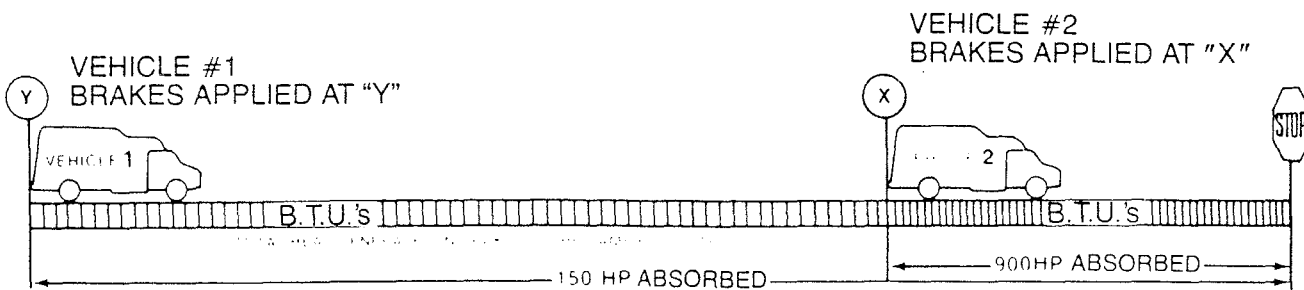


SPECIFICATIONS

Air consumption 7.4 CFM
Min. vacuum capacity 60%
Connection thread 1/4-inch female thread
Canister volume 40 gal.

BRAKES

APPENDIX 6-3 — BRAKE LINING LIFE EXPECTANCY



VEHICLE #1 AND VEHICLE #2 TRAVELING AT SAME SPEED WHEN BRAKES ARE APPLIED

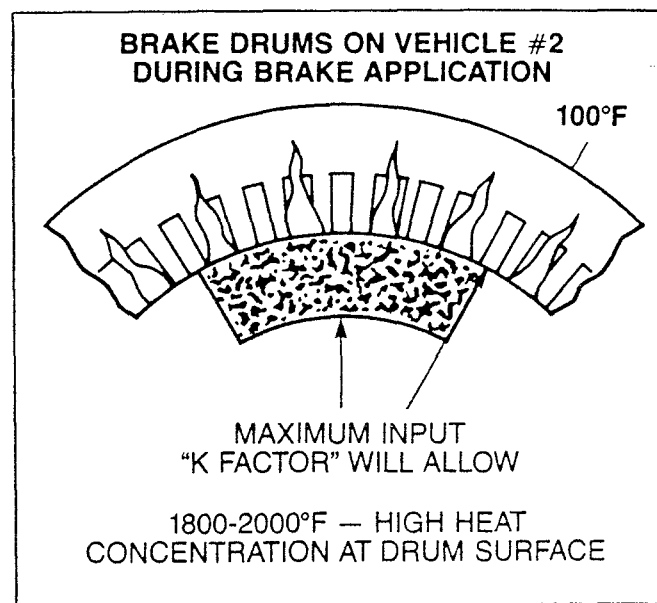
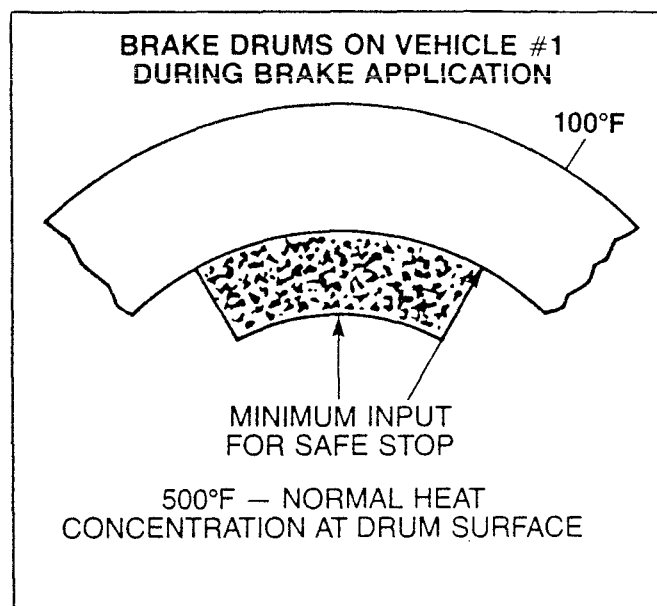
The following information is provided courtesy of Gray-Rock Company as an aid to the motor home owner in understanding brake lining life expectancy and premature drum failure. GM provides no statement as to the accuracy of this information, although it would appear to be correct.

A brake is a heat machine. A soft touch on the brakes pays off in any model vehicle in the form of brake life and fuel economy. Each time brakes are applied, you are converting forward motion (that you bought and paid for as fuel costs) into heat energy of stopping.

Brakes change energy of motion to heat energy, and this energy is the same for *any* stop from a given speed. Many drivers take advantage of good brakes by stopping in shorter distances than necessary. The following example demonstrates improper braking techniques and the results. (See diagram above.)

Assume both drivers (Vehicle No. 1 and No. 2) are operating identical vehicles and making a stop from the same speed. Vehicle No. 1 anticipates the stop and applies the brakes at point "Y" as shown in the diagram. Heat is generated at a rate that the brakes of Vehicle No. 1 can handle—about 500°F at drum surface. The driver of Vehicle No. 2, shown in the diagram, doesn't apply his brakes until he reaches point "X".

Although the work load on the brakes of both vehicles is the same, in the case of Vehicle No. 2, the work load is "poured" into the brakes in 1/6th the time. This means that the brakes must absorb 900 horsepower instead of just 150. Vehicle No. 2 develops up to 2,000°F temperature at drum surface and at a rate faster than it can be transferred and dissipated. The result is short lining life and premature drum failure.



SECTION 7 — ENGINE

Your Chevrolet Motor Home Chassis is equipped with either the 5.7L or 7.4L (Mark IV) gasoline engine or the 6.2L diesel engine. Both the gasoline and diesel engines are four-cycle designs. That is, there are four distinct strokes, intake, compression, power and exhaust in the power cycle of each engine cylinder. The power cycle of a cylinder takes place through two revolutions of the crankshaft.

NOTE: There is a "truck rule of thumb" that says, "For good engine life, the engine shall not cruise for long periods of time at speeds in excess of 80-90% of engine governed speed or as rated." Full-rated speed is acceptable for short durations such as when the transmission is going through its shift points. The chart shown in Figure 7-1 shows the general relationship of engine speed to engine life.

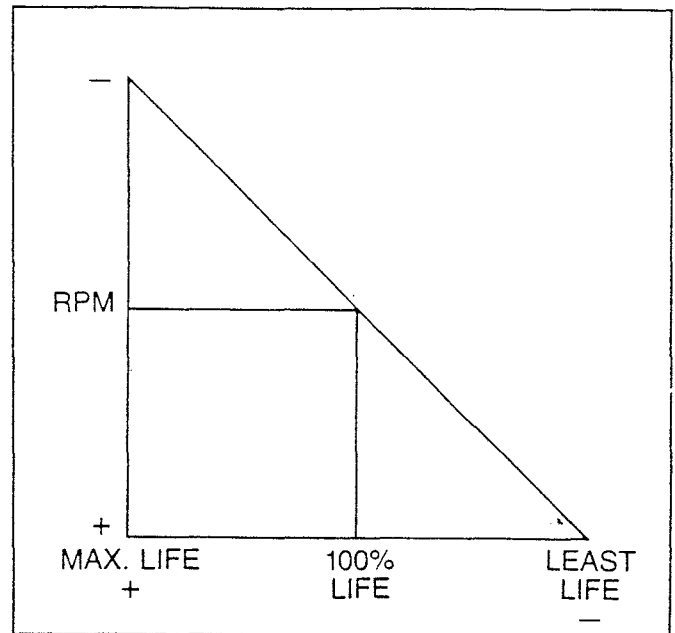


Figure 7-1 — Engine Speed to Engine Life

GASOLINE ENGINE

Both the 5.7L (350 Cubic Inch Displacement) and the 7.4L Mark IV (454 Cubic Inch Displacement) engines have eight cylinders and are designed to operate on no-lead gasoline.

Each is equipped with an electronic ignition system which has no breaker points or condenser. The system uses a spark plug in each cylinder to start combustion.

DIESEL ENGINE

The engine is a V-8, 6.2L engine. This engine is similar to a V-8 gasoline engine in many ways but major differences exist in the cylinder heads, combustion chamber, fuel distribution system, air intake manifold and the method of ignition. The cylinder block, crankshaft, main bearings, rods, pistons and wrist pins are similar to those on a

gasoline engine but are of a heavy-duty design because of the high compression ratio required in the diesel engine to ignite fuel. Ignition of the fuel in a diesel engine occurs because of heat developed in the combustion chamber during the compression stroke. Thus, no spark plugs or high-voltage ignition are necessary for a diesel engine.

SECTION 7 — ENGINE

ENGINE LUBRICATION

GENERAL DESCRIPTION

The oil pan acts as a reservoir for holding the oil waiting to be circulated through the engine. The oil pan is attached to the bottom side or pan rail of the engine.

A pressure-feed type pump is mounted to the bottom side of the rear main bearing cap.

Extending down from the pump and into the oil, is a pick-up tube with a screen cover to filter out foreign material. Oil is picked up by this tube and pumped through the gear-type oil pump. In the gasoline engines, the distributor, driven by a helical gear on the camshaft, drives the oil pump. For the diesel engine, the pump is driven from the engine camshaft by means of an intermediate shaft. The oil is next pumped from the engine and through a cooler located in front of the radiator which cools the oil and thus helps to remove engine heat (Figure 7-2).

From the cooler, the oil passes through a filter. If this full-flow filter becomes clogged, the engine is equipped with a bypass valve which is spring loaded. This valve protects the engine from oil starvation, by opening when increas-

ed pump pressure tries to pump oil through a clogged filter. When the pressure causes the bypass valve to open, the oil bypasses the filter, and the engine continues to receive lubrication. Replacement of the filter at proper intervals will prevent damage to the engine due to a clogged filter.

From the filter, the oil is pumped through the drilled galleries in the case to the various moving metal parts in the engine. After being pumped to the critical engine parts, oil drains back to the crankcase. Also, as the crankshaft rotates, it slings oil off the crankpins to cover cylinder wall pistons, piston pin and piston rings. Oil drains off these parts and back to the engine pan.

There is also a second bypass valve. This is the oil-cooled bypass valve. It works much the same as the oil filter bypass valve and opens to allow an alternate route for the oil if the cooler should become clogged.

There is an oil pressure switch which is assembled to the top rear of the cylinder block to sense oil pressure in the main gallery.

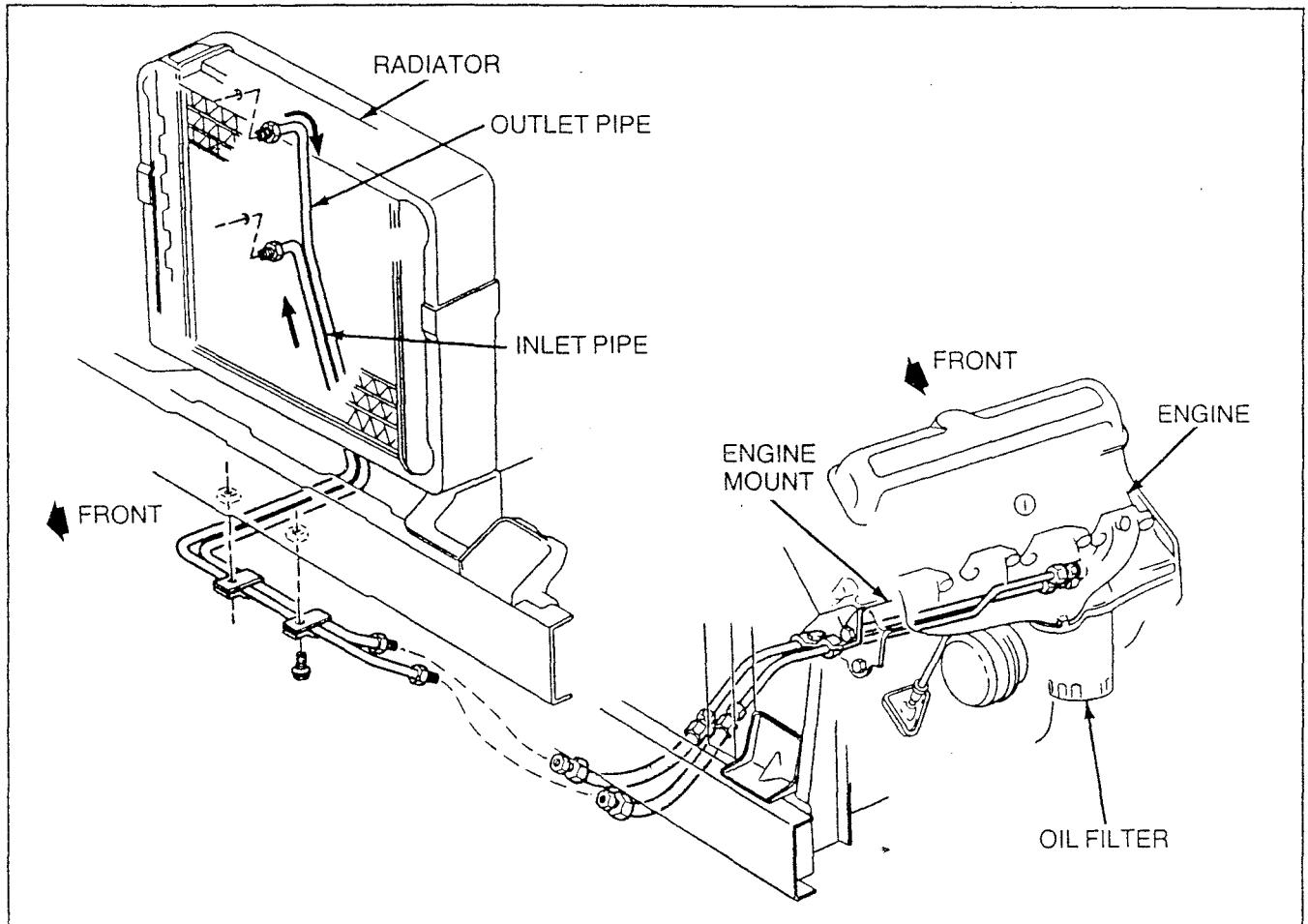


Figure 7-2 — Engine Oil Cooler Installation — Mark IV — Typical

OILS QUALITY

Engine oils are labeled on the containers with various API (American Petroleum Institute) designations of quality. For gasoline engines, Chevrolet recommends the use of an oil with the API designation "SF," either alone or shown with other designations such as "SF/CC." Oils which are **not** labeled "SF" should not be used. For diesel engines, Chevrolet recommends the use of oil designated "SF/CC" or "SF/CD." Other designations including "SF" alone should not be used for diesel engines. Using oils of a quality other than those recommended for Chevrolet gasoline and diesel engines respectively could cause engine damage.

VISCOSITY

Engine oil viscosity (thickness) has an effect on fuel economy. Lower viscosity engine oils can provide better fuel economy; however higher temperature weather conditions require higher viscosity engine oils for satisfactory lubrication. **Using any viscosity oils other than those recommended could cause engine damage.**

When choosing an oil, consider the range of temperature your vehicle will be operated in before the next oil change. Then, select the recommended oil viscosity from the applicable chart shown in Figure 7-3 or Figure 7-4.

GASOLINE ENGINES—For temperatures above 0°F, SAE 10W-30, is preferred for a single choice multi-viscosity oil. However, for heavy-duty expressway driving in summer temperatures, there can be an advantage to a single-viscosity straight SF/CC 30 oil.

NOTE: 10W-40 is missing from the chart shown in Figure 7-3. 10W-40 has been removed from all GM recommendations, because GM Research Laboratories have found generally a 1.2% fuel economy penalty compared to 10W-30. Of the oils surveyed, some contained inadequate additives or even no additives and some did not meet the 10W-40 viscosity requirements. GM testing showed 10W-40 oils tended to be more prone to high-mileage ring sticking. These problems appeared more frequently in 10W-40 oils than in 10W-30 oils.

As a rule of thumb, in heavy-duty applications and sustained high-speed expressway driving, a single viscosity grade oil such as SAE 30 will be more satisfactory than multi-viscosity oils such as SAE 10W-30. Multi-viscosity oils have an advantage of cold weather starting ease and better initial lubrication with cold engine oils.

Notice that on the temperature chart shown in Figure 7-3, there is a trend away from the thinner viscosities as temperature goes up. The reason is that light oils do not have enough body for heavy-duty loads and high temperatures.

DIESEL ENGINES—For temperatures above 32°F, SAE 30 is the preferred viscosity grade. SAE 30 oil is also preferred for continuous daily driving and all driving where the temperature will not be less than 32°F.

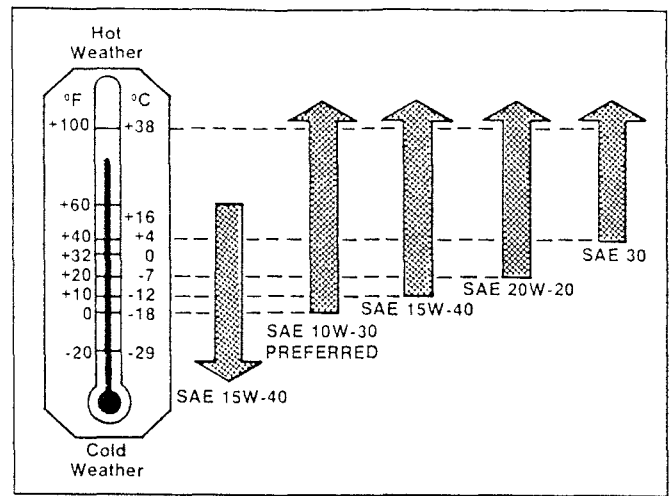


Figure 7-3 — Oil Viscosity Chart — Gasoline Engine

The best lubricating oil you can use in diesel engines is SAE 30 SF/CD; however, SAE 30 SF/CC quality is acceptable. These oils combine excellent film strength with the best available additive package to prevent wear and protect against piston ring sticking at higher mileages. **DO NOT USE SAE 10W-40 oils in diesel engines, because most of them can cause piston ring sticking and engine damage.**

SAE 30 SF/CD and SF/CC oils are generally not suitable when temperatures fall below 32°F because of cold starting considerations. The use of SAE 15W-40 SF/CD or SF/CC at these lower temperatures (and in extremely cold areas SAE 10W-30 SF/CD or SF/CC) may be necessary. Study the chart shown in Figure 7-4 carefully and follow its recommendations. As always, **NEVER** exceed the recommended oil change intervals since oil quality deteriorates rapidly with mileage, as carbon accumulates in the oil.

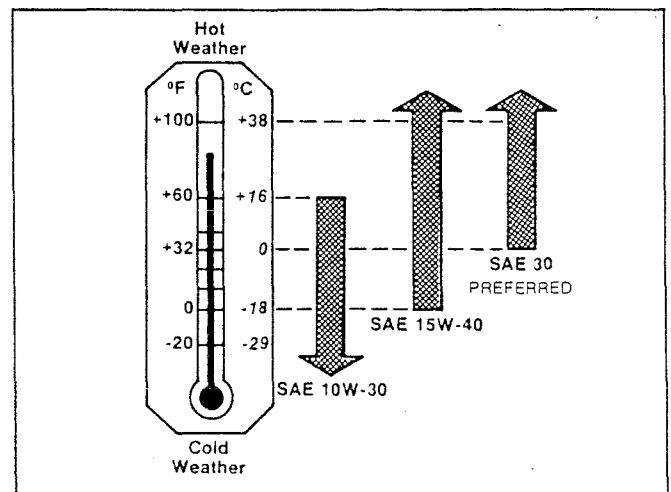


Figure 7-4 — Oil Viscosity Chart — Diesel Engine

SF/CD oils have generally proven to be the most successful oils in diesel applications. The diesel combustion process tends to produce sticking piston rings, and high-sulfur fuels create problems that SF/CD chemistry is best suited to correct. Purchase fuels with a sulfur content of less than 0.4%. When sulfur content raises to between 0.4% and 1.0%, it is a good practice to change oil at one-half the normal interval. When fuel sulfur content is above 1.0%, oil should be changed at one-fourth the normal interval.

SF/CC oils are generally best suited to gasoline engines. Gasoline engines do not have to cope with much of a sulfur problem and rarely develop ring sticking problems with proper oil change intervals. Gasoline engines, because of their temperatures and flat tappet cams, need oils of superior antiwear properties and the SF/CC chemistry is much better for this application.

ENERGY CONSERVING OILS

It is recommended that you select an oil not only of the proper quality and viscosity, but also a fuel-saving product. These oils can be found in dealer service departments, service stations and other retail stores. They are identified by words such as: "Energy Conserving," "Energy Saving," "Conserves Gasoline," "Gas Saving," "Gasoline Saving," "Friction Reducing," "Improved Gasoline Mileage," "Improved Fuel Economy" or "Fuel Saving," etc. **Be sure the fuel-saving oil you choose is of the recommended viscosity and API designations.** Some fuel-saving oils **do not** meet the requirements necessary for your vehicle's engine.

SYNTHETIC ENGINE OILS

Synthetic engine oils and conventional, mineral-oil-based engine oils have some similarities. They are both blends of base oils and additives. In fact, most of the additives used in synthetic engine oils, are identical to those used in conventional engine oils; in at least one so-called synthetic oil, mineral oil is used as the base.

The mineral oil used in conventional engine oils is a mixture of hydrocarbons (hydrogen and carbon) obtained from crude oil pumped from the ground and refined by physical separation processes such as distillation and solvent extraction. The base oil used in most synthetic engine oils is obtained by chemical reaction processes involving materials produced from the same crude oil. For example, an acid and an alcohol can be obtained from crude oil and reacted to produce an ester—a commonly used synthetic base oil—which is a fluid composed of hydrogen, carbon and oxygen.

The performance quality of a finished engine oil, either conventional or synthetic, depends on a careful selection of the base oil and additives to produce the desired characteristics.

Chevrolet currently recommends the use of SF engine oil only. To determine whether an oil meets SF quality requirements, engine dynamometer tests (called Sequence Tests) are run which evaluate the ability of the oil to prevent wear, deposits, and rust and corrosion, as well as thickening of the oil itself.

The Sequence Tests have been carefully developed over many years to ensure that an SF engine oil will perform satisfactorily in car engines under a wide variety of service conditions. Oil change intervals are selected based on many miles of car test and field service experience. Oil quality, engine design, type of service, and change interval, must be carefully balanced to ensure satisfactory engine performance and durability. The current recommended oil change intervals apply to any SF engine oil, conventional or synthetic.

Information currently available on synthetic oils does **not** justify any additional lengthening of the oil change intervals. Any engine part failures caused by using an oil beyond the recommended change intervals **will not** be covered under the New Vehicle Warranty.

MAINTENANCE AND INSPECTION

To provide proper lubrication for the engine and to help prevent engine damage, the oil level should be checked periodically to ensure that there is an adequate amount of oil. Also, the engine oil must be drained and replaced with fresh oil, and the oil filter replaced at the intervals recommended in the appropriate Maintenance Schedule.

CHECKING OIL LEVEL

- **Warm**— The best time to check the engine oil level is when the oil is warm, such as during a fuel stop. First, allow a minimum of 10 minutes for the oil to drain back to the oil pan. Then pull the dipstick out, wipe it clean and push it back down all the way.

NOTE: Failure to allow sufficient time for the oil to drain back into the oil pan can give an erroneous low oil reading and the appearance of excessive oil consumption. This applies to both gasoline and diesel engines. Approximately ten minutes are required for full drain back.

Now pull the dipstick out and look at the oil level on the dipstick. Some dipsticks are marked with "Add" and "Full" lines. Others are marked "Add 1 Qt." and "Operating Range." In all cases, keep the oil level above the "Add" line. Push the dipstick back down all the way after taking the reading. Add oil if needed.

- **Cold**— If you check the oil level when the oil is cold, do not run the engine first. The cold oil will not drain back to the pan fast enough to give a true oil level.

A good method of checking oil is as follows: At the end of a day's driving, pull the dipstick out slightly from the tube so that the tube is not sealed by the cap at the top of the dipstick. Leave the dipstick in this position overnight. Before starting the engine again the following day, seat the dipstick and check the oil level. This method will allow the oil to drain down easily and provide a more accurate reading.

CHANGING THE OIL

Oil can be drained from the engine through the drain hole in the bottom of the oil pan. Replacing oil is added through the fill tube at the top of the engine and near the radiator.

Generally, the recommended oil change intervals for heavy-duty service is 3,000 miles. More frequent intervals are recommended if any of the following severe operating conditions are encountered:

- Frequent long runs at high speeds and high ambient temperatures
- Operating in dusty areas
- Towing a trailer
- Idling for extended periods and/or low-speed operation
- Operating when outside temperatures remain below freezing and when most trips are less than 4 miles (6 kilometers).

NOTE: Refer to the owner's manual and vehicle Maintenance Schedule for the oil type, viscosity and alternate change intervals recommended for the operating conditions encountered.

CHANGING THE OIL FILTER

The oil filter is a spin-on type which can be removed with a band-type filter wrench. The replacing filter should be installed and hand tightened following the instructions with the filter.

454 ENGINE OIL FILL CAPACITY

The 454 engine used in the motor home has a crankcase capacity of six (6) quarts plus one (1) quart for the AC-PF35 oil filter for a total of seven (7) quarts. The seven (7) quart system has been in place for many years.

NOTE: After an oil and filter change, an incorrect dipstick reading could occur showing an overfill. Chevrolet has determined the problem to be in the dipstick and/or tube calibration. Through the process of converting to metric, several different parts sources, and some stack-up and assembly tolerance, it is difficult to fully understand the problem. Chevrolet has determined that there is not a durability problem with operating the seven (7) quart system down as much as two (2) quarts. Nevertheless, to comply with the original design criteria and for other technical reasons, it is recommended you verify the dipstick calibration.

An accurate procedure is as follows:

1. Drain the engine oil when hot. Do not change the filter at this time. Allow 10 minutes drain-down time.

2. Fill the crankcase with 5 quarts of oil. Wait 10 minutes to assure full drain-down from the rockers and heads.
3. Dipstick the engine, and with a small three-cornered file, make a mark at the fluid edge in the dipstick that will indicate the new "Add Oil" mark.
4. Add one more quart of oil, wait 10 minutes, recheck the oil, and with the file, make a second mark at the fluid edge. You now have established the "Full" mark.
5. Now change the AC-PF35 filter and add one more quart of oil. Start the engine and double check for oil leaks.

NOTE: GM has designed a new dipstick and tube assembly that entered production in mid-1985 with the new emission rail. The new tube and dipstick (see Figure 7-5) were necessary to work around the dual A.I.R. pumps that are on the mid-season rail. These parts will fit prior model motor homes. An O-ring must also be used when replacing the tube assembly. GM warns that it is extremely difficult for the average motor home owner to replace the assembly and recommends that the dipstick and tube assembly be replaced by a qualified repair facility.

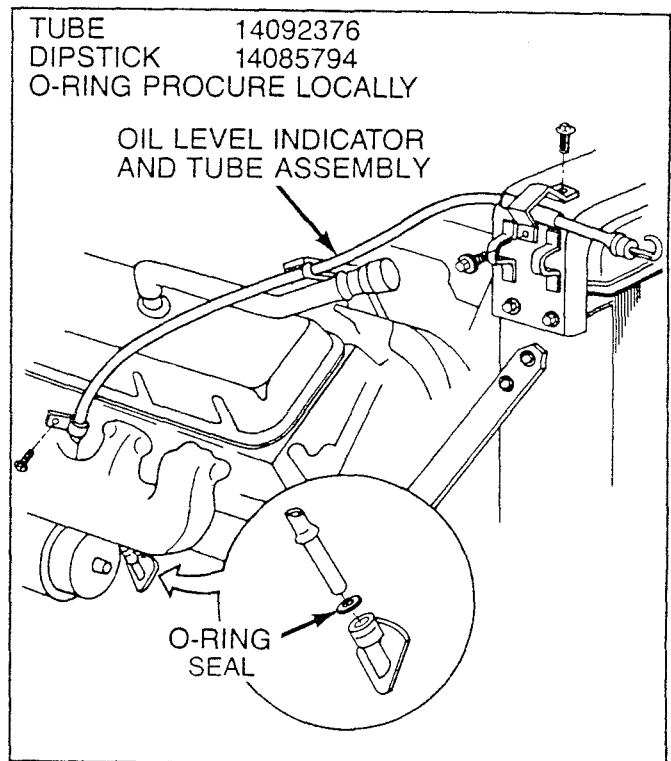


Figure 7-5 — Dipstick and Tube Assembly

ENGINE LUBRICATION

APPENDIX 7-1 — GUIDELINE FOR ENGINE OIL CONSUMPTION

The following information has been provided as a guide to the motor home owner concerning engine oil consumption. GM has produced the following guideline based upon information developed by Detroit Diesel.

Many attempts have been made by various manufacturers to establish how much oil consumption can be expected by the owner. Detroit Diesel established a series of charts that took individual engine families from the smallest to the largest. As an example, the smallest engine family (2-71) operating at 2,100 RPM could be expected in a 10-hour working period to use about one-half quart of oil. The largest engine normally used in stationary application (about seven feet high by nine feet long in an engine stand) is a 16-cylinder engine (called a 16V-71T) that normally uses 8 or 9 quarts of oil at 2,300 RPM in a 10-hour working period. In a stationary application, a very accurate prediction can be made, because the engine generally runs at a given RPM, is of a known size and is doing a given task, so the operator can easily use the charts.

Charts could be produced for gasoline engines just as well, but generally in the automotive industry most applications are not stationary uses. Rather, the normal highway usage includes everything from idle, to wide-open throttle, to pulling a trailer. You have learned from the Detroit Diesel information that the bigger the engine and corresponding horsepower the greater the thirst for oil and petroleum products. For the standard automotive application, General Motors has developed a graph illustrating the relationship between minimum acceptable engine oil consumption and fuel usage. (See Figure A7-1-1.) Engines with oil consumption below the level indicated by the "acceptable" line are potential candidates for repair. Note that engines working harder, i.e. using more fuel, will have higher oil consumption. Heavy-duty trucks, for example, will not achieve the same level of oil economy as passenger cars and, therefore, should not be considered for repair at the same levels.

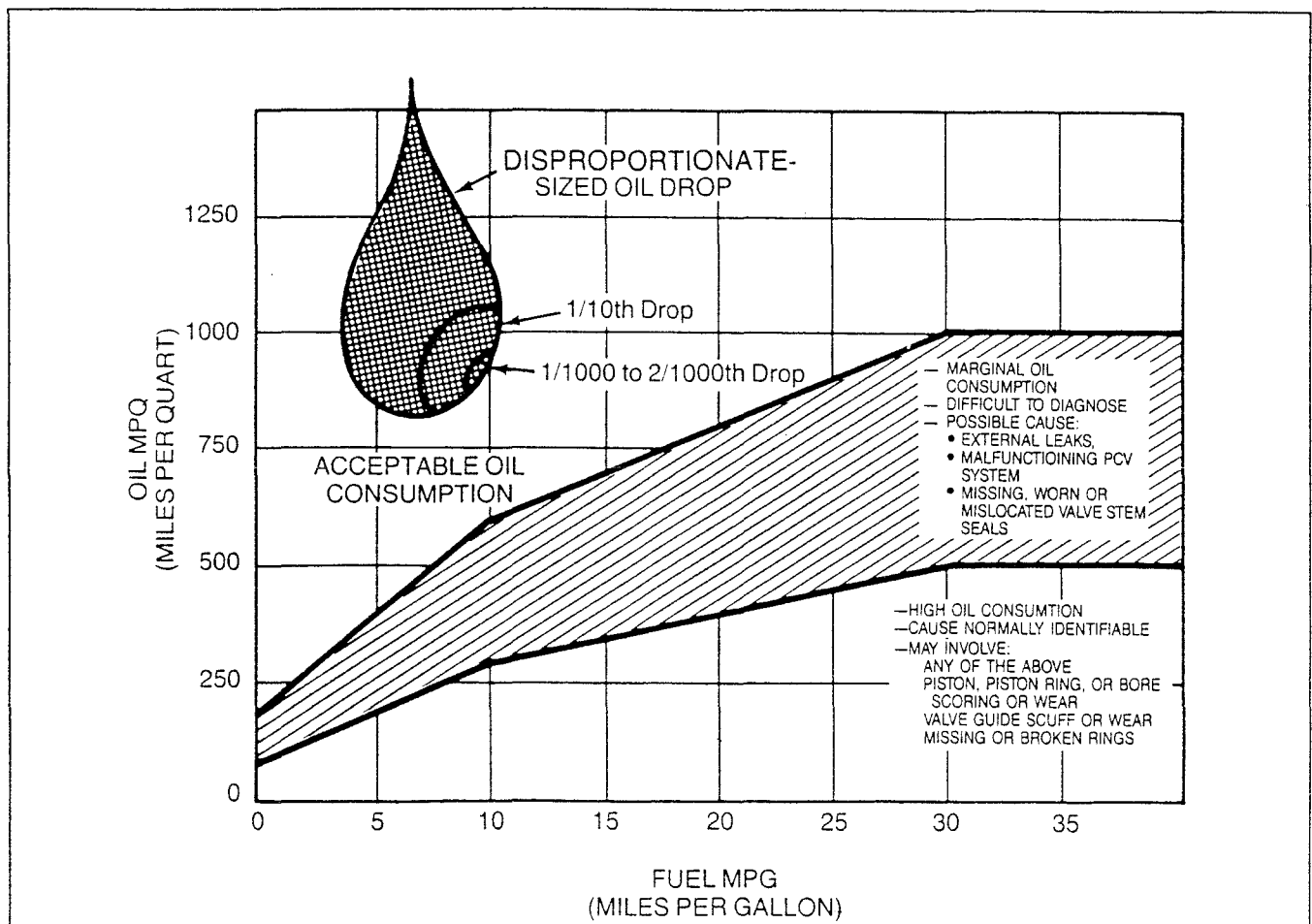


Figure A7-1-1 — Engine Oil Consumption vs. Fuel Usage

APPENDIX 7-1 — GUIDELINE FOR ENGINE OIL CONSUMPTION (CONT'D)

The graph shown in Figure A7-1-1 does not consider time as a factor, however, two time-related factors are involved: (1.) Judgements of excessive oil consumption should not be made until the engine is fully broken in (approximately 5,000 miles) and (2.) A sudden or significant change in oil consumption (when operating conditions remain the same) should be considered when deciding if repair is justified.

Engines with very high oil consumption normally have obvious, easily diagnosed causes. Scuffed bores, broken or overlapped rings, or worn valve guides or seals are typical examples.

Engines with marginally high oil consumption (indicated by the darkened section of the graph in Figure A7-1-1) are very difficult to diagnose even after disassembly. In these cases, initial efforts to correct the complaint should be directed at replacement of easily accessible items like gasketed areas with heavy leakage, PCV valve or oil separator, or valve stem seals, and verifying that the owner

is using the best weight engine oil for the operating temperature before starting heavy repair in the piston ring and bore area.

Manufacturers of power piston rings state that piston rings in today's engines, control oil very effectively. If 1/10 of a drop of oil would be consumed per explosion when driving at 60 MPH, an eight-cylinder car would use about 90 quarts of oil on a 600-mile trip. The actual average consumption of oil per explosion in today's engines is from 1/1,000 to 2/1,000 of a drop.

NOTE: If a service technician determines that your engine seals need replacement, the recommended seals for the 454 engine are the Brown VITON engine seals (GM Part No. 336772) or the Orange VITON engine seals (GM Part No. 460527). Except for the color, both of these seals are identical. VITON is an extremely good material for heavy-duty usage and is standard in the 427 truck engine.

SECTION 7 — ENGINE

ENGINE COOLING SYSTEM

GENERAL DESCRIPTION

To remove the excess heat from the engine and to maintain normal engine operating temperatures, both of the gasoline engines, and the 6.2L diesel engine use liquid cooling systems. Components of a typical system include a pump, thermostat, radiator, coolant recovery tank and hoses.

In operation, the pump circulates coolant through passages in the engine cylinder block and heads where it absorbs heat. The **hot** coolant flows out of the engine through a hose to the radiator. In the radiator, the coolant loses heat to the outside air circulating around the radiator core tubes. Cooled coolant then flows out of the radiator, through a hose back to the engine.

The engines have pressure-type cooling systems with thermostatic control of coolant circulation. The cooling system is sealed by a pressure-type radiator filler cap which causes the system to operate at higher-than-atmospheric pressure.

The higher pressure raises the boiling point of the coolant which increases the cooling efficiency of the radiator. The 15-pound pressure cap used raises the boiling point of coolant to approximately 258 °F at sea level.

All models have a closed cooling system using a round pressure cap (see Figure 7-6) and a coolant reservoir. Coolant can be added without removing the radiator cap.

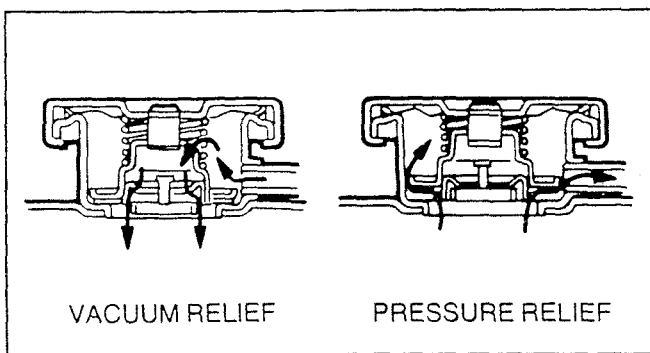


Figure 7-6 — Radiator Pressure Cap

A pressure-vacuum valve radiator cap (Figure 7-6) is used. As the engine warms up, pressure is developed due to the temperature expansion of the coolant. When pressure reaches the preset cap value (usually 15 PSI), the big spring compresses and the large gasket contacting the radiator neck unseats and allows the surplus coolant and air to flow into the coolant overflow tank. Upon shutdown as the system cools, the coolant shrinks in volumetric size creating a partial vacuum in the radiator. This partial vacuum overcomes a small hidden spring and the very center relief valve of the cap unseats. Consequently, coolant from the overflow tank returns to the radiator to start the process over again.

Using the pressure relief cap in conjunction with the overflow tank, the design intent is to assure a 100 percent filled radiator at all times with any air or bubbles being pushed out of the radiator into the overflow tank. However, if the coolant level is too low initially, the cycle between the system and reservoir will not take place.

THERMOSTAT

The thermostat consists of a restriction valve actuated by a thermostatic element to help regulate the operating temperature of an engine. This is mounted in the forward part of the intake manifold, under the coolant outlet on the 5.7L and Mark IV gasoline engines and in the coolant crossover pipe located at the front of the engine on the 6.2L diesel (Figures 7-7 and 7-8). Thermostats are designed to open and close at predetermined temperatures.

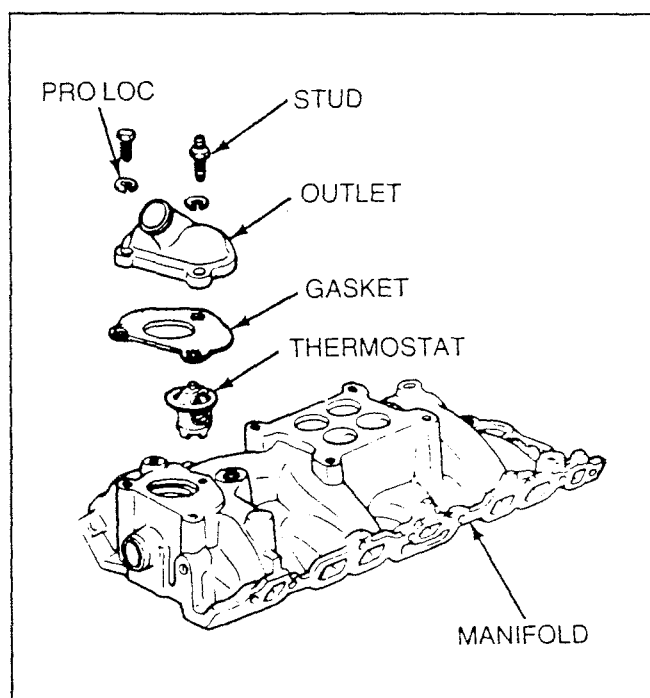


Figure 7-7 — Coolant Thermostat Location — 7.4L Mark IV Gasoline Engine

All Chevrolet engines have a pellet-type thermostat (Figure 7-9) which is used in the coolant outlet passage to control the flow of engine coolant. It provides fast engine warm-up and regulates coolant temperature levels. A wax pellet or power element in the thermostat expands when heated and contracts when cooled. The pellet is connected through a piston to a valve. When the pellet is heated, pressure is exerted against a rubber diaphragm which forces the valve to open. As the pellet is cooled the contraction allows a spring to close the valve. Thus, the valve remains closed while the coolant is cold, preventing circulation of coolant through the radiator, but allowing the coolant to circulate through the engine to warm it quickly and evenly.

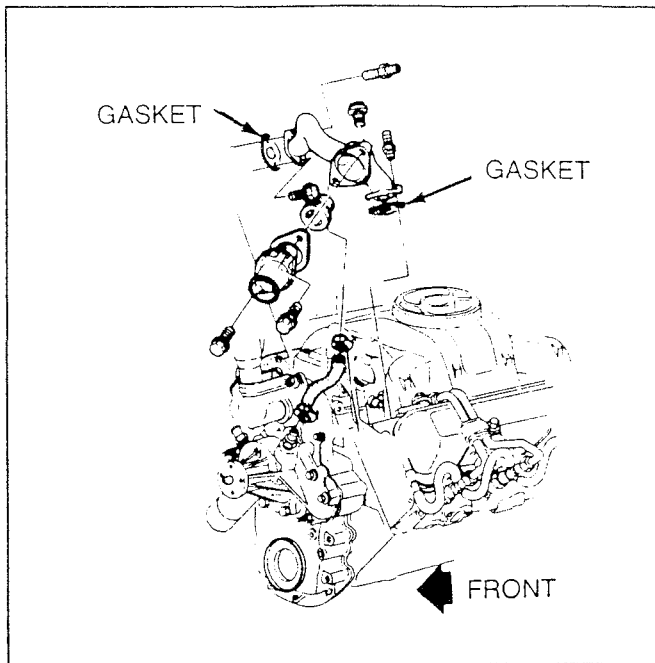


Figure 7-8 — Coolant Thermostat Location — 6.2L Diesel

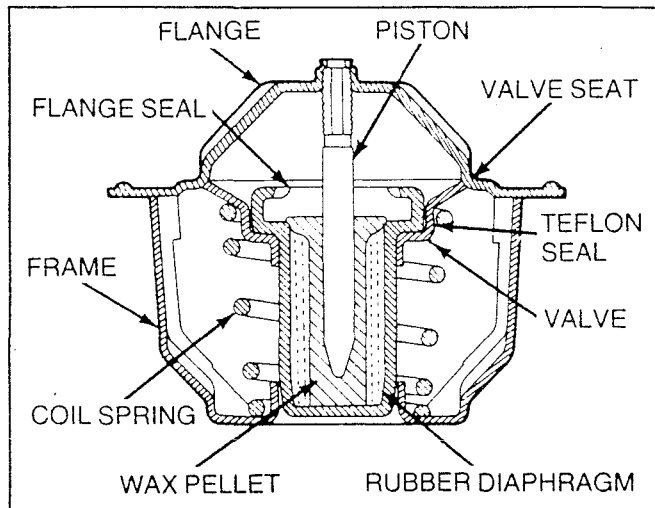


Figure 7-9 — Thermostat — Typical

As the engine becomes warm, the thermostat pellet expands and the thermostat valve opens, permitting the coolant to flow through the radiator where heat is passed through the radiator walls. This opening and closing of the thermostat valve permits enough coolant to enter the radiator to keep the engine operating temperature above the lowest operating value stamped on the thermostat.

The engine thermostat is often the first item that is suspected and replaced when the engine overheat condition is encountered. The thermostat is only designed to keep the engine operating temperature above the thermostat minimum or rated temperature. It has no way to control temperature above this. If an engine is overheating, replacing a thermostat rated at 195°F with one rated at 165°F would not reduce the maximum operating temperature 30 degrees. If an engine is overheating, it is obviously operating above both 165 and 195 degrees Fahrenheit.

ENGINE COOLING FANS

Both the 5- and 7-blade engine cooling fans tend to be very noisy and draw a lot of horsepower. By varying the fan speed, both horsepower losses and noise are lowered except in maximum cooling demand situations. According to numerous industry tests, maximum cooling is required less than five percent of the total vehicle time. With the fan operating on low speed 95 percent of the time, there is a reduction in noise level and substantial savings in fuel.

The fan should be viewed as a two-speed fan—low and high speed. When in the hi-speed mode, the noise level will be more than twice as noisy. Noise levels are somewhat logarithmic in nature. Viscous drive fans always provide some air flow across the radiator and air conditioning. This type of fan drive also helps maintain design temperature differential between inlet temperature and outlet temperature to a 10°F to 15°F differential at maximum engine speed and load. Good cooling system design avoids excessively cold coolant from going back into the bottom of the block. School bus engines will sometimes have heat shock problems because in addition to the radiator there are as many as 4 or 5 heater-and-defrosters and very long lines removing large amounts of heat from the coolant above and beyond the radiator capacity.

The variable drive fan is controlled by a temperature-sensitive clutch. (See Figure 7-10.) The clutch housing is constructed of lightweight metal which is filled with silicone oil and hermetically sealed.

Thermostat control of the fluid clutch permits the fan to operate only when additional air flow is required to reduce radiator coolant temperatures. During periods of operation, when radiator discharge air temperature is low, (below approximately 150°F), the fan clutch limits fan speed to 800-1,400 RPM. At this RPM, the clutch is disengaged since a small oil pump, driven by the separator plate, forces the silicone oil into the reservoir between the separator plate and the front cover assembly. Also the passage from this cavity to the clutch area is closed by a sliding valve. (See Figure 7-11, Line A.)

As operating conditions produce a high radiator discharge air temperature (above approximately 150°F), the temperature-sensitive bimetal coil tightens to move the sliding valve plate, allowing flow of silicone oil into the clutch chamber to engage the clutch, providing maximum fan speed of approximately 2,200 RPM. (See Figure 7-11, Line B.)

The clutch coil is calibrated so that with a road load at an ambient temperature of approximately 90°F, the clutch is at a point of shifting between high and low fan speeds.

No attempt should be made to adjust the calibration of the engine fan clutch assembly as each assembly is individually calibrated at the time of manufacture.

In extreme high temperature for rescue and multi-stop delivery vehicles or winter snowplow applications where the snow blade interferes with airflow, disconnecting the fan clutch thermostat control increases air flow through the radiator by allowing the fan speed to more closely follow engine speed until approximately 2,000 RPM.

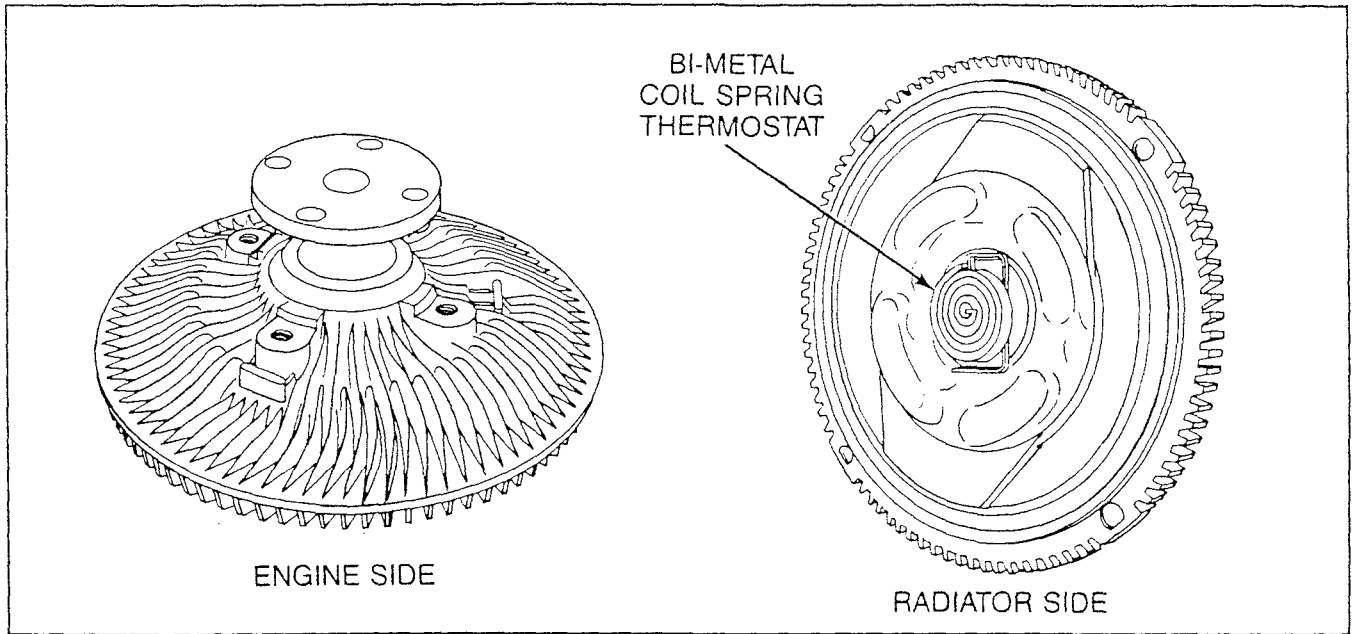


Figure 7-10 — Engine Cooling Fans

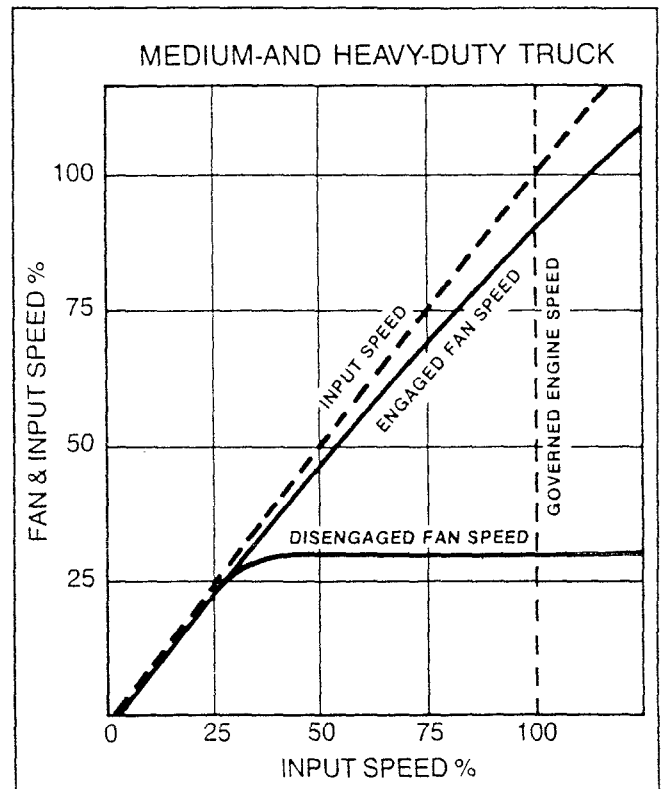
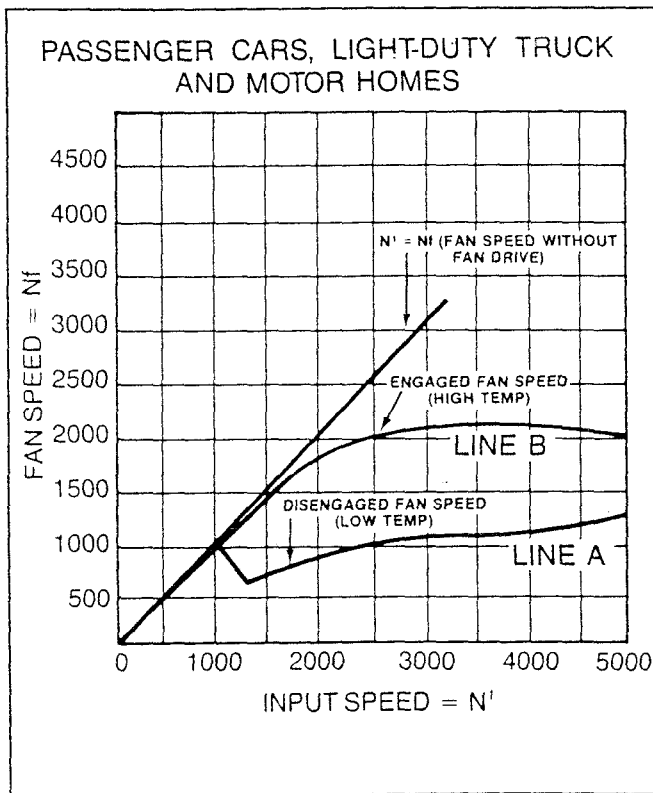


Figure 7-11 — Typical Speed and Temperature Modulations

To disconnect the bi-metal coil spring thermostat on Eaton and Delco types, move the spring end tab out of the retaining slot and position counterclockwise (Figure 7-12).

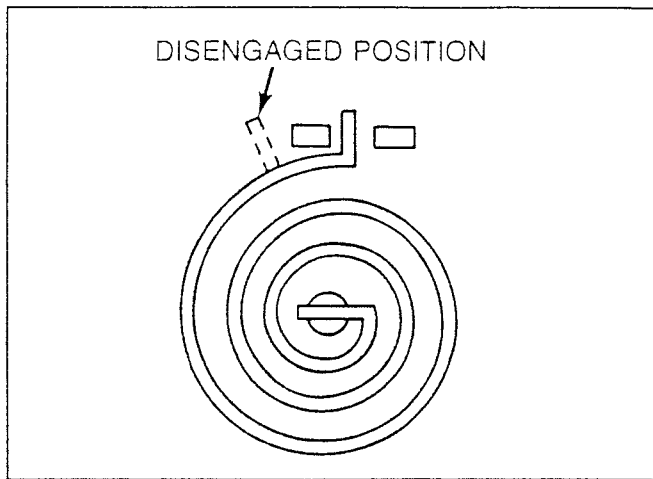


Figure 7-12 — Spring End Tab

CAUTION: Do not remove the spring completely. Complete removal of the spring can cause the fan to “free wheel” and cause overheating.

RADIATOR/HEATER AND ENGINE DEAERATION SYSTEM (After 1983 model)

Heavy-duty cooling equipment is required when air conditioning or auxiliary belt-driven equipment is installed.

Continuous coolant flow is necessary from the heater connection on the engine to the heater connection on the radiator to control oil temperatures during closed thermostat (warm-up) operation. Shutting off this flow may result in premature engine or transmission failure.

If a heater unit is not installed in the vehicle or a heater shut-off valve is required, a line connecting the heater connection on the engine to the heater connection on the radiator must be installed. When a shut-off valve is required in the heating system, it must be “tee’d” into the system in such a manner as to maintain a continuous flow between the engine heater connection and the radiator heater connection at all times.

NOTE: The heater hose routing should not be altered from the standard system. If an auxiliary heater is added, it should be routed similarly to the RPO (C36) rear heater. Where the heater water return is routed to the radiator outlet tank, a shut-off valve should not be placed in the heater circuit.

A nipple has been provided in the radiator outlet tank for heater return water (see Figure 7-13). The temporary rubber shipping cap should be removed, and the heater return (suction) hose should be attached to the radiator nipple using the clamp supplied with the shipping cap.

The 454 CID gasoline engine is essentially the same as the 6.2L diesel engine shown in Figure 7-14 except that hot water comes from the thermostat housing. Hot water enters the bottom of the heater core and exits out the top for better heat dissipation.

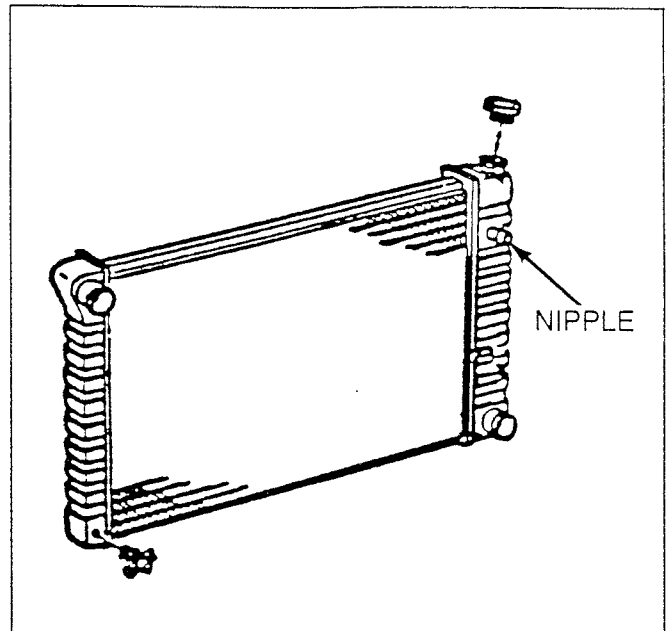


Figure 7-13 — Radiator Outlet Tank — Heater Return Water

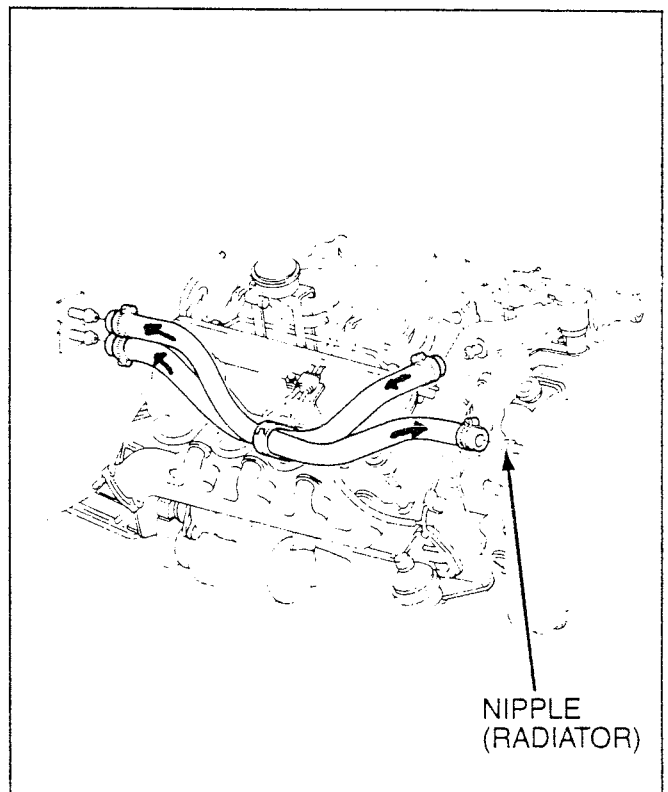


Figure 7-14 — 6.2L Diesel Engine Hot Water Flow

MAINTENANCE AND INSPECTION

The coolant level, appearance and strength should be checked periodically. It should be drained and replaced at the intervals recommended in the Maintenance Schedule, or sooner if it is dirty. Hoses should be checked regularly for signs of damage or deterioration and hose clamps tightened if necessary.

Check hoses for cuts or abrasion damage. If the hoses have become hard and brittle and show signs of cracking as a result of engine heat, they should be replaced. Hoses should also be replaced if they are soft and spongy, or swollen as a result of exposure to oil and grease. Any flaking or deterioration of the inner lining of the hose is also reason for replacement. Such particles can clog the cooling system, reducing its efficiency.

The radiator cap should be washed with clean water and pressure checked every 12 months.

COOLANT LEVEL

The need for additional coolant can be detected by observing the level of coolant in the "see through" reservoir while the engine is at normal operating temperature. The radiator cap need not normally be removed. (See Figure 7-15.)

The coolant level should be at the "Full Cold" mark when the system is cool or at ambient temperature. After the vehicle has been driven sufficiently to obtain normal operating temperatures, the level should be above the "Full Cold" mark.

Periodically, the radiator cap should be removed to observe coolant level in the radiator.

CAUTION: TO HELP AVOID THE DANGER OF BEING BURNED, DO NOT REMOVE THE RADIATOR CAP WHILE THE ENGINE AND RADIATOR ARE STILL HOT. SCALDING FLUID AND STEAM CAN BE BLOWN OUT UNDER PRESSURE IF THE CAP IS TAKEN OFF TOO SOON.

Coolant levels in any radiators with coolant recovery bottles should be maintained to the top of the filler neck.

The recovery bottle should be at its appropriate mark when checking.

Regardless of whether freezing temperatures are expected or not, cooling system protection should be maintained at least to -34°F , to provide adequate corrosion protection and loss of coolant from boiling. With glycol content less than requirement for -34°F protection, coolant boiling point is less than the temperature indicating light setting. The chart shown in Figure 7-16 shows the boiling point of water and of glycol in relation to pressure. The boiling point of glycol is higher than the boiling point of water at a specified pressure.

When adding solution due to loss of coolant for any reason or in areas where temperatures lower than -34°F may occur, a sufficient amount of an ethylene glycol based antifreeze that meets GM specification 1825-M (GM Part No. 1052753—Gallon or equivalent) should be used.

NOTES:

- Factory installed temperature gages have been calibrated so the owner sees a mid-range reading as the "normal" operating temperature. The reason for this is that many owners tend to perceive 212°F as the boiling point. However, this is not the case in an engine with a 15 lb. pressure system and a 50/50 solution of Glycol and water, as shown in the chart of Figure 7-16. If the engine is equipped with a master gage or with one of the various digital electronic gages installed by

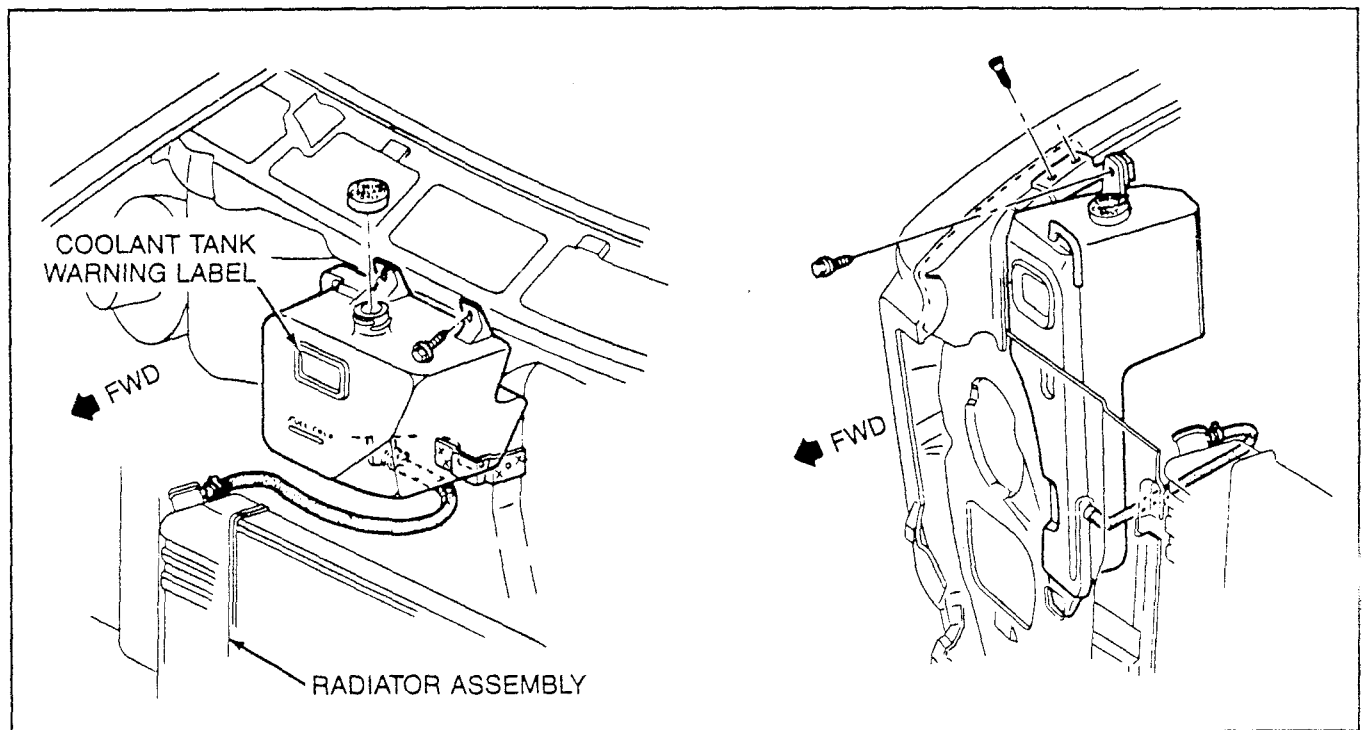


Figure 7-15 — Coolant Recovery Bottle

RV manufacturers, the temperature reading of the engine will be higher than that of the factory-installed system. No matter which gage system is utilized, the motor home owner must realize that the purpose of any gage is to provide a warning of any rapid change in temperature from the "normal" reading of that particular gage.

- Alcohol- or methanol-based antifreeze, or plain water, are not recommended for your engine at any time. They will not provide proper protection against corrosion.
- Additives, in addition to a good quality ethylene glycol based antifreeze meeting the GM specifications, are **not** required or recommended. Many of the claims for additives are associated with better heat transfer or cooling, but these claims are not supported by test data. In some instances, the ingredients may be incompatible with the recommended coolant. Also, when used alone with water as is sometimes suggested, the additive may not provide the corrosion protection given by the recommended coolant solution.

PRESSURE (LBS./SQ. IN.)	BOILING POINT (°F)	
	WATER	GLYCOL
0	212	223.5
1	215.3	227.2
2	218.5	230.0
3	221.6	233.0
4	224.6	236.0
5	227.4	238.8
6	229.8	241.6
7	232.8	244.0
8	234.8	246.2
9	237.1	249.2
10	239.4	251.7
11	241.6	254.5
12	243.7	256.3
13	245.7	258.3
14	247.8	260.3
15	249.7	262.5
16	251.7	264.4
17	253.6	266.2

Figure 7-16 — Boiling Point vs. Pressure Chart — Water/Glycol

THERMOSTAT CHECK

If the thermostat is suspected of not operating properly, it can be removed and tested as follows:

1. Disconnect the battery negative cable at the battery.

2. Drain the cooling system until the radiator coolant level is below the thermostat.
3. Remove the coolant outlet attaching bolts and remove the outlet and thermostat.
4. Hang the thermostat on a hook in a minimum of 33% glycol solution at 25 degrees above the temperature stamped on the thermostat valve. Submerge the valve completely and agitate the solution thoroughly. Under this condition, the valve should open.
5. Remove the thermostat and place it in a 33% glycol solution that is 10 degrees below the temperature indicated on the valve. With the valve completely submerged and the solution agitated thoroughly, the valve should close completely.

If the thermostat tests O.K., it can be reinstalled. If not, it should be replaced.

Prior to installing the thermostat, make sure the thermostat housing and coolant outlet sealing surfaces are clean.

1. Place a 1/8-inch bead of RTV sealer (GM Part No. 1052366 or equivalent) all around the coolant outlet sealing surface on the thermostat housing.
2. Place the thermostat in the housing.
3. Install the coolant outlet while the RTV sealant is still wet. Torque the retaining bolts to 20 ft. lbs.
4. Connect the battery negative cable.
5. Fill the cooling system with an ethylene glycol antifreeze and water mixture of 50/50.
6. Start the engine and run, with radiator cap removed, until the radiator upper hose becomes hot (thermostat open).
7. With the engine idling, add coolant to the radiator until the level reaches the bottom of the filler neck.
8. Install the cap, making sure arrows line up with the overflow tube.

FLUSHING COOLING SYSTEM

Various methods and equipment may be used to perform this service. If special equipment such as a back flusher is used, equipment manufacturer's instructions should be followed. However, it is advisable to remove the thermostat before flushing the system.

ENGINE COOLING SYSTEM

APPENDIX 7-2—RADIATOR ADDITIVES

The following information has been extracted from GM Research Laboratories investigations concerning radiator additives for the prevention of overheating in the engine cooling system. The information is provided as an aid to the motor home owner in understanding the effects of using radiator additives.

The object of the investigation was to review the use of radiator additives that are being marketed with the claim that they improve heat transfer and reduce the coolant temperature in the engine cooling system.

Conclusions were:

1. These radiator additives are composed principally of either water, ethylene glycol, or a combination of the two, and inhibitors such as those commonly used in antifreezes. Some additives contain oil and/or a surface active agent.
2. Tests with these additives fail to show any added benefit in heat transfer or reduction in coolant temperatures.
3. When these additives are used with water alone, they will probably provide less corrosion protection than an antifreeze used at the recommended concentration; when used with conventional water-glycol solutions, the additive inhibitors may not be compatible with those from the glycol antifreeze.
4. Engine damage may result from loss of coolant due to overheating if the vehicle owner follows the recommendation to use these additives with water alone. (The boiling point of water is below the temperature at which the warning light is activated and the driver may not receive warning of a boiling condition.)
5. It is recommended that a strong position be taken against the use of these additives.

There has been a proliferation of additive products on the market that are purported to increase the cooling capability of the cooling system. These products are usually sold in one quart containers at a price ranging between \$2.00 and \$3.50.

Although a number of claims are made for these products, such as added corrosion protection, the removal of scale, and pump lubrication, the principal claim is that associated with improved cooling.

The major portion of these additives is either water, ethylene glycol, or a mixture of the two. Inhibitors have been added that are typical of those commonly used in antifreeze or in summer inhibitor additives. Some of the inhibitors in the additives may be incompatible with inhibitors in antifreeze solutions; for example chromates are often incompatible with ethylene glycol antifreeze. If the additives are used with water alone, the inhibitors may not provide sufficient protection to all metals, and in some cases they may cause excessive corrosion; for example, amine inhibitors are aggressive to copper alloys and nitrite attacks solder unless other inhibitors are present to compensate for these effects.

The one variant in some cases is the use of a surface active agent that may increase heat transfer at a metal surface. One laboratory has shown increased heat transfer under controlled laboratory conditions but not in automotive service. However, surface active agents are often unstable at high temperatures, and they would not be expected to endure for long. The disadvantage of the surface active agent, as well as oil, is its tendency to cause increased foaming in the cooling system.

Most of the claims are associated with better heat transfer or cooling, but these claims are not supported by test data. Since the bulk of the material is water or ethylene glycol, it should not be expected that the addition of these additives would prevent overheating or make the engine run any cooler than when a quart of water or antifreeze had been added. It is possible that, in practice, the addition of a quart of this material may restore the coolant to the proper level, which provides better cooling, but so would the addition of water or ethylene glycol antifreeze.

The claim that these additives provide better heat transfer when added to water alone, is apparently based on the fact that they contain inhibitors that prevent the formation of corrosion products that would impair heat transfer. However, the suggestion that they can be used with water alone may offer a problem. First, the concentration of inhibitors may be less than that normally provided by a good antifreeze at the minimum recommended concentration of 33-1/3% and second, the inhibitors may not be as effective in preventing corrosion as those in a well-formulated antifreeze. Furthermore, the boiling point of water is 12 degrees less than that of a 44% ethylene glycol solution (262°F vs. 250°F at 15 PSIG), and this may lead to loss of coolant and damage to the engine because the warning light is set to come on at a higher temperature than that of the boiling point of water.

SECTION 7 — ENGINE

ENGINE FUELS

GASOLINE ENGINE

Fuel Types

Unleaded Gasoline— (In *GM Vehicles Designed for Leaded Fuels*) The need for leaded gasoline in the U.S. is decreasing as older vehicles designed for leaded gasoline are replaced with new ones requiring unleaded gasoline. Furthermore, the U.S. Environmental Protection Agency (EPA) began phasing down the concentration of lead in leaded gasoline during July, 1985. These two facts taken together could result in limited supplies of leaded gasoline being available for vehicles designed for such fuel.

The lead phasedown was based on health considerations and a desire to eliminate fuel-switching—the practice of using leaded gasoline in vehicles equipped with catalytic converters. Due to the fact that lead destroys the emission control properties of catalysts, leaded gasoline should not be used in engines equipped with these devices. GM supports this EPA effort to reduce lead emissions and to reduce fuel-switching.

All GM gasoline-fueled engines in (1.) passenger cars starting in 1971, (2.) 1971-78 trucks **less** than 6,000 lbs. GVW, and (3.) trucks **less** than 8,500 lbs. GVW starting in 1979, were designed to use unleaded gasoline and are unaffected by lead reduction efforts.

For all GM gasoline-fueled engines in (1.) pre-1971 passenger cars and trucks, (2.) 1971-78 trucks **over** 6,000 lbs. GVW, and (3.) trucks **over** 8,500 lbs. GVW starting in 1979, concerns exist about engine knock and exhaust valve seat durability when such engines are operated on gasoline without lead.

The octane quality of leaded regular gasoline is generally higher compared to unleaded regular gasoline. Thus, switching from leaded regular to unleaded regular in vehicles designed for leaded regular may cause some engines to knock. Occasional light knock is of little concern. However, persistent, heavy knock can cause engine damage and should be avoided. Two alternatives are available to avoid knock. The first is to use unleaded premium gasoline (or a mixture of unleaded regular and unleaded premium). The other is to retard the engine's basic spark timing.

The lead in gasoline creates a "cushion" between the valve and valve seat to minimize wear. Valve seat wear is aggravated by operating at high engine speeds and loads, particularly for long periods of time. Engines designed to use unleaded gasoline have hardened valve seats to compensate for the removal of lead.

Engines designed to use leaded gasoline can avoid excessive wear if operation is limited to reasonable speeds

and loads. However, if excessive valve seat wear does occur, cylinder heads may be rebuilt with hardened valve seat inserts to avoid recurrence of the problem.

For those engines designed for leaded gasoline, GM recommends that they continue to be fueled with leaded gasoline as long as such gasoline is available.

Gasohol— Gasohol, a mixture of ten percent ethanol (grain alcohol) and 90 percent gasoline may be used in Chevrolet gasoline engines without voiding the warranty. However, because of the composition of gasohol, engines will tend to operate leaner with gasohol than with gasoline. This can result in drivability conditions usually associated with leaner mixtures. Also the increased volatility of gasohol can contribute to hot weather drivability problems if adjustments are not made to the gasoline blend during the refining process.

The higher octane rating of gasohol compared to most unleaded gasolines, could help reduce the tendency for spark knock. But, gasohol contains less energy than gasoline, and fuel economy may or may not be quite as good. However, in some instances, depending on the entire design and calibrations, and certain operating conditions, it is possible to get improved fuel economy.

Exhaust emission levels may change up or down with the use of gasohol, again, depending on the calibration of the engine. At the present time, however, the EPA has not restricted the use of gasohol.

If gasohol is spilled on a painted surface, some dulling or softening of the paint may result.

NOTE: Refer to the information contained in Appendix 7-3 and Appendix 7-4 at the end of this section of the manual concerning the use of gasohol in vehicles equipped with gasoline engines, and potential problems of using methanol/gasoline blends.

DIESEL ENGINE

Fuel Types

NOTE: Do not use starting fluids. Such aids can cause immediate engine damage.

Diesel fuel is available in No. 1 or No. 2 grades. The difference between the grades is that No. 1 diesel fuel has had much of the paraffin (wax) removed. While the wax content increases the amount of energy in the fuel, it can clog the fuel filter(s) in cold weather, and stop the flow of fuel to the engine.

The Cetane Number used in rating diesel fuels is an indication of the energy content of the fuel—the higher the

Cetane Number, the higher the energy content. The higher Cetane rating will improve the cold-starting performance of the engine, so long as the higher wax content does not impede the flow of fuel through the system. This introduces two other factors which affect diesel fuel—Cloud Point and Pour Point. The Cloud Point represents the temperature at which a predetermined percentage of the wax content in the fuel solidifies. The Pour Point represents a lower temperature at which the fuel cannot be made to flow.

The moisture content of the fuel can also affect cold

weather starting and performance. Water can separate out of the fuel, settling in low points of the fuel line and freezing, or forming minute ice particles which flow into the filter(s) and tend to clog it.

Additives can be used to lower the Pour Point of the fuel, and to prevent moisture freezing in the fuel. However, additives will have little effect on the Cloud Point. Mixing different grades of diesel fuel can also be used to change the Pour Point and to change the Cloud Point as well.

ENGINE FUELS

APPENDIX 7-3 — USE OF GASOHOL IN GASOLINE ENGINES

The following information was extracted from a Chevrolet Dealer Service Information Bulletin relating to the use of gasohol in vehicles equipped with gasoline engines.

Reference: Chevrolet Dealer Service Information Bulletin No. 80-I-3 (July, 1979)

Gasohol, a fuel generally composed of ten percent ethanol (grain alcohol) and 90 percent gasoline, is receiving considerable attention as a fuel for gasoline engines. It is possible that other kinds of alcohol, such as methanol (wood alcohol) may be added to gasoline in the future; however, this bulletin deals only with gasohol containing up to ten percent ethanol. (Gasohol containing methanol is not being marketed at this time.) The purpose of this bulletin is to provide information which may be helpful in answering questions about gasohol which may arise regarding:

- Availability
- Fuel Economy
- Emission Levels
- Drivability
- Service Adjustments
- Warranty Coverage

Availability

Gasohol currently is available at many retail stations in the Midwest and some retail stations on the East Coast. Nationwide availability is expected to increase.

Drivability

Due to the composition of gasohol, vehicles equipped with gasoline engines will operate leaner with gasohol than with gasoline. This leaner operation with gasohol may tend to cause drivability conditions usually associated with leaner mixtures. However, drivability of vehicles with Computer Controlled Catalytic Converter (C-4) or Closed Loop Catalytic Converter (CLCC) Systems probably will be affected less, because these systems compensate for the leaning effect of gasohol.

NOTE: (Provided as a reference for the motor home owner) If your car is several years old, you should plan on changing all of the fuel filters at least once and the carburetor filter more than once. The reason given for this is that alcohol in itself is a solvent which dissolves the deposits left by gasoline in the fuel system.

The increased volatility of gasohol also can contribute to hot-weather drivability problems if, during the refining process, adjustments are not made to the gasoline blend. In general, gasohol has a higher octane rating than most unleaded gasolines, and it could help reduce the tendency for spark knock.

Fuel Economy

Gasohol (ten percent ethanol, 90 percent gasoline) contains less energy than gasoline by itself. Consequently, fuel economy of gasohol may not be quite as good as gasoline. However, there are differences in engine design and calibration which make it possible in some instances to achieve better fuel economy with gasohol.

Service Adjustments

Specified engine settings must not be changed for gasohol use. The service specifications for which the vehicle has been certified must be maintained.

Warranty Coverage

The use of gasohol containing up to ten percent ethanol will not void the vehicle warranty. Dealers are requested to inform their Area Service Manager of any fuel system failures which are believed to be related to gasohol use. If gasohol contacts a painted surface, it may cause dulling or softening of the paint. Dulling or softening of paint due to contact with gasohol is not covered under the vehicle warranty.

Any drivability condition which is related solely to gasohol use is not covered under the vehicle warranty.

Emission Levels

Some changes in vehicle exhaust emission levels may occur when using gasohol. For example, carbon monoxide (CO) emissions will decrease in most vehicles, due to leaner mixture, but hydrocarbons (HC) and oxides of nitrogen (NOx) emissions may either decrease or increase, depending on how the engine is calibrated. Exhaust emission levels of vehicles equipped with C-4 or CLCC systems should be affected less than vehicles without these systems. The generally higher volatility of gasohol compared to gasoline may result in increased evaporative emissions.

At the present time, the Environmental Protection Agency is not restricting the use of gasohol. However, local or state regulations, if applicable, must be observed.

ENGINE FUELS

APPENDIX 7-4 — METHANOL/GASOLINE BLENDS POSE POTENTIAL PROBLEMS

The following information has been extracted from a GMC Truck and Bus Group Newsletter and is provided as an aid to the motor home owner concerning the potential problems posed by methanol/gasoline blends.

Reference: GMC Truck and Bus Group Newsletter (January, 1984)

USE OF GASOLINE/ALCOHOL BLENDS EXPLAINED IN OWNER'S MANUALS

Owners of 1984 model GM automobiles are given specific information in their owner's manuals on what types of fuel may be used in their vehicles. On the subject of gasoline/alcohol blends, the manuals state:

Gasoline/Ethanol Blends

Blends of unleaded gasoline and ethanol (grain alcohol), sometimes known as gasohol, are available in some areas. You may use these blends in your car, if they are not more than ten percent ethanol, without jeopardizing the New Vehicle and Emission Warranties. Be sure the gasoline/ethanol blend has octane ratings no lower than those recommended for unleaded gasoline. Most drivers will not notice operating differences with blends of up to ten percent ethanol, but some may. In that case, your dealer can make certain adjustments, provided they do not violate the Federal Emissions Standards. If you are still not satisfied with ethanol gasoline blend performance, you may prefer to use unleaded gasoline.

Other Gasoline/Alcohol Blends

Some fuel suppliers sell gasoline containing alcohol without advertising the presence of alcohol or giving it a special name such as gasohol. If you are not sure whether there is alcohol in the gasoline you buy, check with the service station operator.

DO NOT USE gasolines containing methanol (methyl or wood alcohol) that do not also contain cosolvents and corrosion inhibitors for methanol. Also, **DO NOT USE** gasolines that contain more than five percent methanol even if they contain cosolvents and corrosion inhibitors. Fuel system damage or vehicle performance problems resulting from the use of such fuels is not the responsibility of General Motors and may not be covered under the new vehicle warranties.

Although gasolines containing five percent or less methanol and appropriate cosolvents and inhibitors for methanol may be suitable for use in your car, evidence of their suitability is as yet incomplete; therefore (GM Division) cannot, at this time, endorse their use.

METHANOL/GASOLINE BLENDS POSE POTENTIAL PROBLEMS

Gasoline quality is an important factor in providing satisfactory engine and vehicle performance and fuel system life. Gasoline has traditionally been composed entirely of a mixture of hydrocarbons and its quality generally has been sufficient to prevent problems with vehicle performance and fuel system materials.

In recent years, however, the quality of some gasolines has changed. Economic and other factors have led suppliers to use alcohols as gasoline components. The first of these was ethanol (grain alcohol), which was popularized in gasoline under the name "Gasohol." Vehicle performance and fuel system durability with gasolines containing up to ten percent ethanol, by volume, have generally been satisfactory.

More recently, methanol (wood alcohol), an alcohol with distinctly different properties than ethanol, has become a gasoline blending agent. The addition of methanol to gasoline for use in motor vehicles is receiving increased attention due to favorable economics, excess methanol production capacity, and the desire to reduce petroleum imports.

General Motors recognizes the favorable aspects of pure methanol as a future alternative fuel and certainly will produce cars that can use methanol if it becomes generally available. However, current use of methanol in gasoline can pose problems if used in today's cars over an extended period—even at low methanol concentrations in gasoline.

GM is concerned about the rapid increase in the use of methanol/gasoline blends in today's cars for two reasons:

- There is no hard evidence on how much methanol can be blended with gasoline without adversely affecting vehicle operation and durability.
- There is no adequate service station pump labeling system that will tell motorists the methanol content of the fuel they are purchasing.

There is limited information that suggests small amounts (up to five percent) of methanol in gasoline may be suitable if a *cosolvent*—an ingredient that prevents the gasoline and methanol from separating when trace amounts of water are in the fuel—and a *corrosion inhibitor* to prevent damage to fuel system components are used. Evidence on the suitability of such blended fuels is incomplete and, therefore, their use cannot be endorsed by GM at this time.

APPENDIX 7-4 — METHANOL/GASOLINE BLENDS POSE POTENTIAL PROBLEMS (CONT'D)

It is likely some engines and fuel systems will be sensitive to methanol/gasoline blends that contain higher concentrations (greater than ten percent) of methanol—even if the fuels contain cosolvents and corrosion inhibitors. This sensitivity is generally related to compatibility with materials commonly used in vehicle fuel systems, such as fuel tank plating and certain rubber parts in carburetion systems. Also, drivability—performance of the vehicle—is adversely affected.

GM is continuing to evaluate methanol/gasoline blends in both laboratory and vehicle tests to determine the effects of the blends on fuel system materials, engine deposits, drivability, emissions and fuel economy.

There are economic advantages that encourage blending methanol with gasoline. The average national tank price for unleaded gasoline sold to service station dealers (excluding taxes) in August, 1984 was approximately 94 cents a gallon, while methanol's cost was between 45 and 49 cents a gallon. On the other hand, ethanol's cost was between \$1.62 and \$1.80 per gallon. Ethanol/gasoline blends are competitive with gasoline only if a tax subsidy is allowed, but methanol/gasoline blends are not only competitive, they are enticing for the refiner, blender and retailer.

The U.S. Environmental Protection Agency (EPA) has granted waivers, legally allowing the blending of methanol in gasoline. Waivers cover methanol concentrations as high as 12 percent, as long as cosolvents are used. GM and other auto companies have not agreed with the EPA's decisions granting waivers for methanol/gasoline blends. The concern over use of methanol/gasoline blends has been heightened because illegally high levels of methanol have been found in some gasolines.

An EPA probe that began in the spring of 1983 in the Detroit area, revealed illegally high levels of methanol in gasoline. Out of 250 samples of unleaded gasoline from about 150 service stations, about eight percent—or 20 samples—had levels of methanol above those allowed by waivers, or did not contain cosolvents.

Because of concern over the compatibility of methanol/gasoline blends with current vehicle engines and fuel systems, and illegal blending of methanol in gasoline, a number of states are planning to require that the methanol content of the fuel be posted on dispensing pumps. Although this is a step in the right direction, GM believes that motorists would be better served by a uniform labeling system nationwide. This would eliminate confusion caused by states adopting different labels.

Historical Perspective

Alcohol/gasoline mixtures have been studied for more than 50 years. In the 1960s and early 1970s, the use of these blends was proposed (not always appropriately) as a way to reduce vehicle exhaust emissions and improve fuel

economy. However, because the cost of alcohol was significantly higher than that of gasoline, the widespread use of alcohol/gasoline blends was not economically feasible.

Two significant actions of the past decade have renewed and expanded interest in alcohol/gasoline blends.

First, the severe interruptions of petroleum imports emphasized the need to increase production of domestic energy sources and reduce dependence on imported oil.

The production of alcohol fuels, particularly ethanol, became politically attractive in the late '70s at the height of the energy crisis. Its use was encouraged through tax subsidies. Commonly sold as Gasohol, it is now also marketed as "unleaded with ethanol," "super unleaded," or "premium unleaded" gasoline, depending on its octane level.

Also, during the recent recession, capacity for production of methanol from natural gas far exceeded demand. Methanol thus assumed a new attraction as a gasoline blending agent. The outlook for use of pure methanol as an automotive fuel is positive because the technical knowledge necessary to design and build methanol-fueled engines and vehicles is rapidly developing. (See Figure A7-4-1.) In blends with gasoline, as stated earlier, methanol may not be suitable for use in either existing vehicles or future model year vehicles unless the vehicles are modified.

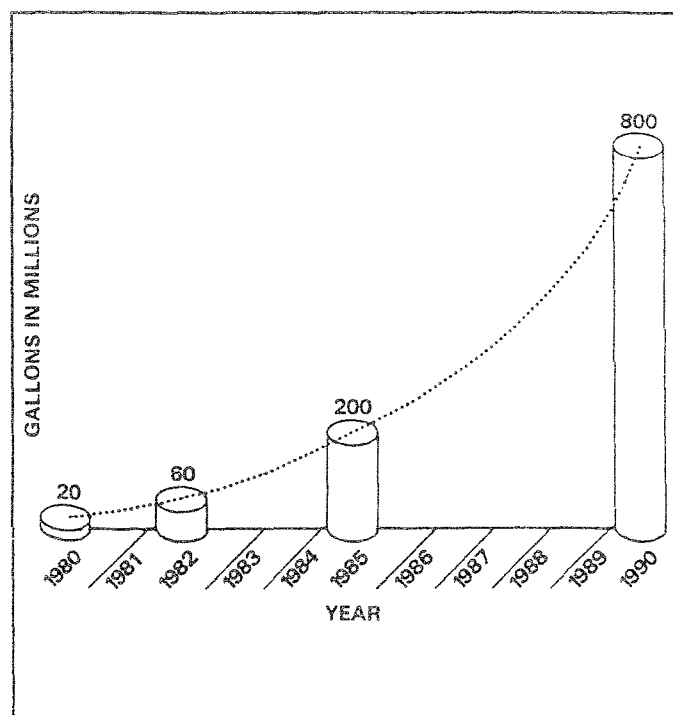


Figure A7-4-1 — U.S. Fuel Methanol Forecast

APPENDIX 7-4 — METHANOL/GASOLINE BLENDS POSE POTENTIAL PROBLEMS (CONT'D)

NOTE: Several trade publications have predicted a sharp increase in the amount of methanol used as automotive fuel by the end of the decade. The "Lundberg Letter" projects methanol fuel use in 1990 will be 40 times greater than in 1980.)

The second action which increased interest in alcohols as fuels was the reduction in the amount of lead antiknock additives used in gasoline. This reduction spurred by the EPA, occurred for two reasons:

- The need for unleaded gasoline in cars equipped with catalytic converters.
- The need to limit the emissions of lead into the atmosphere (by lowering permissible lead concentrations in leaded fuel).

Alcohols offer a means of replacing some of the octane (antiknock) quality previously provided by lead compounds.

Major Disadvantages of Methanol/Gasoline Blends

There are a number of disadvantages associated with the use of methanol/gasoline blends in vehicles designed for gasoline. Of major significance are:

- **DETERIORATION OF FUEL SYSTEM MATERIALS.** Rubber, plastic, and metallic fuel system components in most vehicles were designed for use with gasoline, and may not provide satisfactory service with methanol/gasoline blends. Although few long-term durability tests have been run with blends, the results from a number of laboratory evaluations, as well as problems reported by motorists, make it clear that a variety of problems can occur. Most material problems are a function of time rather than distance traveled, so a 50,000-mile test completed in one year may not indicate what would happen during 50,000 miles of operation over four or five years. Components possibly affected include fuel tanks, in-tank fuel pumps, carburetion and fuel injection systems, and nitrile rubber commonly used in vehicle fuel systems.
- **DRIVABILITY.** Drivability is generally worse with methanol/gasoline blends than with gasoline alone. In hot weather, the generally high volatility of the blends, compared with gasoline, causes a greater tendency toward vapor lock problems. Cold weather problems—stalling and hesitation—have been reported.
- **SEPARATION.** The presence of even trace amounts of water in the fuel system may cause methanol/gasoline blends to become cloudy and separate into two layers, a gasoline layer on top and an alcohol/water layer on the bottom. A vehicle will not run satisfactorily on the

alcohol/water mixture and corrosion of fuel system parts and deterioration of rubber parts can be greatly accelerated by contact with this mixture. Water tolerance of blends is increased by cosolvents, but even these do not completely eliminate the separation problem.

- **FUEL ECONOMY.** In late-model cars, fuel economy (miles per gallon) generally decreases with the addition of methanol to gasoline. This is due to the lower energy content (per gallon) of methanol compared with gasoline. For example, a blend of ten percent methanol in gasoline contains about five percent less energy per gallon than gasoline.
- **EVAPORATIVE EMISSIONS.** Unless major changes are made in the distillation characteristics of gasoline, the addition of methanol to it significantly increases vapor pressure. This almost always results in a substantial increase in vehicle evaporative emissions.

Regulatory Considerations

The regulatory aspects of methanol/gasoline blends are complex. The Clean Air Act prohibits the addition of additives to unleaded fuel, including methanol, unless the fuel additive manufacturer obtains a waiver from the EPA. In order to obtain such a waiver, the fuel additive manufacturer must show that the fuel will not cause—or contribute to—the failure of the vehicle or engine to meet the applicable emission standards for five years, or 50,000 miles.

The EPA has published guidelines that stress the need for development of data on possible methanol blending problems. GM supports the principles embodied in the guidelines, but believes it is important that EPA give careful consideration to potential problems when reviewing any fuel additive waiver application for alcohol/gasoline blends. During the last five years, a number of waivers have been granted.

GM and other automobile manufacturers are concerned that some of the blends approved by the EPA may be detrimental to vehicle emissions, performance and components. Although several fuel suppliers have been successful in marketing methanol/gasoline blends, the long-term effects of the blends on vehicle durability are not yet known.

To assure customer satisfaction with its vehicles, GM is establishing a system to track reported vehicle problems to determine if methanol/gasoline blends are responsible.

If further investigation determines methanol/gasoline blends can be used in the existing fleet of vehicles without materials, drivability, or emissions problems, GM believes their use should be permitted. But only with adequate labeling of fuel at the pump will consumers be able to recognize the contents of the fuel they are purchasing.

SECTION 7 — ENGINE

ENGINE FUEL SYSTEMS

There are distinct differences between the gasoline and diesel engine fuel systems. The 5.7L and 7.4L (Mark IV) gasoline engines use a carburetor to mix fuel with air. Strong engine vacuum, drawing intake air through the carburetor venturis, causes fuel to flow from the carburetor ports to be mixed in the air stream turbulence. This air/fuel mixture is distributed to each cylinder through the intake manifold. Engine speed is controlled by the position of throttle plates in the carburetor which open and close (by means of the accelerator linkage) to vary the amount of air/fuel mixture entering the manifold and cylinders. In the diesel engine, fuel is injected directly into a pre-chamber above each cylinder where it is mixed with air. Engine speed is controlled by varying the amount of fuel injected.

The components used in each system, gasoline and diesel, will be described in separate sections.

GASOLINE ENGINE SYSTEM DESCRIPTION

The fuel system includes the fuel tank, fuel pump, fuel filter, carburetor and all fuel and vacuum lines.

FUEL TANK

The fuel tank is located behind the rear axle and is strapped to the frame. It includes the fuel filler cap and neck, and a fuel gage sending unit. Its sole purpose is to provide a place for fuel storage.

FUEL PUMP

The fuel pump is located on the lower front half of the engine block on the passenger's side. Its purpose is to provide adequate pressure to move fuel to the carburetor.

The fuel pump is a diaphragm-type pump and is actuated by the rocker arm through a link and a pushrod.

Some vehicles have a fuel pump with an outlet for a vapor return system. Any vapor which forms, is returned to the fuel tank along with hot fuel through a separate line. This greatly reduces any possibility of vapor lock by keeping cool fuel from the tank constantly circulating through the fuel pump.

EVAPORATIVE CONTROL SYSTEM

A light-duty and some heavy-duty vehicles are equipped with an emissions system designed to prevent escape of fuel vapor to the atmosphere (Figure 7-17). Vapor generated by evaporation of fuel in the tank, previously exhausted to the atmosphere, is transferred by an emission line to the engine compartment. During periods of inoperation, an activated charcoal canister located in the emission line stores any vapor generated, for consumption during the next period of operation.

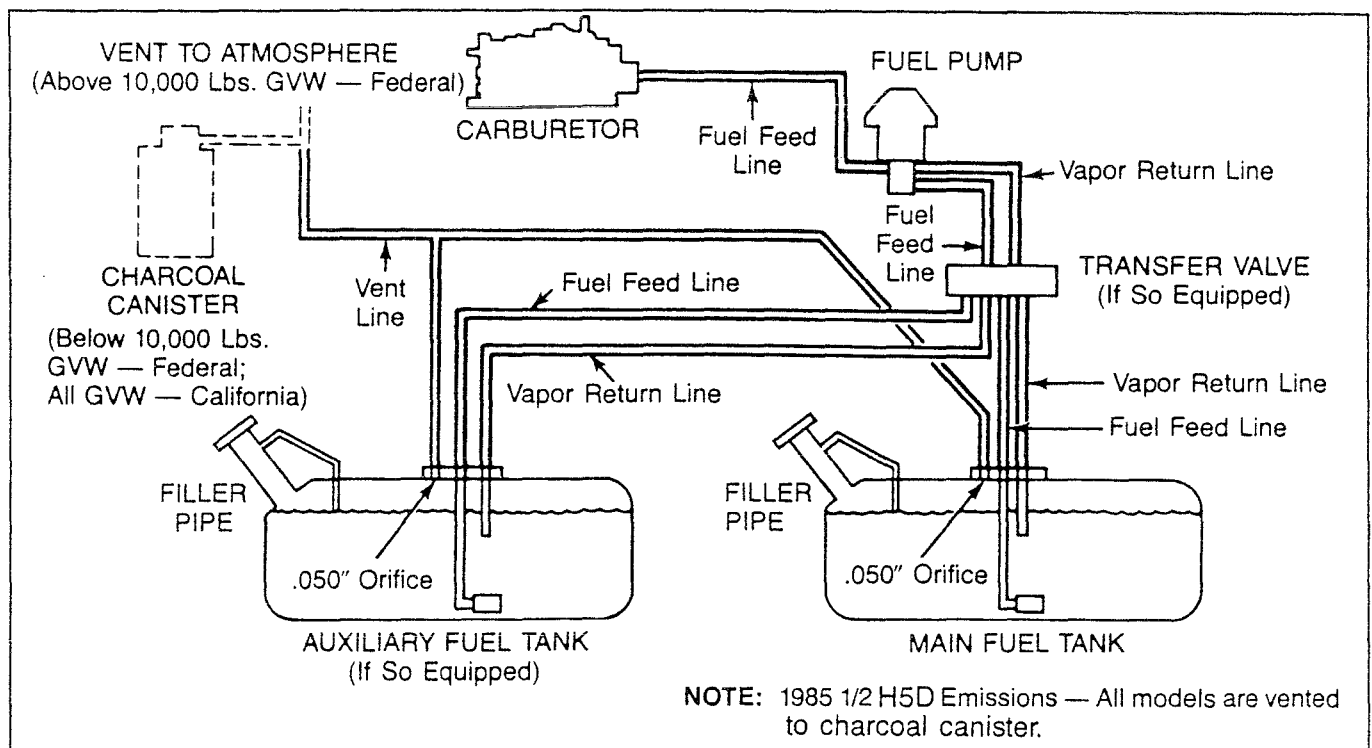


Figure 7-17 — Evaporative Control System

The amount of vapor drawn into the engine at any time is too small to have any effect on fuel economy or engine operation.

With this closed system, it is extremely important that only vapors be transferred to the engine. To avoid the possibility of liquid fuel being drawn into the system, these following features are included as part of the total system:

1. A fuel tank overfill protector is provided on all series to assure adequate room for expansion of liquid fuel volume with temperature changes. (Fill is limited to 80-90% total capacity.)
2. A one-point fuel tank venting system is provided on all series to assure that the tank will be vented under any conceivable vehicle attitude.
3. To protect the tank from mechanical damage in the event of excessive internal or external pressures resulting from the operation of this closed system, a pressure-vacuum relief valve, located in the gas cap, will control the tank's internal pressure.

System Hook-Up for Auxiliary Tank

If an auxiliary fuel tank is to be added, it must be vented as shown in Figure 7-17. See Figure 7-18 for additional fuel tank considerations.

FUEL FILTERS

An engine fuel filter is located in the carburetor fuel inlet. These fuel filter elements are of pleated paper. Elements are placed in the inlet hole with the gasket surface outward. A spring holds the element outward, sealing it by compressing a gasket surface against the inlet fitting.

The carburetor inlet fuel filter should be replaced at the intervals shown in the Maintenance Schedule. A plugged filter and/or check valve will restrict fuel flow.

After assembling any filter element in the carburetor, always start the engine and check for leaks in the fuel line and fittings before installing the air cleaner.

For the P-Series, an additional fuel filter is located in the fuel line along the inside or outside of the right frame rail depending on the year built. It is replaced by disconnecting the fuel line on both sides of the filter assembly, removing the old assembly, installing a new one, and then reconnecting the fuel line. Use caution to avoid fuel spillage.

NOTE: The position of the filter(s) may vary on the P-Series with the installation of aftermarket fuel tanks. The installation of additional filters at **each** tank is not recommended, because of the added work load these restrictions would place on the mechanical fuel pump.

A woven plastic filter is located on the lower end of the fuel pickup pipe in the fuel tank. This filter prevents dirt from entering the fuel line. Normally, no maintenance is required. Fuel stoppage at this point, indicates that the tank contains an abnormal amount of sediment; consequently, the tank should be removed and cleaned thoroughly.

CARBURETOR

The carburetor is located on the top of the engine block, just under the air filter housing. Proper operation of the carburetor is extremely important as it performs several necessary functions. First, it controls the amount of air drawn in by the engine and controls the amount of fuel

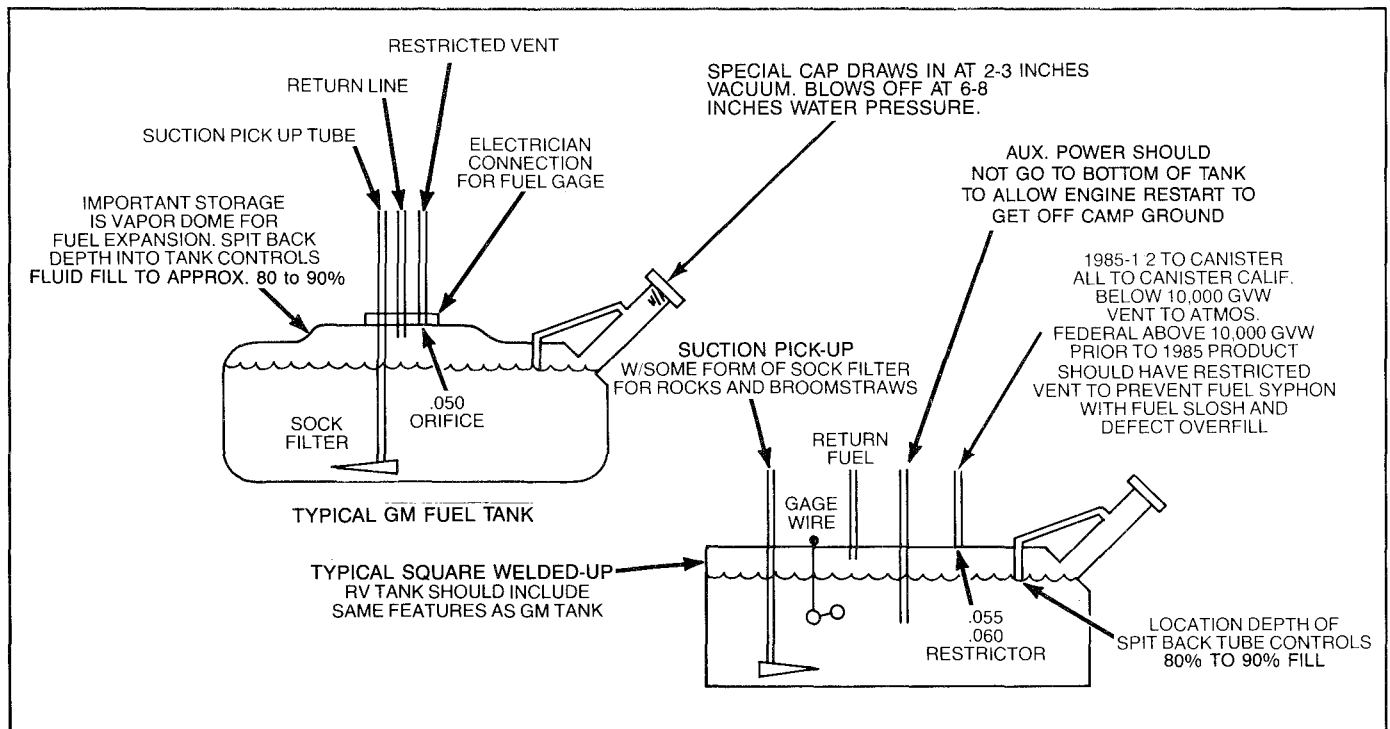


Figure 7-18 — Typical Fuel Tank Design Considerations

that is combined with air to form a combustible mixture. This must be done adequately to cover a wide range of operating speeds and conditions. Consequently the carburetor also controls engine output and speed by varying the amount of mixture reaching the eight cylinders.

Finally, the carburetor provides vacuum control for the spark advance and vacuum source for many of the federally mandated emission controls.

The M4MC model carburetor is used on most of the gasoline engines. It features tamper-resistant controls to discourage readjustment of factory settings, which could affect either or both emission control and drivability.

MAINTENANCE AND INSPECTION

The system should be inspected and maintained in accordance with the Maintenance Schedule. Fuel lines should be checked for signs of leakage, damage or deterioration. Clamps must be tightened if they are loose. Filters in the fuel line and the evaporative control system should be replaced at the recommended intervals. The carburetor choke linkage should be checked and the mounting bolts tightened as recommended.

DIESEL ENGINE SYSTEM DESCRIPTION

The 6.2-liter diesel engine fuel system is composed of:

- Fuel tank with water sensor and screen filter
- Primary fuel filter
- Mechanical fuel pump
- Secondary fuel filter

- Fuel line heater
- Injection distributor pump
- High pressure lines
- Fuel injection nozzles.

Fuel is pulled from the fuel tank by the mechanical pump which is located on the right side of the engine. It is driven by an eccentric lobe on the camshaft through a pushrod. Fuel is pulled through the primary filter, by the mechanical pump. Fuel is then pumped through the fuel line heater and through the secondary filter mounted on the inlet manifold. Both filters remove foreign material which could damage the injection pump or clog the injector nozzle. From the filter, the fuel is pumped to the injection pump. (See Figure 7-19.)

The 6.2-liter injection pump is mounted on top of the engine under the intake manifold. It is gear driven by two gears—one attached to the front end of the camshaft which drives the second gear that is attached to the end of the injection pump shaft. These two gears are the same size and have the same number of teeth; thus, the injection pump shaft turns at the same rate as the camshaft and one-half the speed of the crankshaft. The pump will turn in the opposite direction to that of the camshaft and crankshaft.

The injection pump is a high-pressure rotary-type pump that directs a metered, pressurized fuel through the high pressure tubes to the eight injector nozzles. The eight high pressure lines are all the same length although their shapes may be different. This prevents any difference in timing, cylinder to cylinder.

The fuel line heater operates when the ambient temperature is low enough to require heating of the fuel.

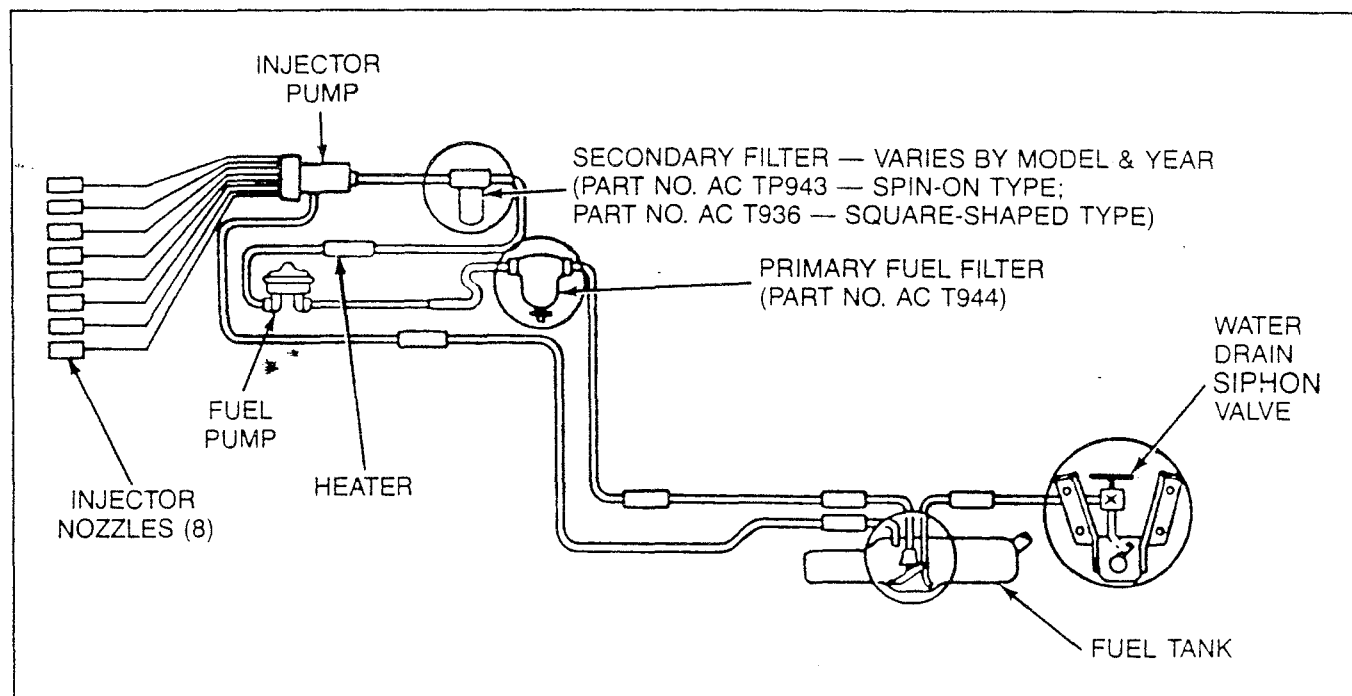


Figure 7-19 — Diesel Engine Fuel System

MAINTENANCE AND INSPECTION

WATER IN FUEL

The diesel engine has a "water-in-fuel" warning system allowing the user to guard against water in fuel, which is very critical in diesel engines.

The fuel tank is equipped with a filter which screens out the water and lets it lay in the bottom of the tank below the fuel pickup. When the water level reaches a point where it could be drawn into the system, a warning light flashes in the cab. A siphoning system starting at the tank and going to the rear spring hanger on some models and at the midway point of the right frame rail on other models permits the user to attach a hose at the shut-off and siphon out the water.

A primary filter (Figure 7-20) is located on the front of dash and it also has water-draining provisions.

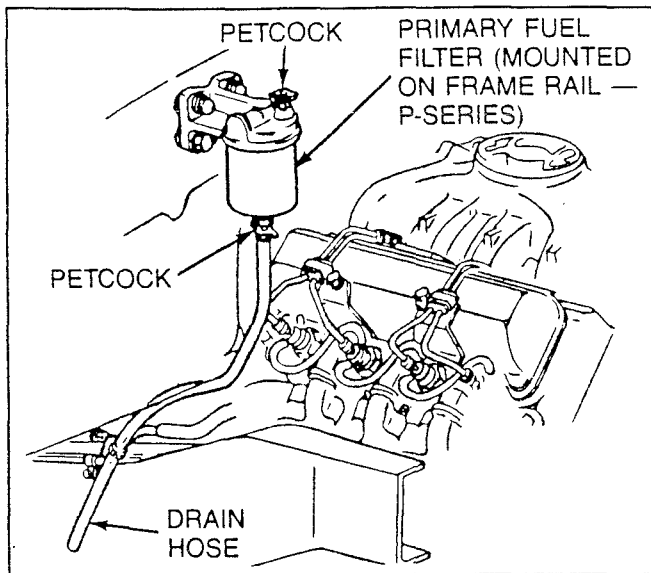


Figure 7-20 — Primary Fuel Filter (AC Type T944)

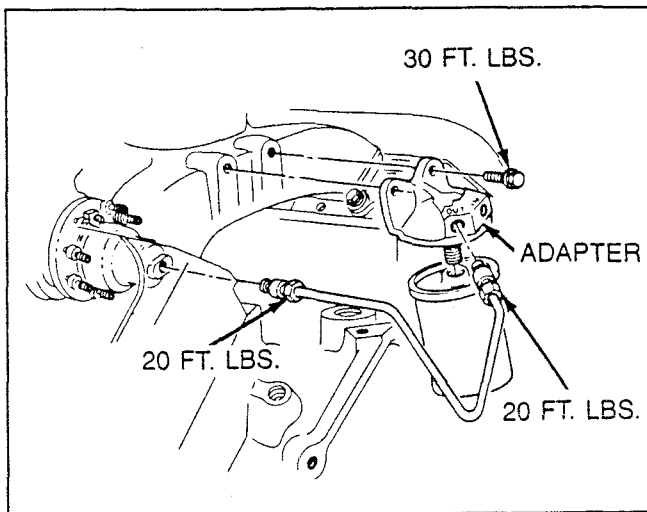


Figure 7-21—Secondary Fuel Filter (AC Type TP943)

A secondary in-line fuel filter (Figure 7-21) is the final filter before fuel enters the injection pump.

See Appendix 7-7 — Secondary Fuel Filters at the back of this section of the manual for additional equipment operation information.

When changing the fuel filter or when the vehicle has run out of fuel, disconnect the connector from the temperature switch and jumper connector terminals. This will aid in purging air from the pump. (This procedure is necessary only on a hot engine, as the circuit will always be closed when the engine is cold.)

PRIMARY FUEL FILTER WATER DRAIN

If it should become necessary to drain water from the fuel tank, check the primary fuel filter (Figure 7-20) for water. This can be done as follows:

1. Open the petcock on the top of the primary filter housing.
2. Place a drain pan below the filter and open the petcock on the bottom of the drain assembly. (A length of hose is attached to the petcock to direct drained fluid below the frame.)
3. When all water is drained from the filter, close the petcock firmly.

NOTE: If the filter is completely drained, remove the filter and refill it with clean diesel fuel to prevent engine stalling.

4. Close the upper petcock tightly.
5. Start the engine and let it run briefly. The engine may run roughly for a short time until the air is purged from the system.
6. If the engine continues to run roughly, check that both petcocks at the primary filter are closed tightly.

SECONDARY FUEL FILTER

(See Figure 7-21)

Removal

1. Remove the fuel filter lines from the adapter.
2. Remove the fuel filter adapter from the intake manifold.
3. Remove the filter.

Installation

Anytime either of the fuel filters is removed or replaced, refill it with clean diesel fuel to prevent engine stalling after start-up, and to avoid very long engine cranking time.

1. Install the filter to the adapter.
2. Install the adapter to the intake manifold.
3. Install the fuel filter lines.

ENGINE FUEL SYSTEMS

APPENDIX 7-5 — PLUGGED FUEL RETURN LINE AND ENGINE PERFORMANCE

The following information has been extracted from a Chevrolet Dealer Service Technical Bulletin and concerns poor engine performance due to a plugged fuel return line—on the G-30 Cutaway and P-Series Class A Rail.

Reference: Chevrolet Dealer Service Technical Bulletin No. 78-I-53 (September, 1978)

Prior to Cutaway and Class A Rail body completion, a temporary fuel tank was utilized and required that the fuel return line remain disconnected and plugged.

The line was to be unplugged and connected by the body builder prior to final delivery of the completed vehicle. Failure to reconnect the fuel return line can cause a vapor lock condition at high altitudes or high ambient temperatures.

In the event of a lack of power or rough engine complaint on the subject vehicles, check for the proper connection of the fuel return line. (See Figure A7-5-1.)

NOTE: Some 1978 and 1979 "G" Vans with V-8 engines, when operated in high ambient temperatures and under high engine fuel demands, have experienced the deformation of the flexible hose which connects the fuel feed line to the fuel pump. (See Figure A7-5-1.)

This condition is difficult to diagnose due to the unusual conditions under which it takes place.

To prevent this hose from deforming, a new molded hose (GM Part No. 14010036) has been released for 1980 production and can also be used for service replacement.

Effective with 1980 model production, an improved flexible hose was also introduced into production for the Class A Motor Home chassis. The new hose resists "sucking shut" in high heat and high fuel demand situations; however, it still will draw closed if tank or line filters become plugged. (GM Part No. 14026551 for 454 engines and GM Part No. 14026550 for 350 engines.)

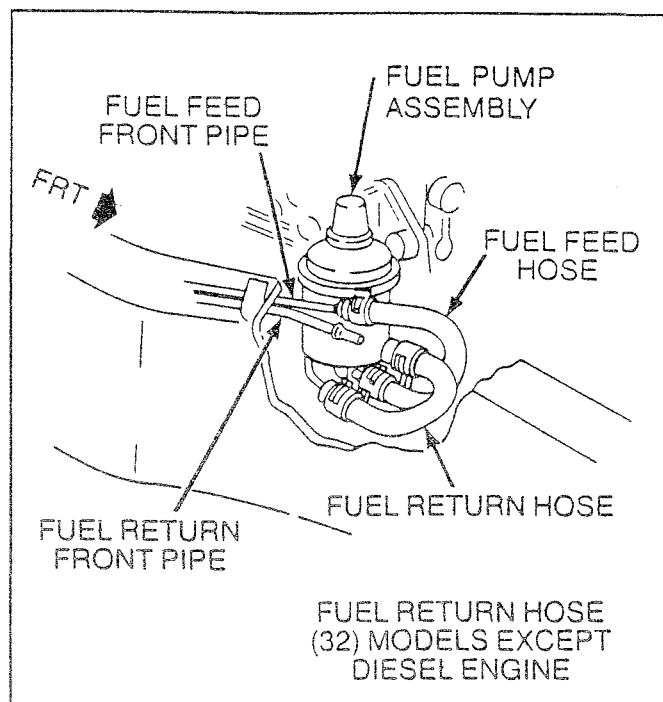


Figure A7-5-1 — Fuel Return Line Connections

ENGINE FUEL SYSTEMS

APPENDIX 7-6 — VAPOR LOCK CAUSE AND CURE

The following information has been compiled from extensive research and testing performed by Chevrolet Engineering and RV manufacturers concerning fuel handling problems of the Class A Motor Home (during 1982 and 1983). Chevrolet and the RV manufacturers examined typical "problem units" furnished by various owners in order to better understand "real-world" vapor lock problems in the highly customized Class A Motor Home and develop corrective actions.

This information is presented as an aid to the motor home owner in understanding the problems associated with vapor lock and the suggested solutions.

Fuel System Plumbing

As determined from initial studies, Chevrolet engineers and RV manufacturing representatives determined that part of the problem concerning vapor lock involved the RV manufacturers' approach to the fuel system plumbing. Examination of problem units identified considerable plumbing errors, such as:

- Four feet of rubber hose added in the middle of the stretch chassis.
- A length of hose positioned over the top of the tank to the pickup.
- Total rubber plumbing which is tied to the rear hot water lines with zip straps so that there was a tendency for the fuel to boil and the lines to "suck shut" or kink at each zip strap.
- Vehicles equipped with a defective switch valve so that the ports did not line up properly and some of the valves would only switch occasionally. (Ports that did not line up caused restriction as did units that had two additional fuel filters and a stretch chassis. All of these factors add to the load on the mechanical fuel pump.)
- An electric fuel pump installed in the return line rather than the suction line.
- Incorrect tank cap venting.
- And so on.

Chevrolet and the RV manufacturers' representatives determined that 100% of the motor homes produced with plumbing errors such as those above could have vapor locking problems. Investigation showed that, a properly plumbed fuel system down the inside of the frame rail was also not a 100% cure for the problem.

Fuel Properties

As part of the investigation, Chevrolet Fuel and Lubrication Engineers conducted a nationwide survey examining the possibility that fuels could cause vapor lock. Results of the survey show that oil companies have contributed to the cause of vapor lock by the addition of alcohol to the fuel without informing the public or advertising the fuel as gasohol. Also, it was determined that butane was added to "cover up" lower grade crudes and to increase octane ratings. The result of the fuel being adjusted and the octane modifiers was a general increase in the Reid vapor pressure of the fuels. (The higher the Reid vapor pressure the greater the possibility of vapor lock.) The average Reid vapor pressure of regular unleaded gasoline was 9.3 in 1980, 9.8 in 1981 and 10.3 in 1982 (with individual locations showing a reading of 12 and 13). With fuel changes toward the higher Reid vapor pressure fuels, some motor home owners who have never experienced any problems could have vapor lock problems that did not exist a year or so ago. Also, it was determined that mountains, steep grades and overloaded vehicles tend to aggravate the vapor lock problem, as recorded in a park survey at Pikes Peak. Vapor lock at Pikes Peak is the single most recorded mechanical problem encountered.

NOTE: GM's testing was performed under strict test procedures. The results are shown in Figure A7-6-1. The tests were performed on 10-lb. RVP fuel and 12-lb. RVP fuel. As shown on the charts, add the ratings after idle, after soak and 5-mile grade. The right-hand number on the charts indicates the overall rating. The higher the number the better the success rate.

Results of Vapor Lock Investigation

During the week of October 17, 1983, Chevrolet invited all Class A motor home manufacturers to the GM Proving Grounds in Phoenix, Arizona. The purpose of this meeting was to discuss the findings of the investigation into the cause of vapor lock and to make specific corrective recommendations for current and future production vehicles (including changes in truck emissions). The meeting was attended by 34 of 36 RV manufacturers. Chevrolet suggested that the RV manufacturers incorporate the following recommendations into current and future vehicle building, as well as develop some adaptation for problem units already existing in the field. The following recommendations were presented:

- A one-half inch steel fuel line mounted on the outside of the frame rail, protected against rub and chafe (see Figure A7-6-2).
- An electric fuel pump mounted off the frame at the tank using an adjustable regulator set to 5 PSI at engine idle measured at the mechanical pump inlet (see Figure A7-6-2). Best success was obtained with the Holley Fuel Pump (No. 12-802) that includes a regulator and has ample volume for this engine (see Figure A7-6-3).

APPENDIX 7-6 — VAPOR LOCK CAUSE AND CURE (CONT'D)

- The fuel requirements for the 454 engine at wide-open throttle are 25 gallons per hour at 2 PSI minimum and 3 PSI maximum. If fuel line lengths or routings create a situation where this cannot be met, an electric pump should be added at the fuel tank to supply fuel to the mechanical pump on the engine. Pressure in the supply line will further reduce the chance of bubbles forming versus a negative pressure situation with a mechanical pump only. (See Pressurized Fuel System Diagnosis Chart in Figure A7-6-6.)
- A single in-line filter should be placed between the tank and the electric fuel pump. (One filter choice is AC Part No. GF62C.)
- A three-eighths inch rubber fuel line connection should be made at the mechanical fuel pump and at the fuel pump sending unit.
- Power for the electric fuel pump should be controlled through a relay or special oil pressure switch to assure shut-down in the event of vehicle upset (see Figure A7-6-3). Consideration could be given to a manual priming override in the event the system has totally run out of fuel. Normal starts would occur with the fuel remaining in the carburetor and upon starting as oil pressure came up the special switch or relay and would turn on

the electric pump. (See installation instructions in Figure A7-6-4.)

Chevrolet invited all RV manufacturers to the Phoenix meeting to share the findings and test information, as it would be difficult for a singular RV manufacturer (or customer) to produce these tests on their own. Chevrolet informed the RV manufacturers that all necessary steps would be taken to correct any vapor lock problem on any chassis with a 137-, 158-, or 178-inch wheelbase with a 100-percent factory system. Additionally, Chevrolet requested that the RV manufacturers correct any field problems that are reported to them on any units that have been modified by the RV manufacturer—such as stretch chassis, dual tanks, dual fuel, oversize tanks, etc., as the individual manufacturers are more knowledgeable of their own systems and are in a better position to make their own modifications for the various models, years and options.

NOTE: Chevrolet has completed testing of a new 60-gallon tank. With the start of 1985 production, new fuel lines were installed on the outside of the frame rail. In the spring of 1985, a complete system was in production with in-tank electric pusher pump and external regulator adjustable by the RV manufacturer for an oversize wheelbase. (See Figure A7-6-5.)

APPENDIX 7-6 — VAPOR LOCK CAUSE AND CURE (CONT. 2)

1982 TESTING

Performance Rating Guide: 10 Excellent 8 Good 6 Fair 4 Poor 2 Bad

Test Condition:	SURGE DURING W.O.T.				
	R. V. P.	After Idle	After Soak	5-Mile Grade	Test Rating
Production lines with tank vent line and .055 restricter.	12	5	4	4	13
Front section of fuel line outside frame. 3/8" from switching valve to pump.	12	8	7	4	19
Production lines with electric pump in-tank. No mech. pump.	12	4	4	Pressure dropped to '0'	8
Same, with mech. pump and elec. in-tank pump.	12	7	8	Pressure too high. Spewed badly above 5-6 PSI at carb.	15
3/8" outside frame, full length	10	8	6	10	24
Same as above except R. V. P.	12	8	7	5	20
1/2" outside frame, 3/8" at ends. Full length	10	5	10	10	25
Same as above except R. V. P.	12	6	6	6	18
Production fuel lines, booster pump installed. Pressure set at 4 lbs., at booster pump @ WOT Holley # 12-802	10	10	8	10	28
Same as above except R. V. P.	12	6	8	5	19
Aux. tank, production lines.	10	10	5	5	20
Same as above except R. V. P.	12	4	4	4	12

Figure A7-6-1 — Payson Grade Test — 1982 Test Results

NOTE: As indicated on the chart for the 5-mile grade, the pressure dropped to 0 and on another occasion pressure was too high and fuel spewed badly. The Rochester carburetor can operate with between 1-1/2 and 5 lbs. of pressure. It is possible to starve the engine as well as to overshoot with too much pressure, which would provide evidence as to why many add-on electric pumps have not been successful and have often created a second problem.

APPENDIX 7-6 — VAPOR LOCK CAUSE AND CURE (CONT'D)

1983 TESTING

Performance Rating Guide: 10 Excellent 8 Good 6 Fair 4 Poor 2 Bad

FULL LINE CONFIGURATIONS							
10# FUEL							
Regulator at Rear	Mech. Pump	Elec. Pump	Reg'ltr at 4 PSI	Reg'ltr at 5 PSI	Rating/Min.	Comments	Test No.
3/8" Inside Full Length	X		10# Fuel		4/34	w/Filter & Shielded Lines	5
3/8" Inside 1/2" Outside Front	X				4/36	w/Filter & Shielded Lines	6
12# FUEL							
3/8" Inside RR Outside Front	X	X		X	7/60	w/Filter & Shielded Lines	39
3/8" Outside Full Length	X	X		X	4/35	w/Filter in line STD Location	40
.5" Outside Full Length	X				4/18	w/Carb. Filter No Filter Inline	30
"		X	X		3/8	w/Carb. Filter No Filter Inline	31
"	X	X	X		6/60	w/Carb. Filter No Filter Inline	32
"	X	X		X	10/60	w/Carb. Filter No Filter Inline	33
"		X		X	4/18	w/Vapor Return Fuel Filter	38
"	X	X		X	7/60	w/Filters '84 Proposed	43
"	X	X		X	8/60	w/o Carb. Filter '84 Proposed	44
"	X	X		X	4-5/60	Same as *44 Only Red Elect. Pump	46
"		X	X		4/18	No Filter	35
"		X		X	4/18	No Filter	36
"		X		X	4/30	w/Vapor Return Fuel Filter	37
3/8" Inside Shielded to 3/8" Outside		X	X		4/35	w/Vapor Return Filter-Merrit	41
"		X		X	4/36	"	42
"		X		X	4/24	Merrit-w/Red Low Pres. Pump	45

Figure A7-6-1 — 1983 Test Results — 10-lb. and 12-lb. RVP Fuel

APPENDIX 7-6 — VAPOR LOCK CAUSE AND CURE (CONT'D)

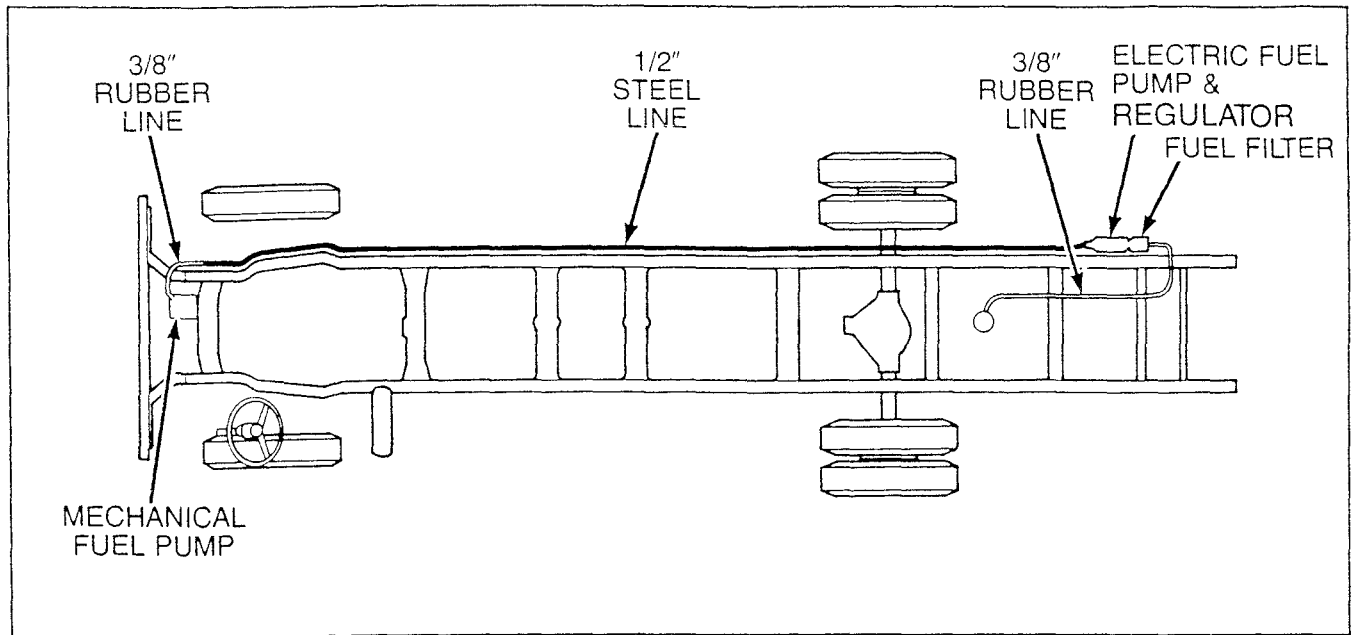


Figure A7-6-2 — 1984 Recommended Field Fix

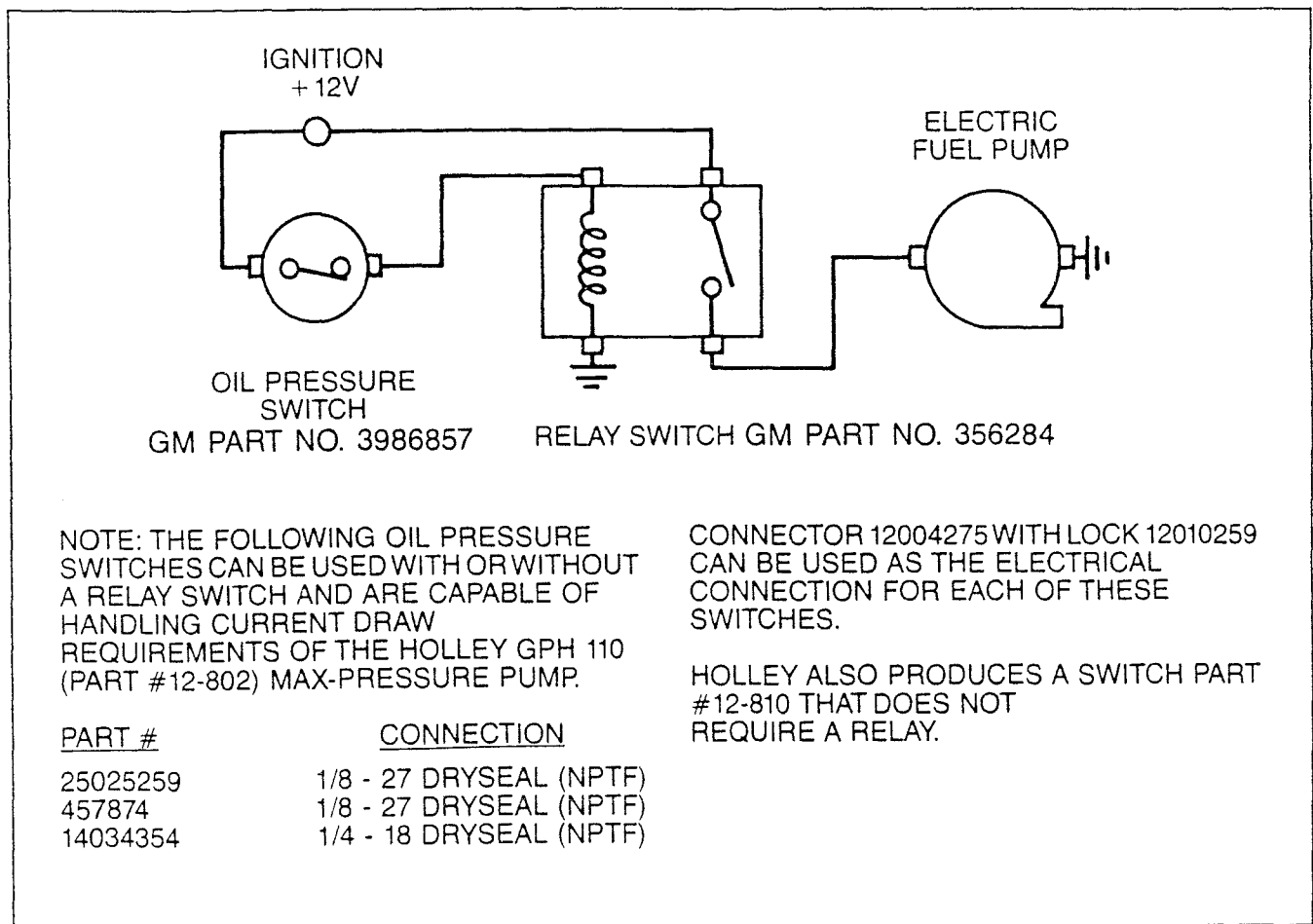


Figure A7-6-3 — Electric Fuel Pump/Oil Pressure Switch Relay

APPENDIX 7-6 — VAPOR LOCK CAUSE AND CURE (CONT'D)

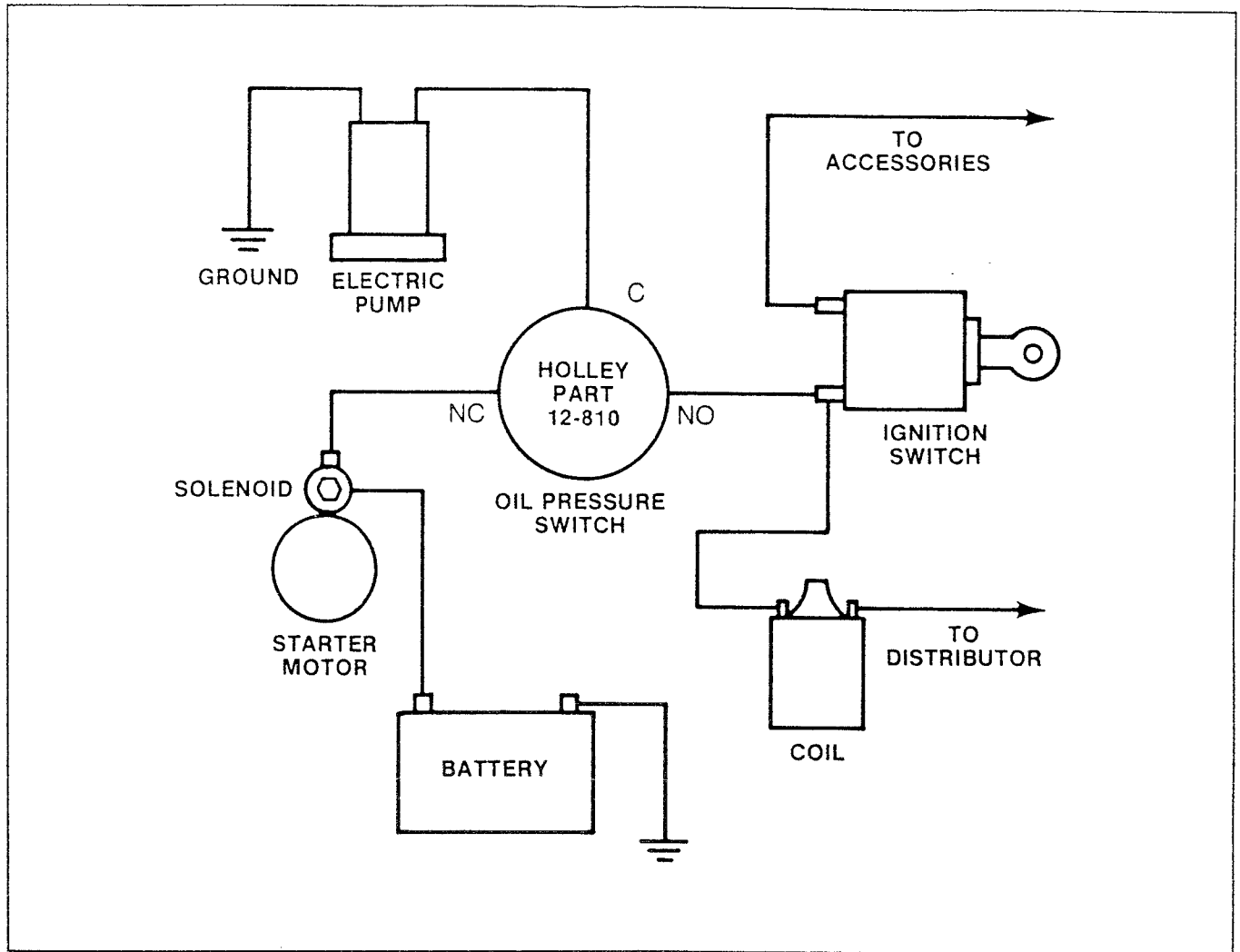


Figure A7-6-4 — Oil Pressure Switch — Typical Wiring Diagram

INSTALLATION INSTRUCTIONS

NOTE: Please read instructions completely before making installation.

1. Disconnect cable from battery.
2. Remove original equipment oil pressure switch and retain.
3. Screw a 1/8" pipe nipple into the hole from which the pressure switch was removed. Use any suitable thread sealant on all fittings, taking care to avoid an excess which might contaminate the engine.
4. Screw a 1/8" pipe tee onto the nipple and position it in a manner to facilitate the installation of the original oil pressure switch and the new fuel pump pressure switch in the remaining two holes.
5. Screw in the two switches and reconnect the lead to the original equipment oil pressure switch.

NOTE: The pump oil pressure switch will normally have three terminals marked: *C* (common), *NC* (normally closed), and *NO* (normally open).

6. Connect the fuel pump (black lead) to the terminal marked "C." In this line, add an in-line fuse holder and a 7.5 amp fuse.
7. Connect the terminal marked "NO" to the ON terminal of the ignition switch.
8. Connect the terminal marked "NC" to the starter motor circuit.
9. To complete the installation, connect the ground cable to the battery.

BE SURE TO CRIMP SECURELY ALL ELECTRICAL CONNECTORS AND CLEAN ANY AREA WHERE GROUND LEADS WILL BE FASTENED.

APPENDIX 7-6 — VAPOR LOCK CAUSE AND CURE (CONT'D)

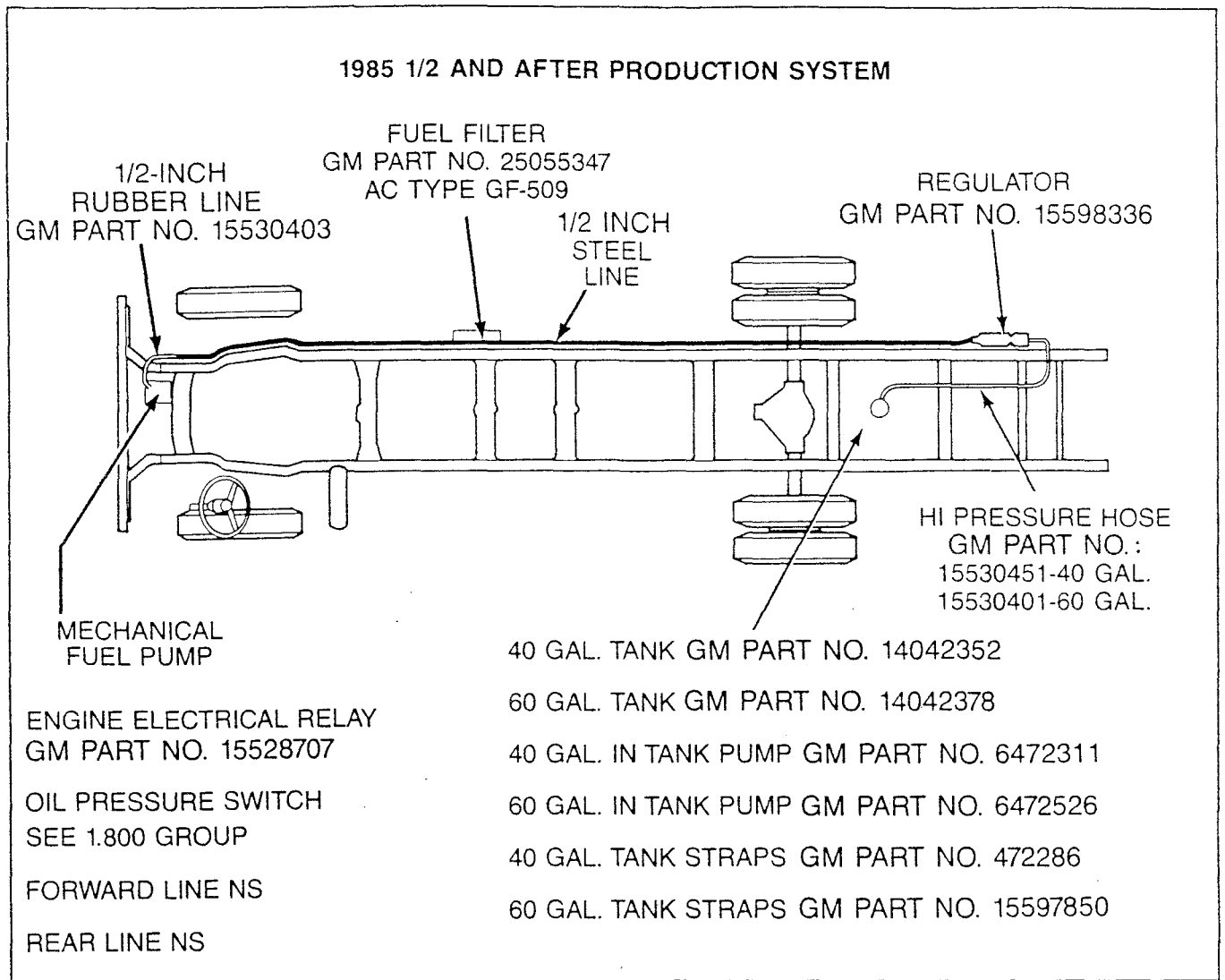


Figure A7-6-5 — 1985½ Pressurized Fuel System Components

NOTE: In July, 1985, GM began production of a new pressurized fuel system. From production, the RV manufacturer may choose a 40-gallon standard system, an optional 60-gallon system (Option No. NN4) or specify Option No. 9H2. Option No. 9H2 deletes Chevrolet's system and requires the manufacturer to install its own system.

APPENDIX 7-6 — VAPOR LOCK CAUSE AND CURE (CONT'D)

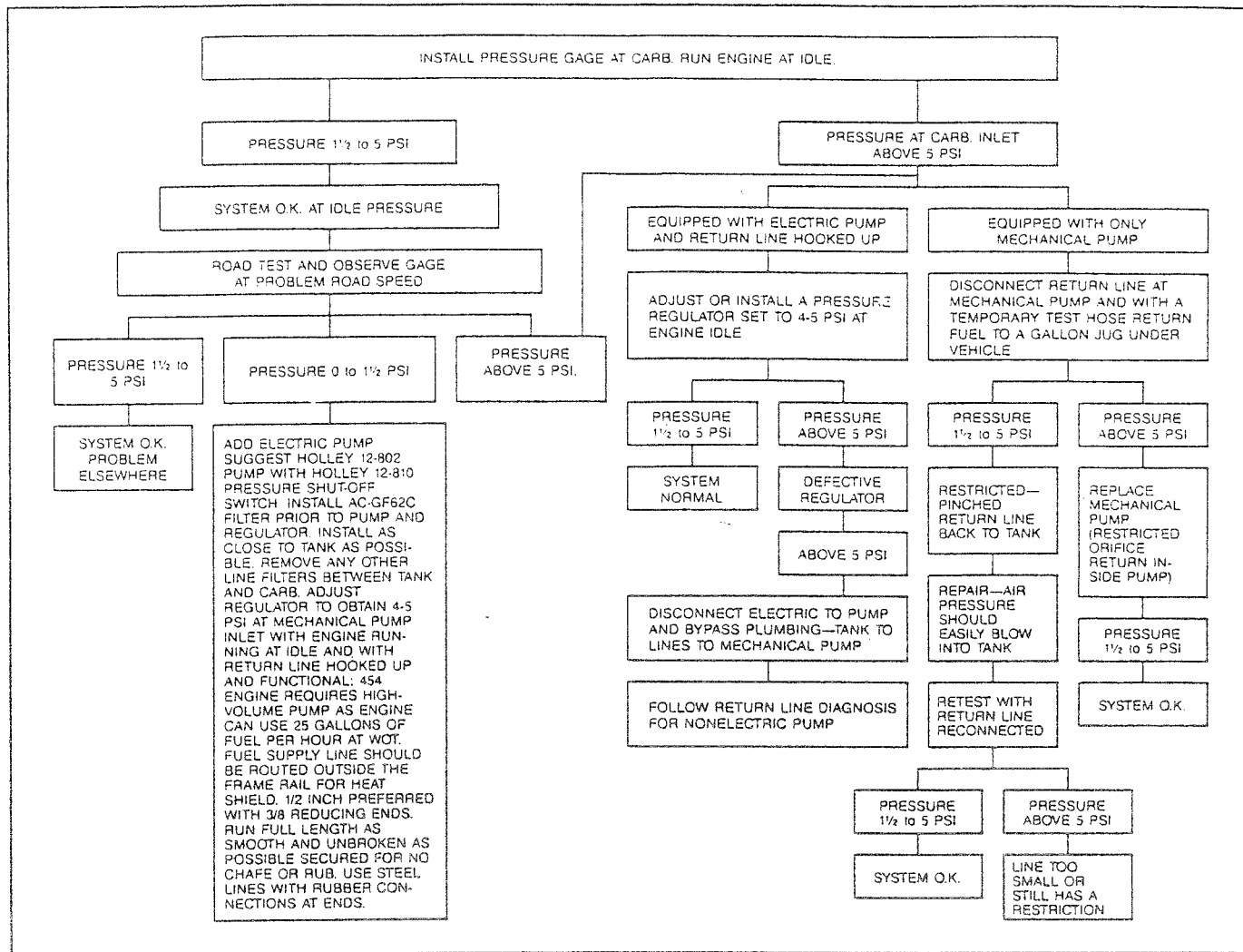


Figure A7-6-6 — Pressurized Fuel System Diagnosis Chart

NOTE: Cool fresh air should be introduced through the fresh air induction via hose from the front of the radiator to the carburetor air cleaner snout. This has proven effective in reducing fuel percolation in the carburetor fuel bowl.

ENGINE FUEL SYSTEMS

APPENDIX 7-7 — SECONDARY FUEL FILTERS

The following information has been extracted from the GM 6.2-Liter Diesel Engine manual. The information covers general operation, application and replacement part numbers of both the Model 75 and Model 80 Secondary Fuel Filter.

G-P SERIES—MODEL 75 SECONDARY FUEL FILTER

The G-P Series uses a Stanadyne Model 75 secondary fuel filter in 1983. (See Figure A7-7-1.) It is fastened using two ball clips. It is particularly important to place absorbent towels under the filter when changing it to improve cylinder and case valley drain and prevent fuel oil contamination of the clutch-driven disc.

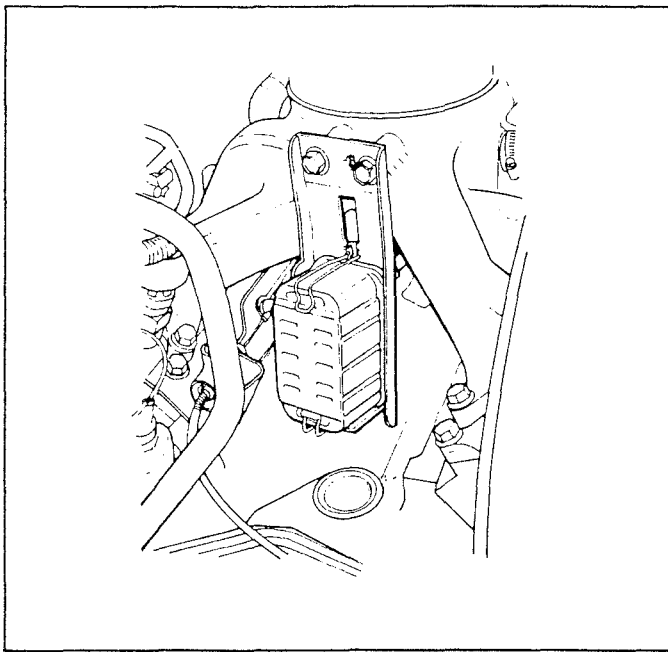


Figure A7-7-1 — Model 75 Secondary Fuel Filter

The Model 75 filter is a two-stage pleated paper type filter. The first stage consists of approximately 400 square inches of filtering area and will remove 94% of particles 10 microns or larger. The second stage is made of the same paper material and consists of approximately 200 square inches of filtering surface. The second stage is 98% effective in filtering the fuel already filtered by the first stage.

Particles which are larger than 10 microns may damage the pump's internal components. Figure A7-7-2 compares various micron sizes and will ultimately show the filter's effectiveness.

G-P SERIES—MODEL 80 SECONDARY FUEL FILTER

The Model 80 Stanadyne Fuel Filter provides the following features in one unit:

- Two-stage fuel filter
- Fuel/water separator
- Electronic "water-in-fuel" signal
- Electric fuel heater
- Integral hand primer
- "Filter change" signal.

Fuel Heater

The purpose of the heater (see Figure A7-7-3) is to heat fuel, so that the filter does not plug with paraffin wax crystals. This will allow use of fuels at temperatures substantially below the Cloud Point of the fuel. The heater is electrically powered from the ignition circuit 39 and is thermostatically controlled to work when waxing of the fuel is expected.

The device can be divided into two major functional components—the heater and the power control assemblies.

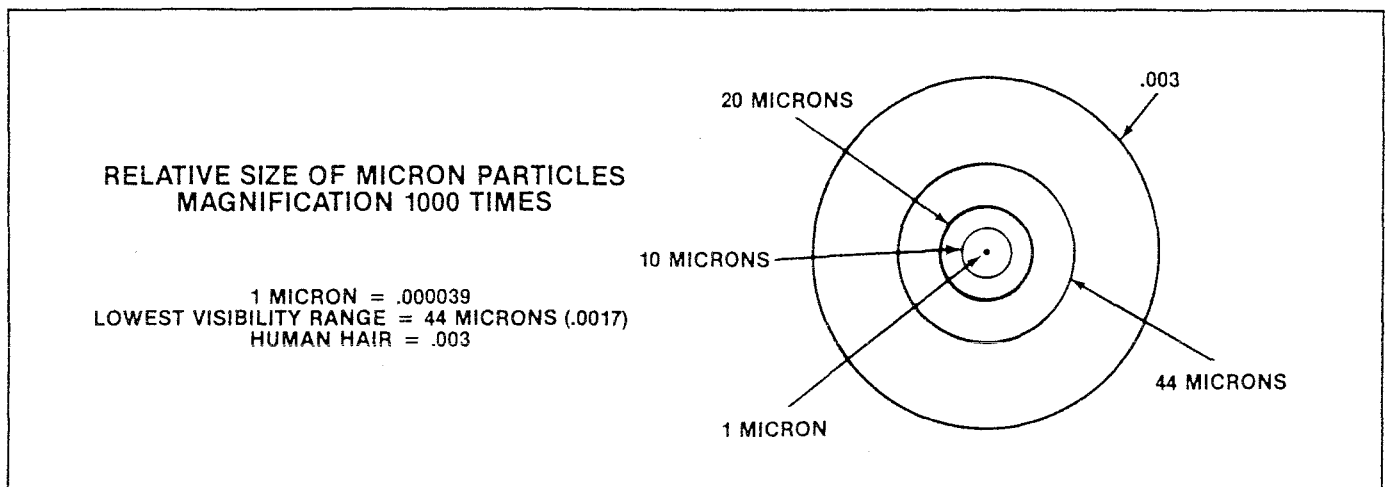


Figure A7-7-2 — Relative Size of Micron Particles

APPENDIX 7-7 — SECONDARY FUEL FILTERS (CONT'D)

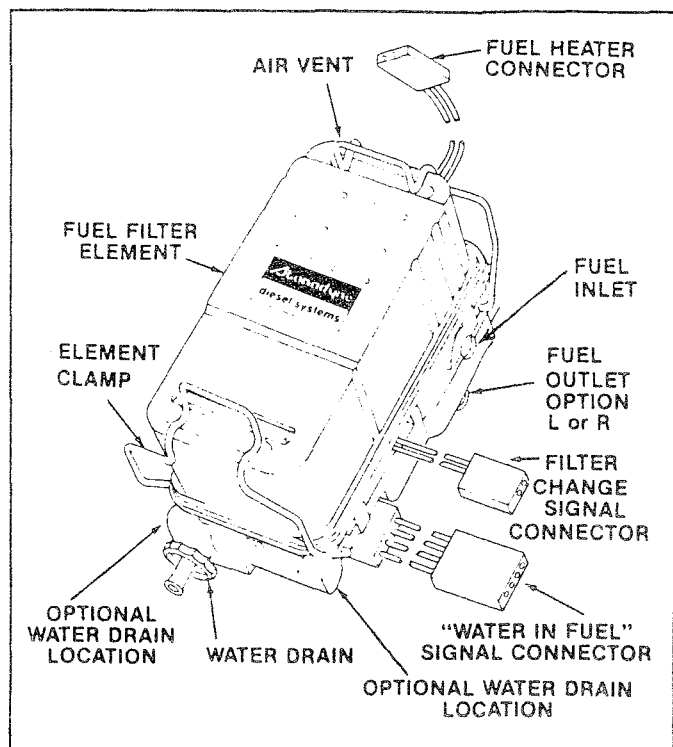


Figure A7-7-3 — Model 80 Fuel Filter and Base Assembly

Fuel Filter

The engine fuel filter is a two-stage pleated paper type filter (see Figure A7-7-4). The first stage consists of approximately 350 square inches of filtering area and will remove 96% of particles 5-6 microns or larger (see Figure A7-7-2). The second stage is made of the same paper material with glass particles and consists of approximately 100 square inches of filtering surface.

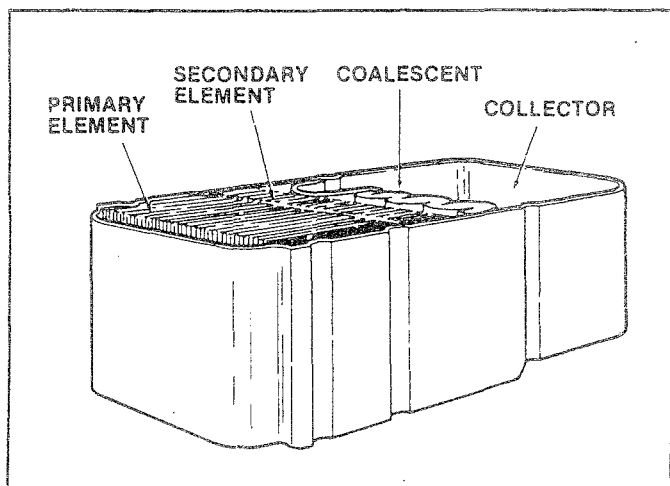


Figure A7-7-4 — Model 80 Filter Cross Section

The second stage is 98% effective in filtering the fuel already filtered by the first stage. Particles which are larger than 10 microns may damage the pump's internal components.

Water Sensor

The 6.2L uses a "water-in-fuel" warning system, which allows the user to guard against water in the fuel.

The water is detected by a capacitive probe located in the filter base. Electronics within the probe will connect a ground (circuit 150) to the ground side of the "water-in-fuel" lamp (circuit 508). This lamp is in the center of the instrument panel next to the glow plug lamp. In 1984 (4-wire water-sensor module) a bulb check was made anytime the ignition switch was in the start position. A "B+" signal on the purple wire at the "A" test switch (Figure A7-7-5) causes pin "D" to pull low, grounding the "water-in-fuel" bulb. In 1984-1/2 and 1985 (3-wire water sensor module) when the ignition is turned on, the lamp will glow from 2 to 5 seconds, and fade away. This is done as a bulb check.

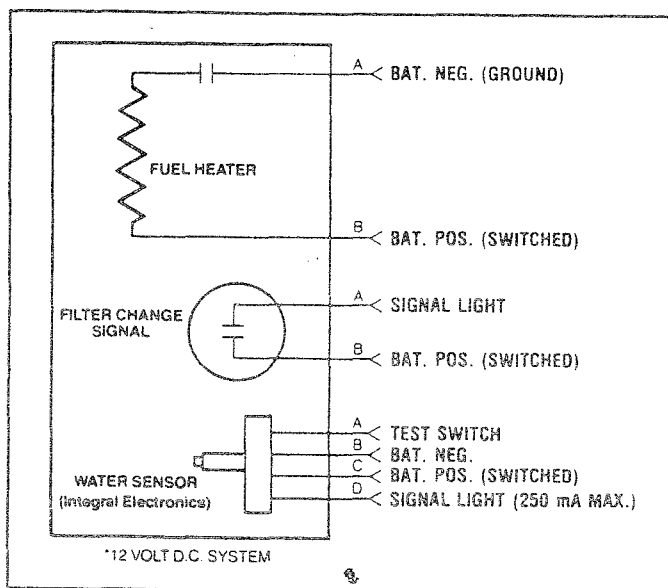


Figure A7-7-5 — Filter Base Wiring

Water Separator

The bottom of the filter is a hollow water collector (Figure A7-7-6). Because of the greater density of water, the water droplets will separate from the fuel oil. It will hold approximately 260 cubic centimeters of water (approximately 3-10%).

A nylon/fiberglass coalescent is used to blend the small water droplets into larger ones.

Fuel Flow

See Figure A7-7-6. Fuel enters at the top right inlet and flows into the heating chamber. The heater is activated at 8°C (46°F) and below. The heated fuel enters the element at the top and flows down through the two-stage fuel filter media pack. While passing through the third stage, water coalesces out and drops to a sump holding area. Clean fuel returns to the base and exits to the fuel injection pump. An electrical signal is obtained from the filter-change sensor located in the return path.

APPENDIX 7-7 — SECONDARY FUEL FILTERS (CONT'D)

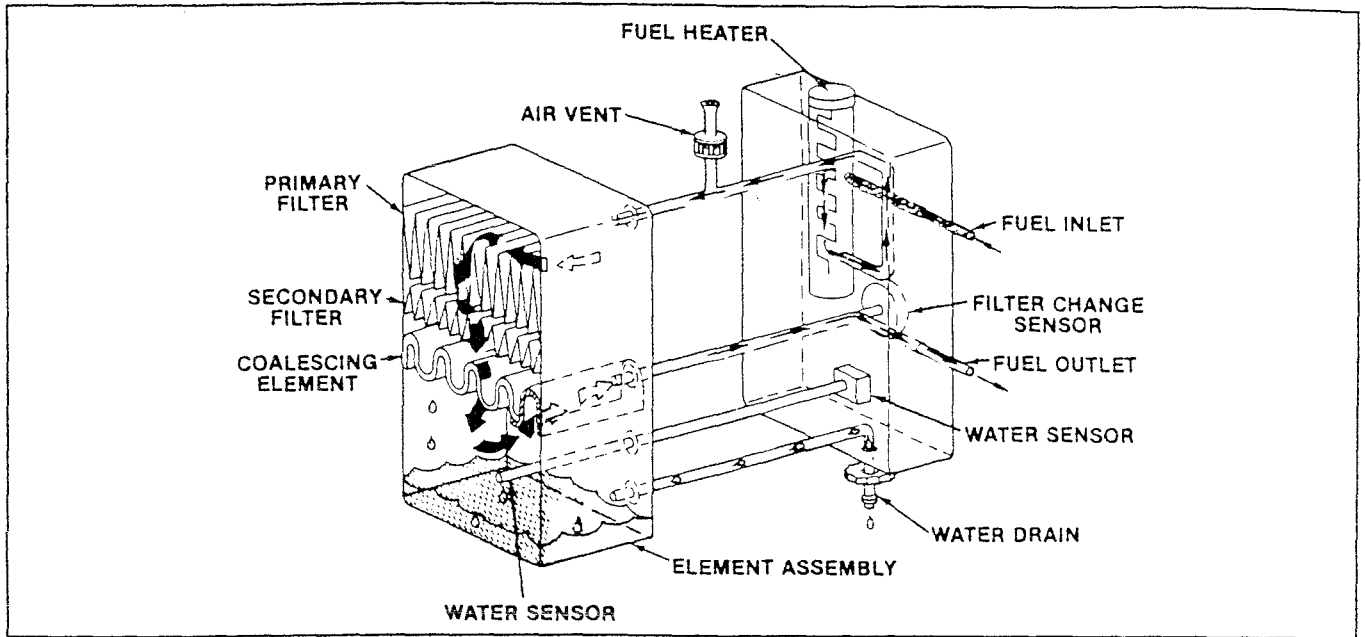


Figure A7-7-6 — Filter and Base Flow Schematic

SECTION 7 — ENGINE

ENGINE ELECTRICAL SYSTEM

The engine electrical system is separate from the motor home "living" system. It consists of a chassis battery, starting system, charging system, ignition system and instrument panel wiring and chassis information gages.

BATTERY GENERAL DESCRIPTION

The battery is a device designed to store electrical power for later use. It performs this function through chemical action.

The battery has three major functions in the electrical system. First, it is a source of electrical energy for cranking the engine. Second, it acts as a voltage stabilizer for the electrical system. And third, it can, for a limited time, provide energy when the electrical load exceeds the output of the alternator.

The sealed battery (Figure 7-22) is standard on all vehicle lines (see Specifications for specific applications).

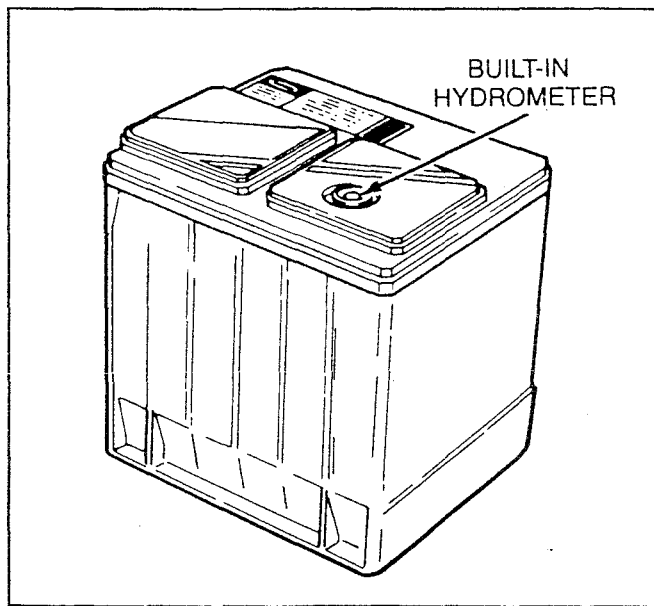


Figure 7-22 — Sealed-Top Battery

There are no vent plugs in the cover. The battery is completely sealed, except for two small vent holes in the side. These vent holes allow the small amount of gas produced in the battery to escape. The battery has the following advantages over conventional batteries:

1. No water addition for the life of the battery. This improvement makes the sealed battery possible.
2. Overcharge protection. If too high a voltage level is applied to the battery, it will not accept as much current as a conventional battery; the excess voltage will cause gassing, which leads to liquid loss.

3. Reduced self-discharge compared to a conventional battery. This is important when a battery is left standing for long periods of time.
4. Comparable power available in a lighter and smaller case.

RATINGS

A battery has two ratings: (1.) a reserve capacity rating at 80°F which is the time a fully charged battery will operate the vehicle with no generator operation, (2.) a cold crank rating at 0°F which indicates the cranking load capacity. (see Specifications for specific battery ratings.) The ampere/hour rating formerly found on batteries was based on the reserve capacity rating and is no longer used.

MAINTENANCE AND INSPECTION

A battery is not designed to last indefinitely; however, with proper care, it will provide many years of service. If the battery tests as good but fails to perform satisfactorily in service, the following are some of the more important factors that may point to the cause of the trouble.

1. Accessories left on overnight.
2. Slow average driving speeds for short periods.
3. The vehicle's electrical load is more than the alternator output particularly with the addition of aftermarket equipment such as radio equipment, air conditioning, window defoggers or light systems.
4. Defects in the charging system such as electrical shorts, slipping fan belt, faulty generator or voltage regulator.
5. Battery abuse, including failure to keep the battery cable terminals clean and tight or a loose battery (one that is not securely held in place).
6. Batteries in vehicles stored for long periods of time become discharged with sulfation occurring. Sulfation of the plates reduces the battery's capacity for accepting a charge. Also, under conditions of high ambient temperature, the temperature of the electrolyte may become excessive—causing boiling and loss of electrolyte.

NOTE: The inspection and test procedures which follow apply for the Delco sealed-top Freedom Battery. If your vehicle is equipped with a conventional-type and/or other brand battery, be sure to follow the test procedure and specifications recommended by the manufacturer.

VISUAL INSPECTION

The external condition of the battery should be checked periodically for damage such as cracked cover or case (Figure 7-23). Also check terminal area for loose or broken parts.

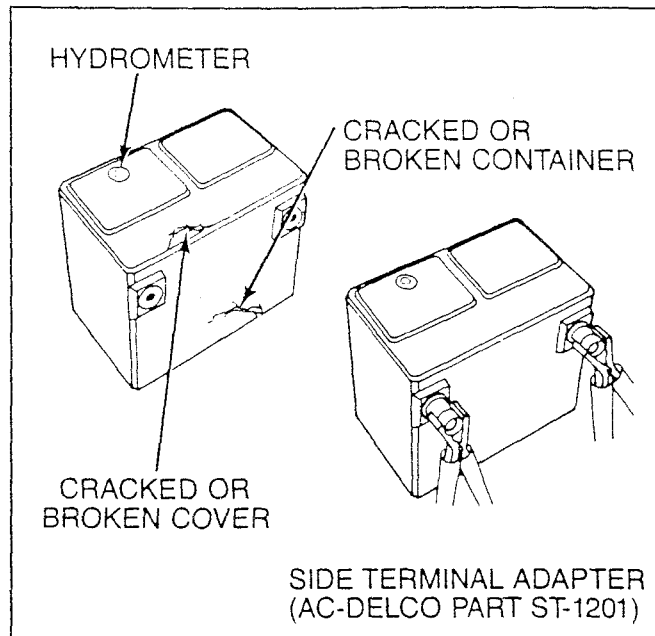


Figure 7-23 — Visual Battery Inspection

CAUTION: BATTERIES PRODUCE EXPLOSIVE GASES, CONTAIN CORROSIVE ACID, AND SUPPLY LEVELS OF ELECTRICAL CURRENT HIGH ENOUGH TO CAUSE BURNS. TO LESSEN THE CHANCE OF PERSONAL INJURY WHEN WORKING NEAR A BATTERY:

- Always wear eye protection or shield your eyes. Do not lean over a battery. Remove all metal jewelry.
- Never expose a battery to open flames or electric sparks. Also, do not smoke near a battery.
- Do not allow battery acid to contact eyes or skin. Flush any contacted area with water immediately and thoroughly. Get medical help.
- Do not allow metal tools to contact both the positive (red, "+") battery terminal (or any metal connected to this terminal) and any other metal on either vehicle at the same time. Make certain when attaching the jumper cable clamps to the positive terminals of the batteries that neither clamp contacts any other metal.
- Batteries should always be kept out of the reach of children.

BUILT-IN HYDROMETER (DELCO SEALED-TOP BATTERY)

The Delco sealed battery has a built-in temperature-compensated hydrometer in the top of the battery. This hydrometer is to be used with the following diagnostic procedure. When observing the hydrometer, make sure that

the battery has a clean top. A light may be required in some poorly lit areas to see the right indication.

Under normal operation, two indications can be observed (Figure 7-24):

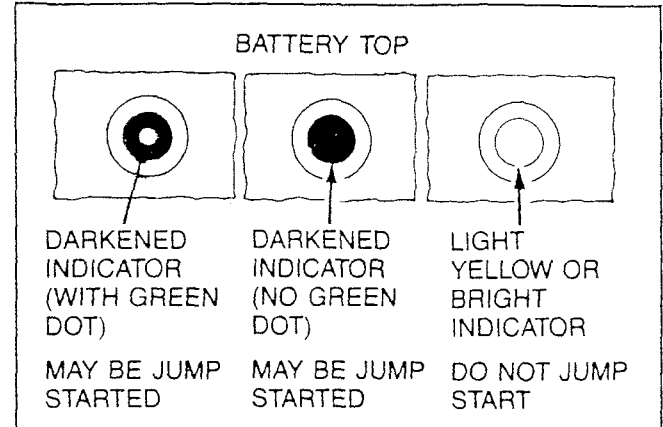


Figure 7-24 — Built-In Hydrometer

1. GREEN DOT VISIBLE. Any green appearance is interpreted as a green dot and the battery is ready for testing. Do **not** charge the battery.
2. DARK; GREEN DOT NOT VISIBLE. If there is a problem with cranking, the battery should be tested following the Electrical Load Test in this section. But, before testing, the battery must be recharged until the green dot is visible. After charging, you may have to shake or tilt the battery slightly for the green dot to show.

NOTE: A battery that has sat in a completely discharged condition or is extremely cold may not accept current for several hours after starting the charger.

The charging and electrical systems should also be checked at this time.

Occasionally, a third condition may appear:

3. CLEAR OR LIGHT YELLOW. This means the fluid level is below the bottom of the hydrometer. This may have been caused by excessive or prolonged charging, a broken case, excessive tipping or normal battery wearout. When finding a battery in this condition, it may indicate high charging voltage caused by a faulty charging system and therefore, the charging and electrical system may need to be checked. If a poor cranking condition exists and is caused by the battery, it should be replaced.

NOTE: DO NOT charge or test the battery or jump start the vehicle when the hydrometer is clear or light yellow. Not following this condition could result in serious personal injury (particularly to eyes) or property damage from battery explosion or battery acid.

CAUTION: SEE CAUTION UNDER "VISUAL INSPECTION" (THIS PAGE).

ELECTRICAL LOAD TEST (DELCO SEALED-TOP BATTERY)

Preliminary Steps

- If the battery has been on charge, remove the surface charge by connecting a 300-ampere load for 15 seconds.

CAUTION: SEE CAUTION UNDER "VISUAL INSPECTION."

- If the battery is in the vehicle, attach the voltmeter leads to the battery terminals. If the battery is out of the vehicle, attach the voltmeter leads to the side terminal adapters (AC-Delco Part ST-1201 or GM 1846855) on the battery. For Delco heavy-duty batteries with threaded stud terminals, attach the voltmeter leads to the snug-fitted terminal adapter ST-1201; or if not available, attach the leads between the lead pad and the bottom of the terminal hex nut.

Test Procedure

1. Connect the voltmeter (preliminary steps) and apply the test load to the value printed on the battery label.
2. Read the voltage after 15 seconds with the load connected.
3. Disconnect the load and compare the voltage reading with the chart in Figure 7-25. If the voltage is less than the reading specified in the chart, replace the battery. If the reading is equal to or greater than that specified in the chart, the battery is good.

NOTE: Refer to battery top for additional load test amperes.

BATTERY	TEST LOAD (AMPS.)
692, 83-50	150
693, 83-60	180
695, 87A-60	230
696, 89A-60	270

Load Test Values

MINIMUM VOLTAGE	TEMPERATURE (°F)
9.6	70
9.5	60
9.4	50
9.3	40
9.1	30
8.9	20
8.7	10
8.5	0

Minimum Voltage Drop

Figure 7-25 — Battery Test Load Table and Voltage Chart

JUMP STARTING — WITH AUXILIARY (BOOSTER) BATTERY

NOTE: Do not push or tow the vehicle to start. There are no provisions in the GM automatic transmission for engagement of the transmission to turn over the engine. Efforts to push or tow the vehicle to start it will have no effect.

Both booster and discharged battery should be treated carefully when using jumper cables. Follow the conditions and procedure outlined below, being careful not to cause sparks. **Departure from these conditions or procedures could result in a.) serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid, or electrical burns; and/or b.) damage to electronic components of either vehicle.**

CAUTION: SEE CAUTION UNDER "VISUAL INSPECTION" IN THIS SECTION OF THE MANUAL. IN ADDITION:

- Be sure the jumper cables and clamps to be used for jump starting do not have loose or missing insulation. Do not proceed if suitable cables are not available.
 - If either battery has filler caps, check the fluid level. (Do not check with open flame). If low, fill to the proper level with clear drinking water. Replace all caps before jump starting.
 - Do not route the cable (or attach the clamp) on or near pulleys, fans, or other parts that will move when the engine is started.
1. Set the parking brake firmly and place the automatic transmission in PARK (NEUTRAL for manual transmission). Turn off the ignition, turn off lights, and all other electrical loads.
 2. Check the built-in hydrometer. If it is clear or light yellow, replace the battery, do not attempt to jump start.
 3. Only 12-volt batteries can be used to start the engine.

NOTE: When jump starting a diesel engine vehicle with charging equipment, be sure equipment used is 12-volt and negative-ground. Do not use 24-volt charging equipment. Using such equipment can cause serious damage to the electrical system or electronic parts.

4. Attach the end of one jumper cable to the positive terminal of the booster battery and the other end of the same cable to the positive terminal of the discharged battery (Figure 7-26). Do not permit vehicles to touch each other as this could cause a ground connection and counteract the benefits of this procedure.

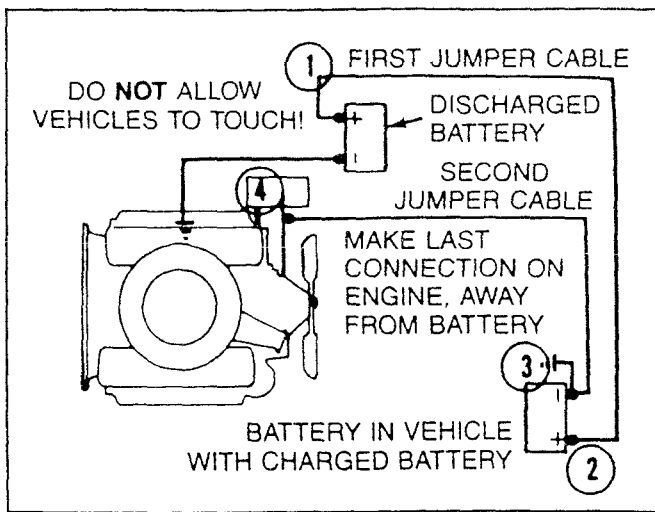


Figure 7-26 — Jump Starting Connections

- Attach one end of the remaining negative cable to the negative terminal of the booster battery, and the other end to a solid engine ground (such as A/C compressor bracket or generator mounting bracket) at least 18 inches from the battery of the vehicle being started. (DO NOT CONNECT DIRECTLY TO THE NEGATIVE TERMINAL OF THE DEAD BATTERY.)
- Start the engine of the vehicle that is providing the jump start and turn off electrical accessories. Then start the engine in the vehicle with the discharged battery.
- Reverse these directions exactly when removing the jumper cables. The negative cable must be disconnected from the engine that was jump started first.

BATTERY REMOVAL AND REPLACEMENT

When handling a battery, the following safety precautions should be observed:

- Hydrogen gas is produced by the battery. A flame or spark near the battery may cause the gas to ignite.

- Battery fluid is highly acidic. Avoid spilling on clothing or other fabric. Any spilled electrolyte should be flushed with large quantities of water and cleaned immediately. To remove or replace a battery, always disconnect the negative cable first, then the positive cable. Torque the battery cables at battery to 9 ft. lbs.

NOTE: See Appendix 7-8 at the back of this section of the manual for additional information concerning battery replacement.

CRANKING SYSTEM

The starter on your motor home chassis requires no maintenance. It will provide years of service if proper cranking procedures are used. When starting an engine, never crank the starter longer than 30 seconds and allow at least 15 seconds between starting attempts. This will help keep the starter from overheating.

GENERAL DESCRIPTION

The function of the starting system is to rotate the engine crankshaft at sufficient speed for ignition and the start of engine operation. This is done by means of the cranking circuit which consists of the battery, starting motor, ignition switch, and the related electrical wiring. In addition, vehicles with automatic transmissions have a neutral start switch which prevents the engine from being started in any transmission selector lever position other than NEUTRAL, or PARK. These components are connected electrically as shown in Figure 7-27.

When the ignition switch is turned to START, electrical current flows from the battery through the key switch, neutral start switch and through the starter switch to ground. Inside the starter switch, current flow from this control circuit activates the solenoid which closes the circuit between the battery and the cranking motor. The solenoid also moves the starter drive gear into contact with the crankshaft ring gear.

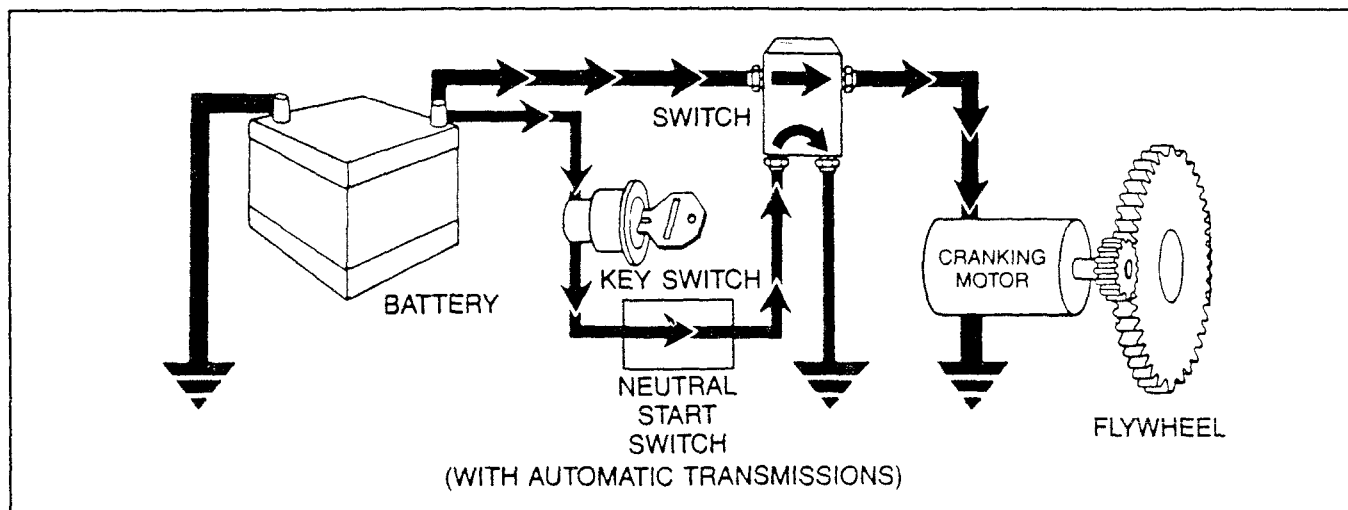


Figure 7-27 — Cranking Circuit

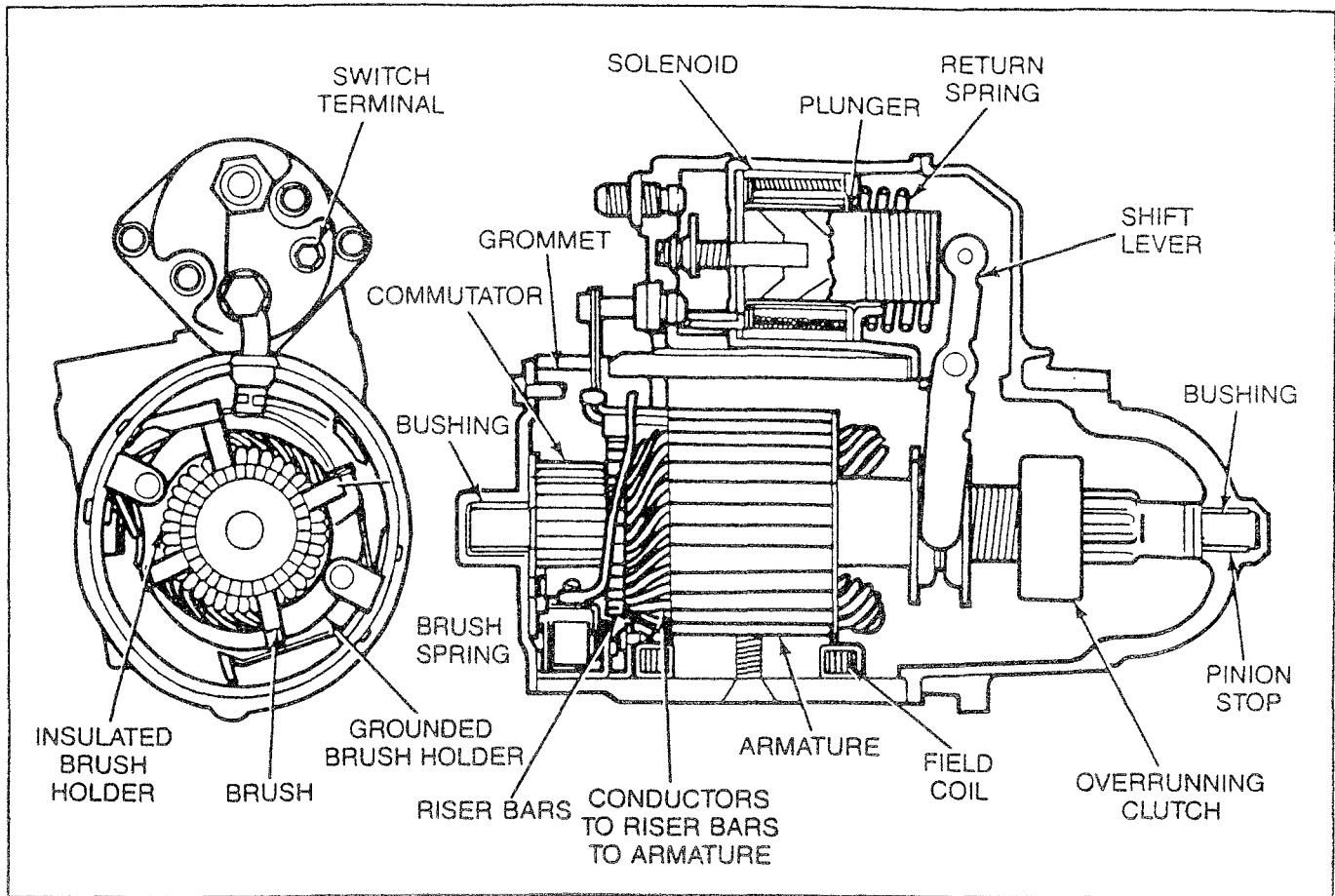


Figure 7-28 — 10MT Starting Motor

Two types of starter motors are used. The first, referred to as the 10MT series, is shown in Figure 7-28. The second type, referred to as the 27MT series, is used on diesel-equipped engines. The main difference is that the 27MT has a center bearing.

Certain cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icing conditions and splashing.

In the basic circuit shown in Figure 7-27, the solenoid windings are energized when the switch is closed. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear and the solenoid main contacts to close and cranking takes place. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage. To prevent excessive overrun, the switch should be opened immediately when the engine starts.

The electrical operation of the solenoid is shown in Figure 7-29. The top illustration shows the starter disengaged. The center drawing depicts the pinion partially engaged with the pull-in coil and the hold-in coil activated. The bottom view shows the pinion fully engaged and the starter motor cranking with only the hold-in coil functioning.

MAINTENANCE AND INSPECTION

While the starter motor does not require maintenance, the system wiring should be inspected periodically for damage or corrosion. Inspect all connections to the cranking motor, solenoid, ignition switch, neutral start switch and battery, including all ground connections. Clean and tighten all connections as required.

If there appears to be a problem with the starting system and the battery, wiring and switches are in satisfactory condition and the engine is known to be functioning properly, refer to the appropriate shop manual for more detailed diagnosis and test procedures.

STARTING PROBLEMS (HIGH AMBIENT TEMPERATURES)

Under some conditions of high ambient temperatures, when the engine has been turned off and the vehicle allowed to set for 10 to 15 minutes, it is possible to encounter a problem with the starter motor not activating when you attempt to restart the engine. This possibility occurs more frequently with the 7.4L engine when high engine compartment temperatures and the radiated heat from the exhaust pipe cause high resistance in the coil wires of the starter solenoid. This high resistance reduces current flow preventing activation of the solenoid and starter motor. After the engine has cooled down sufficiently, the starter

motor should activate properly upon restart. (Refer to Appendix 7-10—"Hot Start" Problem Conditions and Appendix 7-11—Starter Motor Relay on 7.4L Engines at the back of this section of the manual for additional corrective procedures.

CHARGING SYSTEM GENERAL DESCRIPTION

The function of the charging system is to provide electrical power to the engine ignition system, to the vehicle accessories and to restore power lost from the battery.

The primary component of the system is the alternator. The alternator assembly includes the rotor, stator and rectifier subassemblies and an integral voltage regulator. When the engine is operating and turning the rotor, an alternating current flow is induced in the stator assembly by the electromagnetic field established in the rotor. The alternating current produced in the stator is changed to the direct current needed in the vehicle's electrical system by the rectifier assembly. This is accomplished through the use of diodes in the rectifier assembly which allow current flow in one direction only. The output of the alternator is controlled by the voltage regulator. The regulator does this by varying the strength of the electromagnetic field established in the rotor assembly.

The alternator is connected to the vehicle electrically as shown in Figure 7-30. The integral regulator is mounted beneath the rear cover of the alternator.

The brown field wire to the alternator is used to initially activate the alternator by providing the current needed to establish the electromagnetic field in the rotor. The 10-ohm resistance, provided by either the alternator warning lamp or the resistance wire with optional gages, is needed to protect the diodes in the rectifier assembly.

ALTERNATOR SIZING AND SELECTION

The base alternator, or Delcotron, in the GM motor home is rated 63 to 66 amps. Normally, this rating is large enough for most applications. However, in recent years, the typical RV owner has purchased and/or added on optional electrical equipment pushing base charging system capacity beyond current abilities.

A charging system that has demands beyond system ability can create problems, as there is not a way to charge the batteries when the system is always running with an electrical "short fall." The life expectancy of the charging system will be greatly reduced when the system is operating at 100% of capacity for an extended time and/or mileage intervals. Also, engine compartment configurations and optional equipment can aggravate the situation due to restricted air flow and alternator overheating. To assist the motor home owner, GM has introduced two special order optional charging systems—Option No. 7K4(80 AMP) and Option No. 7K7 (100 AMP).

NOTE: If changing the GM factory systems, the size of the main charging wire in the harness must be changed from a 3mm or 12 AWG wire size to a 8mm or 8 AWG wire size. The larger size charging wire is mandatory when installing an upgraded charging system.

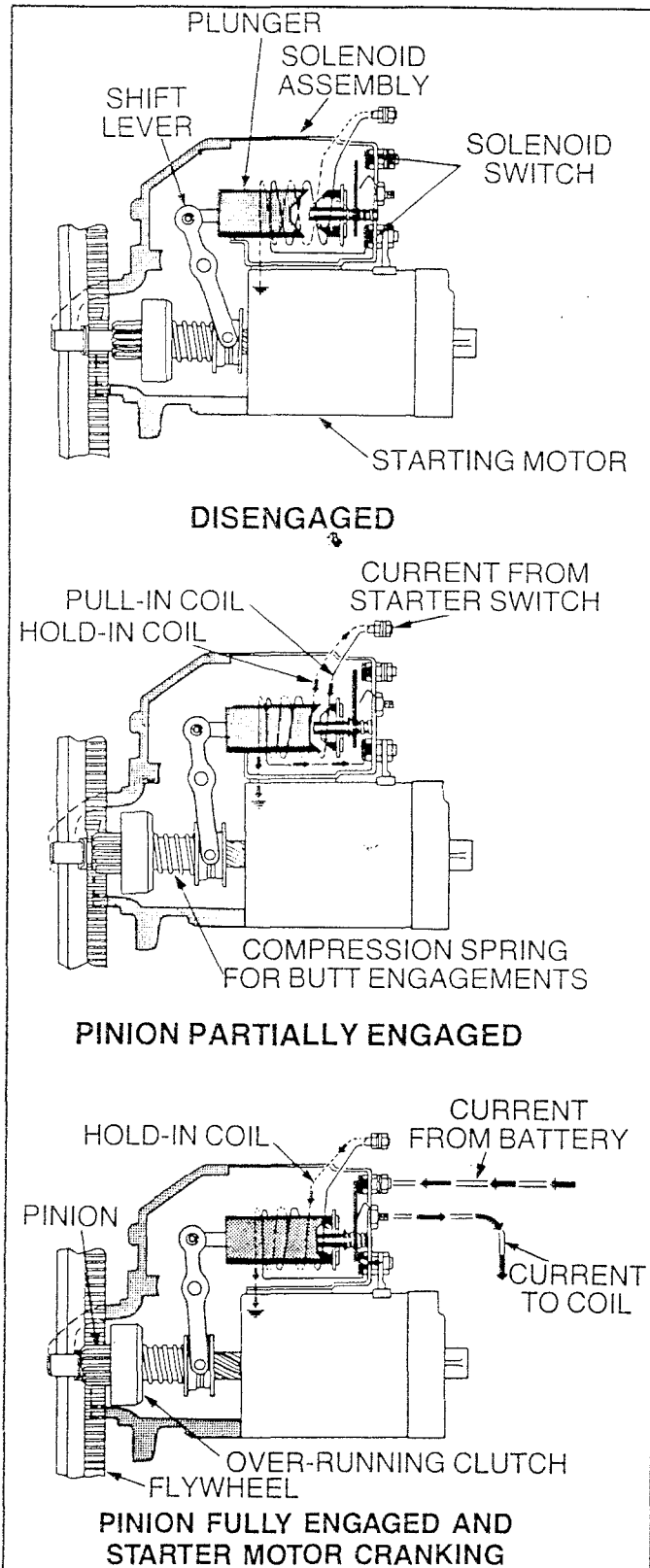


Figure 7-29 — Solenoid Electrical Operation

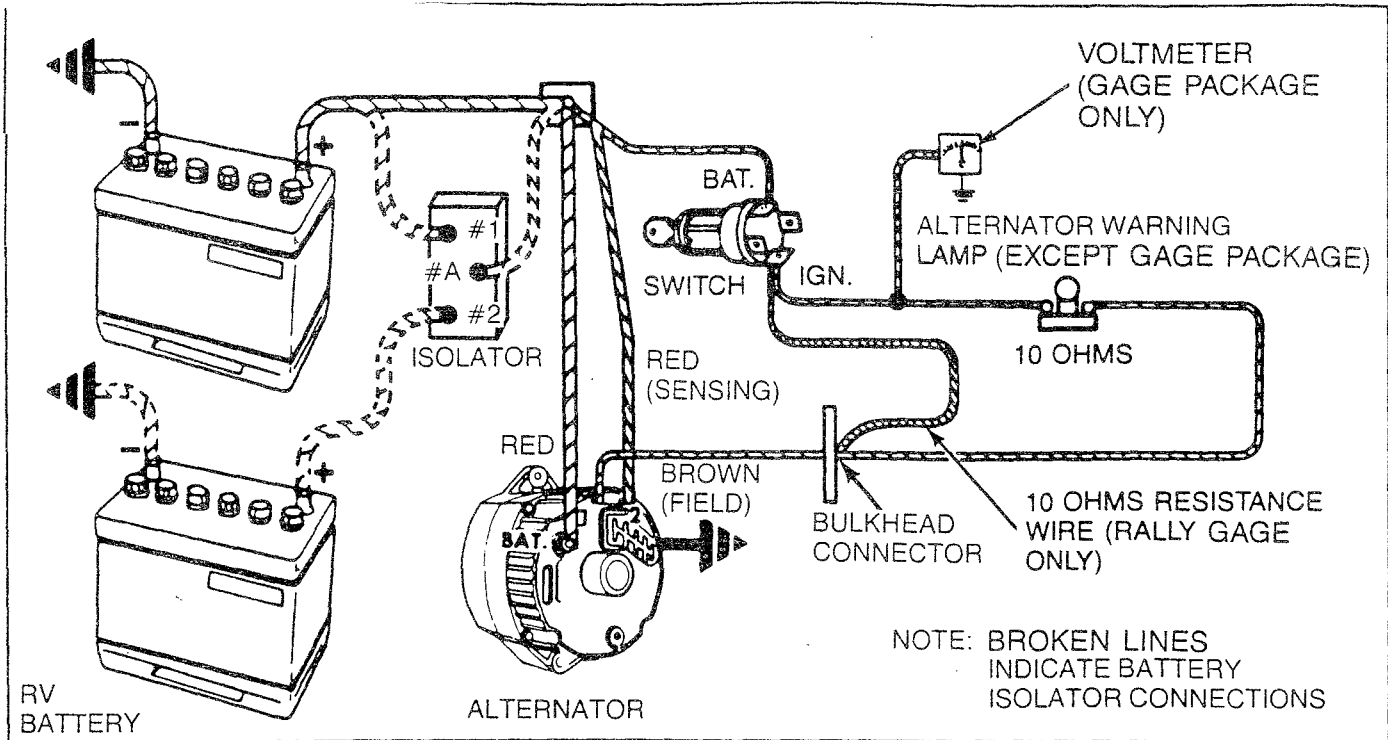


Figure 7-30 — Charging Circuit—SI System

BATTERY ISOLATOR

The battery isolator is a very important link in the total electrical system. Typical isolator hook-ups are shown in Figure 7-30 using broken lines. As shown, the red wire from the battery to the alternator is moved to terminal No. 1 of the battery isolator. A replacement wire connects the alternator to terminal "A" on the battery isolator as shown.

A typical RV battery isolator wiring schematic is shown in Figure 7-31. The isolator is equipped with one-way diodes allowing no reverse current flow back to "A" or between "1" and "2."

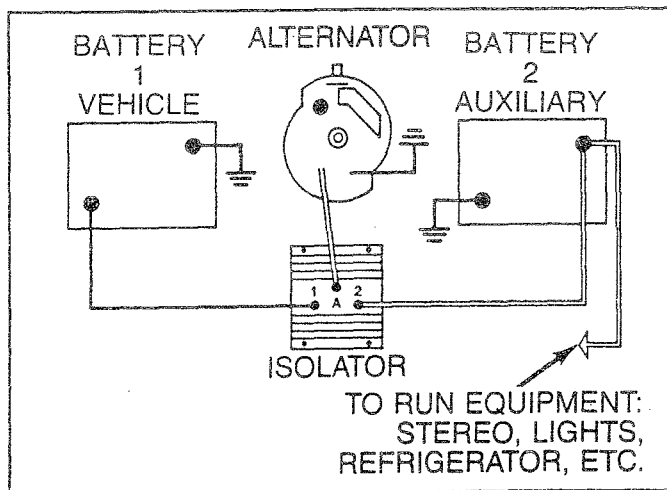


Figure 7-31 — Typical RV Battery Isolator Wiring

Shown in Figure 7-32 are two typical RV isolator voltmeter checks that will identify a functional isolator. Voltages are

based on a reasonable state of charge in all batteries (12 volts).

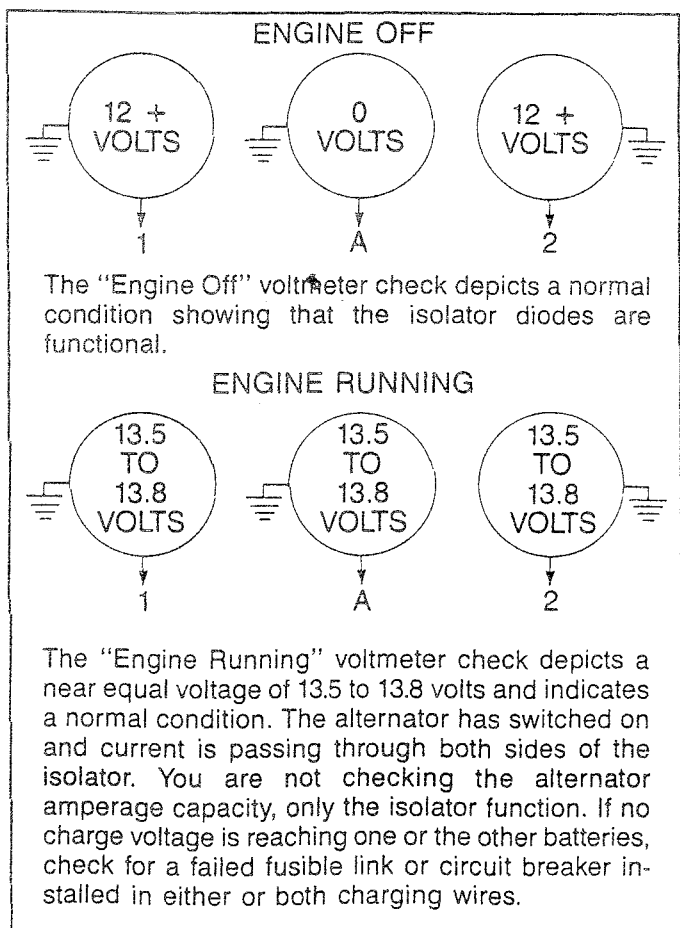


Figure 7-32 — Typical RV Isolator Voltmeter Checks

NOTE: A voltage drop of about ½ volt to "1" and "2" (shown in the figure) would be a normal drop through the diodes.

Shown in Figure 7-33 are typical RV battery isolator failure modes.

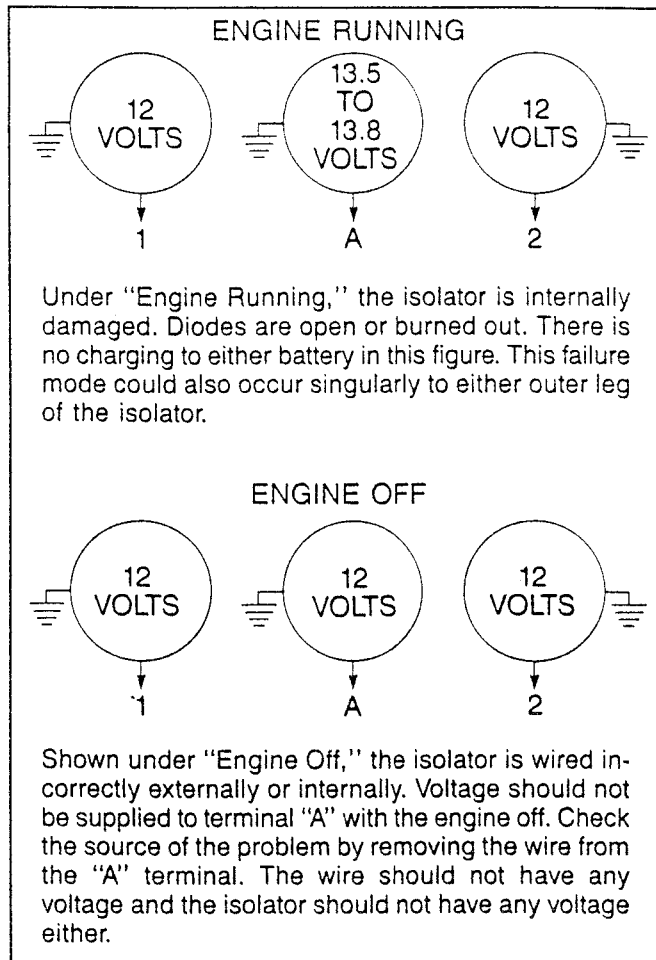


Figure 7-33 — Typical RV Battery Isolator Failure Modes

Three prime rules that must be followed for isolators are:

1. Each leg of the isolator must be sized to equal or exceed the total alternator output. The reason is that one battery may require all of the alternator's output while the other(s) require none. Thus a single leg must be

capable of carrying the maximum alternator current output. Isolators should be purchased oversized if there is any chance of upgrading the alternator at a later date.

2. In the auxiliary battery side, a circuit breaker or fusible link should be included. A fusible link on the automotive side will be standard as produced by GM.
3. The size of the charging wire should be chosen using the chart shown in Figure 7-34.

MAINTENANCE AND INSPECTION

No periodic adjustments or maintenance of any kind are required on the entire alternator assembly. However, belt tension should be checked periodically and adjusted as required. See Appendix 7-12 — Alternator Belt Usage on 6.2L Diesel Engines at the back of this section, as well as the manual Appendix 1 — Drive Belts and Tension Specifications located at the back of the manual for additional information concerning belt tension specifications.

Noise from a alternator may be caused by a loose drive pulley or loose mounting bolts. These parts should be tightened as required. Other causes of alternator noise can be worn or dirty bearings, defective diode(s) or a defective stator. Such causes require an overhaul.

IGNITION SYSTEM GENERAL DESCRIPTION

The ignition circuit consists of the battery, the distributor, the ignition switch, the spark plugs and the primary and secondary wiring.

Electrical current to power the ignition system is provided by the battery during starting and by the charging system when the engine is operating. This low-voltage current flows through the ignition switch, the electronic module in the distributor and the coil in what is called the primary circuit. In the coil, the low-voltage current is changed to a high-voltage current each time the primary circuit is switched off and on by the electronic module. The module breaks the circuit in response to signals from the magnetic pickup assembly. These signals are timed with the power stroke of each cylinder.

ALTERNATOR RATED OUTPUT IN AMPS	MINIMUM CHARGING WIRE SIZE FOR WIRE LENGTH IN FEET				
	UP TO 10 FEET	11 FEET TO 14 FEET	15 FEET TO 20 FEET	21 FEET TO 25 FEET	26 FEET TO 30 FEET
Up to 70 amp	10	8	8	6	6
70 to 95 amp	6	6	4	4	4
95 to 120 amp	4	4	4	2	1
120 to 160 amp	4	4	2	2	0

Figure 7-34 — Charging Wire Size to Output

The high-voltage current generated in the second part of the coil, flows to the center terminal of the distributor cap through the rotor, to each outer terminal of the distributor cap in rotation. From each distributor cap outer terminal, the current flows through the wire to the spark plug. At the spark plug, the current jumps the gap between the electrodes to ground, producing the spark for ignition. This high-voltage circuit is referred to as the secondary circuit.

H.E.I. DISTRIBUTOR

The High Energy Ignition (H.E.I.) distributor used on the 5.7L and the Mark IV engines, combines all ignition components in one unit (Figure 7-35). It is located on top of the engine block directly behind the carburetor. The external electrical connections (Figure 7-36) are the ignition switch feed wire, the tachometer pickup and eight spark plug leads. The ignition switch feed connector to the distributor has full battery voltage when the ignition switch is in the "RUN" and "START" positions. There is NO RESISTOR WIRE FROM THE IGNITION SWITCH TO THE DISTRIBUTOR.

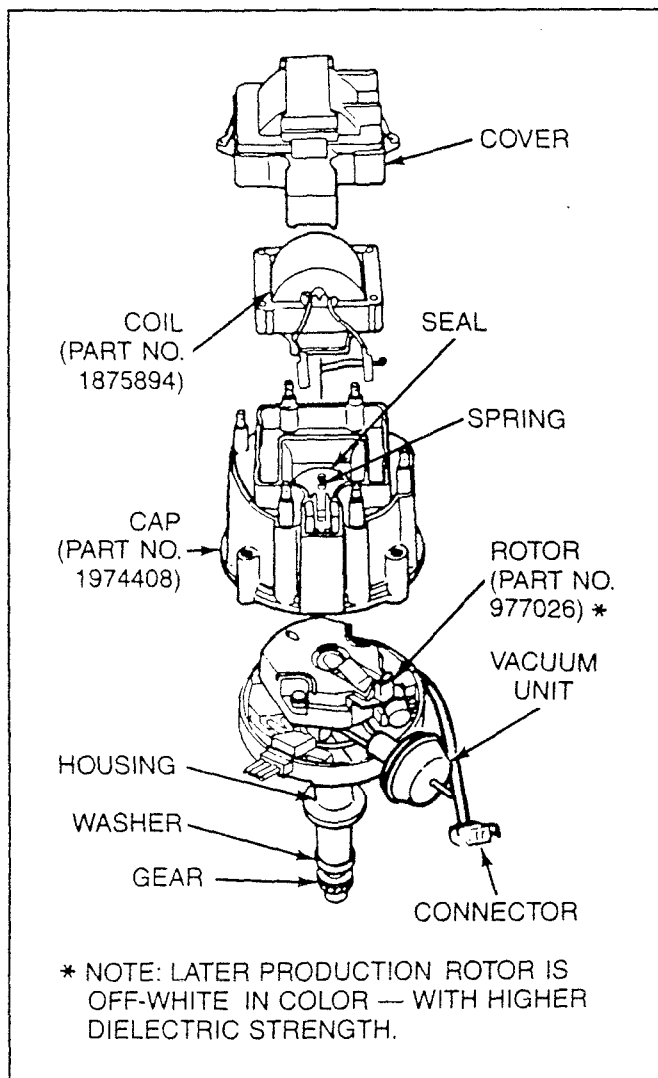


Figure 7-35 — H.E.I. Distributor — Exploded View

The ignition coil is in the distributor cap and connects through a resistance brush to the rotor. The High Energy Ignition System is basically identical in operation to conventional ignition systems except that the module and pickup coil replace the contact points.

The High Energy Ignition is a magnetic-pulse-triggered, transistor-controlled, inductive discharge ignition system. The magnetic pickup assembly located inside the distributor contains a permanent magnet, a pole piece with internal teeth, and a pickup coil. When the teeth of the timer core rotating inside the pole piece line up with the teeth of the pole piece, an induced voltage in the pickup coil, signals the electronic module to trigger the coil primary circuit.

The primary current decreases and a high voltage is induced in the ignition coil secondary winding which is directed through the rotor and secondary leads to fire the spark plugs. The capacitor in the distributor is for radio noise suppression.

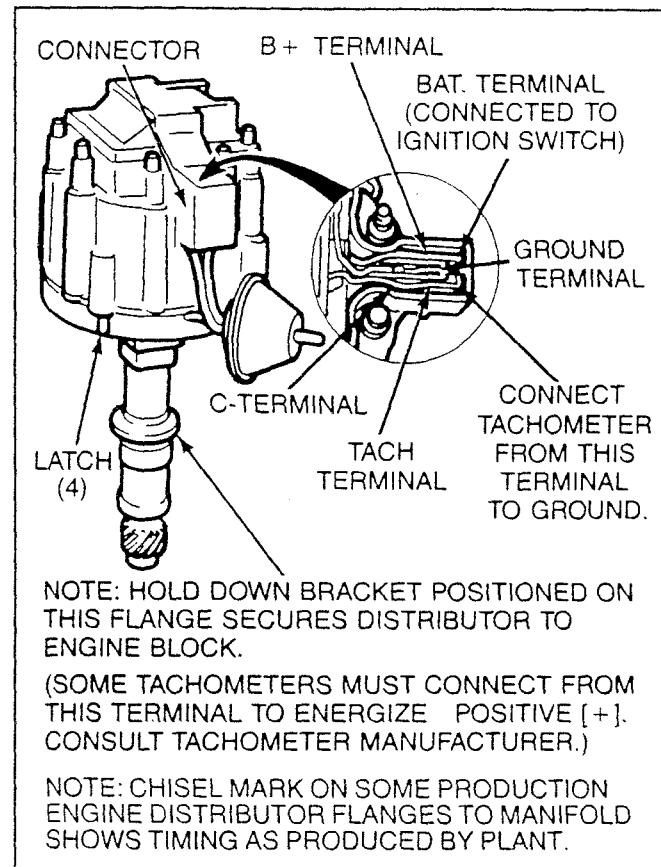


Figure 7-36 — H.E.I. Distributor Assembly Electrical Connections

The magnetic pickup assembly (Figure 7-37) is mounted over the main bearing on the distributor housing and is made to rotate by the vacuum control unit, thus providing vacuum advance. The timer core is made to rotate about the shaft by conventional advance weights, thus providing centrifugal advance.

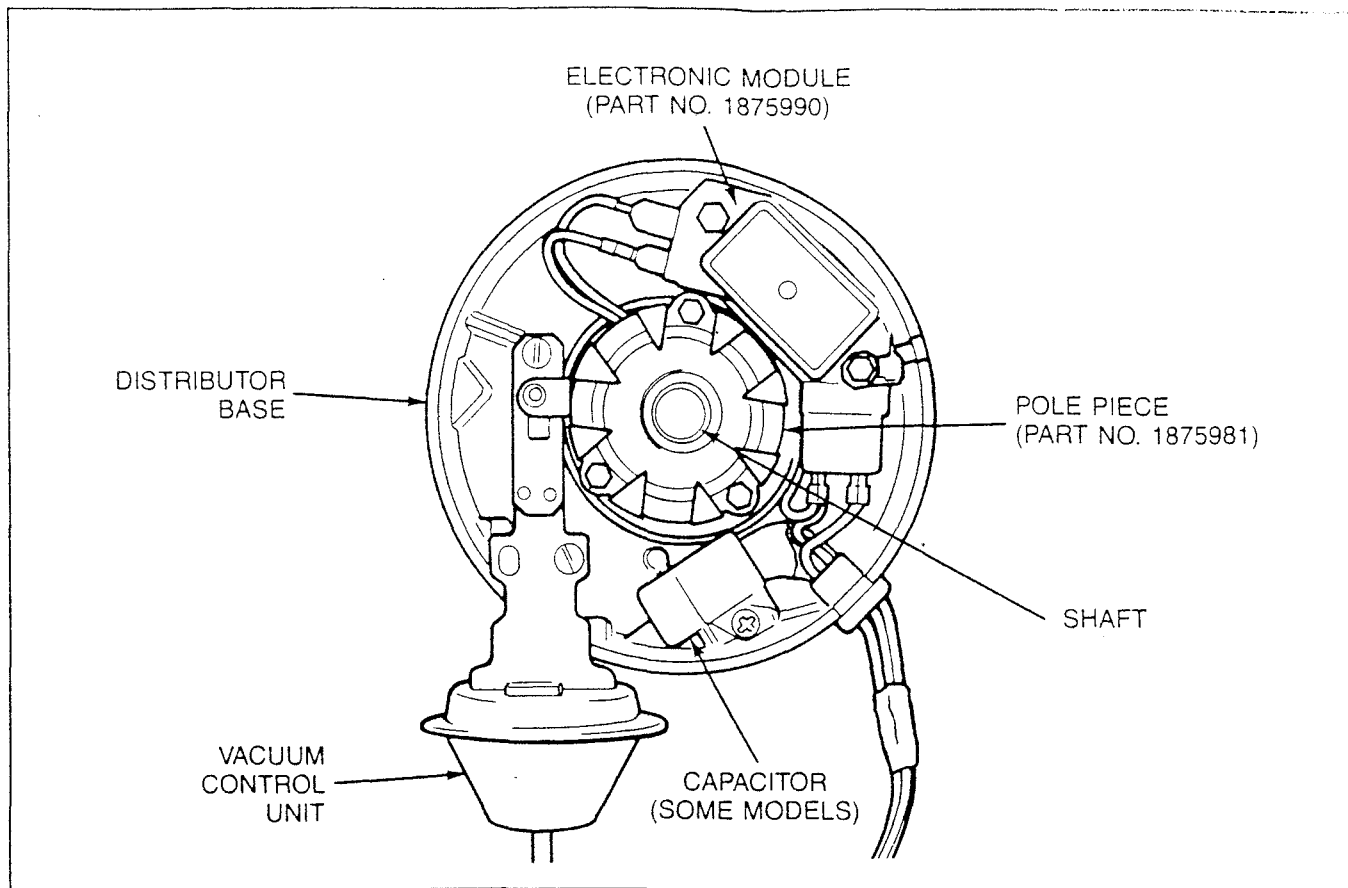


Figure 7-37 — H.E.I. Magnetic Pickup Assembly

The module automatically controls the dwell period, stretching it with increasing engine speed. The H.E.I. system also features a longer spark duration, made possible by the higher amount of energy stored in the coil primary winding. This is desirable for firing lean mixtures.

SECONDARY WIRING

The spark plug wire used with the H.E.I. system is carbon-impregnated cord conductor encased in an 8mm diameter silicone rubber jacket. The silicone wiring will withstand very high temperatures and also provides an excellent insulator for the higher voltage of the H.E.I. system. The silicone spark plug boots form a tight seal on the plug:

SPARK PLUGS

Resistor-type, tapered-seat spark plugs with a 14mm thread diameter are used on the 5.7L and Mark IV gasoline engines. (See Figure 7-38.) No gasket is used on these tapered-seat plugs. The recommended torque specification for installing the plugs in these engines is 17-27 ft. lbs.

Normal or average service is assumed to be a mixture of idling, slow-speed and high-speed operation with some of each making up the daily total driving. Occasional or intermittent high-speed driving is essential to good spark plug performance as it provides increased and sustained combustion heat that burns away any excess deposits of carbon or oxide that may have accumulated from frequent

idling or continual stop-and-go or slow-speed driving. Spark plugs are protected by an insulating nipple made of special heat-resistant material which covers the spark plug terminal and extends downward over a portion of the plug insulator. These nipples prevent flash-over with resultant missing of engine, even though a film is allowed to accumulate on exposed portion of plug porcelains.

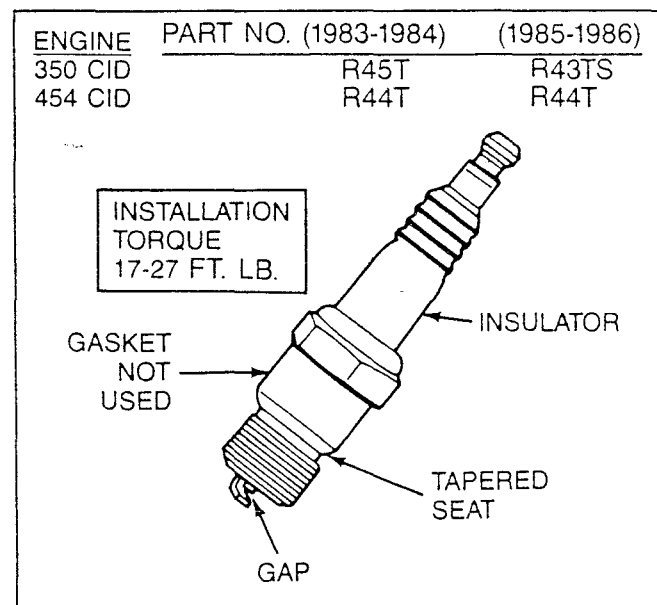


Figure 7-38 — Spark Plug

Do not mistake corona discharge for flash-over or a shorted insulator. Corona is a steady blue light appearing around insulator, just above the shell crimp. It is the visible evidence of high-tension field and has no effect on ignition performance. Usually it can be detected only in darkness.

This discharge may repel dust particles, leaving a clean ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

IGNITION TIMING

To assure optimum engine performance, the ignition must be properly timed. This means that the spark plug must fire at precisely the instant when the fuel mixture is correct and cylinder compression is highest.

Set the ignition timing by following these instructions:

1. Refer to the Vehicle Emission Control Information Label located on the radiator support panel. Follow all instructions on the label.
2. With ignition off, connect the pickup lead of the timing light to the number 1 spark plug wire (engines with the timing pointer mounted over the upper side of the damper), or to the number 5 or 8 spark plug wire (engines with the timing pointer mounted at the lower left side of the damper). Use a jumper lead between the wire and plug or an inductive-type pickup. **DO NOT** pierce the wire or attempt to insert a wire between the boot and the wire. Connect the timing light power leads according to manufacturer's instructions.
3. Disconnect and plug the vacuum line at the distributor.
4. Start the engine and aim the timing light at the timing mark. (See Figure 7-39.) The line on the balancer or pulley will line up at the timing mark. If a change is necessary, loosen the distributor hold-down clamp bolt at the base of the distributor. While observing the mark

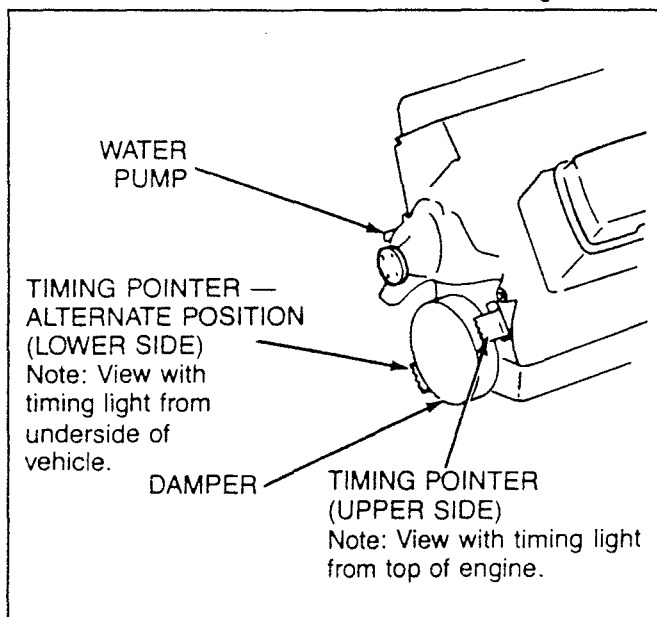


Figure 7-39 — Timing Mark — Typical

with the timing light, slightly rotate the distributor until the line indicates the correct timing. Tighten the hold-down bolt and recheck the timing.

On motor home chassis with engines having the timing pointer mounted at the lower left side of the damper, the timing light must be aimed up from beneath the vehicle. This procedure requires two people, one to observe the mark with the timing light while the second person makes any required adjustments at the distributor.

5. Turn off the engine and remove the timing light. Reconnect the number 1 spark plug wire, if removed.

MAINTENANCE AND INSPECTION

H.E.I. DISTRIBUTOR

No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.

H.E.I. TEST PROCEDURE

If there appears to be a problem with the ignition system, the following procedure can be used as a quick check in determining the cause. More detailed procedures are given in the appropriate shop manual.

General Test

1. Remove a spark plug wire from each spark plug one at a time and check for spark using an H.E.I. Test Spark Plug ST125 (GM Part No. 5613602) or equivalent. If spark is present, the H.E.I. system is O.K.

NOTE: Using the Test Spark Plug to check for spark instead of allowing the spark to jump to ground from the disconnected wire can help to avoid possible damage to the module. A Test Spark Plug should be available at a local auto parts store.

2. Connect a test light between the distributor TACH terminal and ground.
3. Turn on the ignition switch.
 - If the light does not glow, check for power at the distributor BAT terminal. If there is no power at the BAT terminal, the problem is in the circuit wiring or the ignition switch. Repair as required. If there is power at the BAT terminal, and no power at the TACH terminal, the ignition coil primary winding is open. Replace the coil.
 - If the light glows, crank the engine. The light should glow intermittently, indicating that the module and pickup coil are working. Remove the distributor cap and check for spark at the center terminal of the cap using the H.E.I. Test Spark Plug and a jumper wire. If there is spark, the rotor is not functioning and should be replaced. If there is no spark, the coil is not functioning and should be replaced.

If the light glows steadily while the engine is being cranked, perform the module test.

Module Test

1. Remove the distributor cap and connect the H.E.I. Test Spark Plug to the center terminal with a jumper wire.
2. Remove the pickup coil connector from the module and turn the ignition switch on.
3. Touch one end of another jumper wire to the positive terminal of the battery and the other end to the small terminal of the module momentarily. As the jumper wire is removed from the module terminal, if there is:
 - a spark—the pickup coil is not functioning properly and may need to be replaced.
 - no spark—the module is not functioning properly and may need to be replaced.

CHECKING H.E.I. SYSTEM CONNECTIONS

If a component appears to be inoperative, the condition may actually be due to poor connections. This is especially true of low-voltage circuits, such as the pickup coil to module connections, in the H.E.I. system.

Before any component or assembly is considered faulty and replaced, their terminal(s) should be cleaned, the connector to terminal fit tightened and the wire to terminal connection checked and resoldered if necessary.

The following procedure covers one example involving H.E.I. low-voltage circuits where good connections are essential. Refer to Figure 7-40.

1. Remove the module and clean the terminals with emery cloth or a wire brush to remove any oxide film.

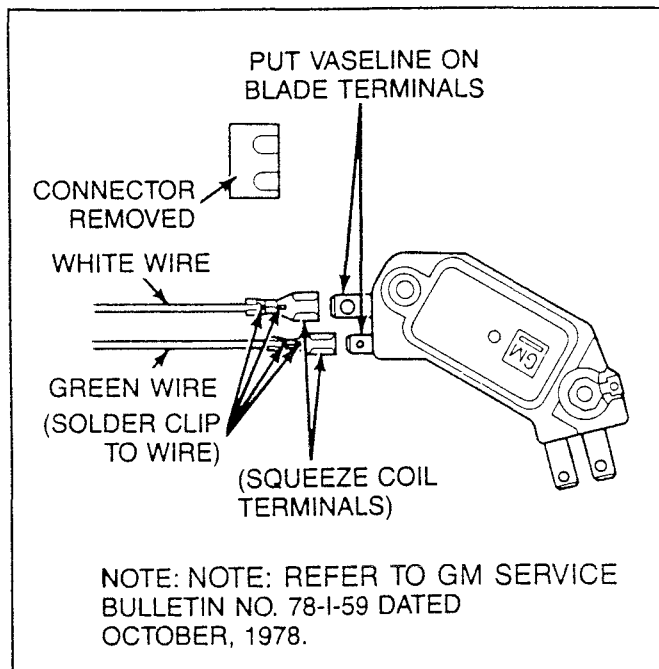


Figure 7-40 — Module Connections

2. Remove the connector body (if so equipped) from the pickup coil leads. Carefully inspect the terminal-to-wire connections (green and white leads) and re-crimp if loose. Reflow the existing solder, and add solder if necessary to assure good connections. Avoid excess solder. Use a small iron or gun. Do not allow heat to damage the insulation or solder to run under the terminal. Squeeze the side rails of the terminals with needle-nose pliers to assure a tight fit on the module terminals.
3. Apply a thin coating of petroleum jelly (Vaseline) on all module terminals to reduce future oxidation. Make sure a small amount of silicone heat transfer grease (AC-Delco D-1920 or equivalent) is present on the module base. Apply the grease if necessary.
4. Reinstall the module on the H.E.I. base and reconnect the leads, making sure all terminals are seated with good metal-to-metal contact.

SPARK PLUG WIRES

Use care when removing spark plug wire boots from spark plugs. Twist the boot 1/2 turn before removing, and pull on the boot only to remove the wire. Burroughs tool No. BT7901 or equivalent will make the removal of the spark plug wires easier. (See Figure 7-41.)

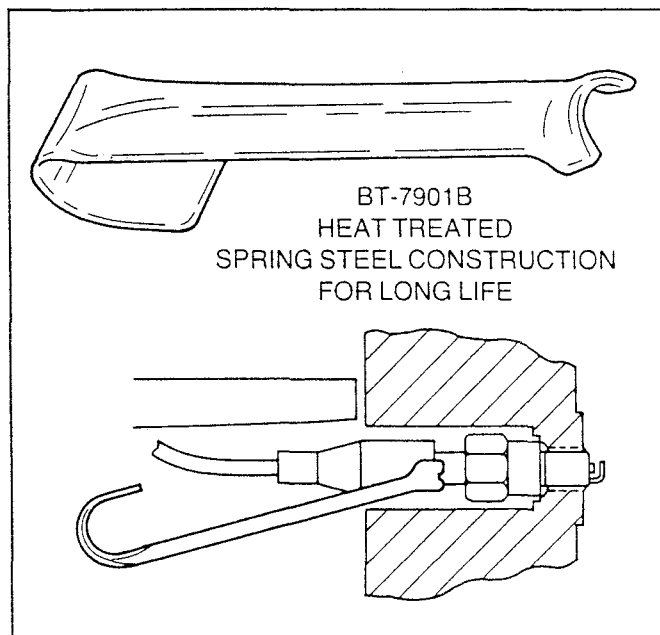


Figure 7-41 — Spark Plug Boot Puller

It is extremely important when replacing plug wires to route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to ground.

SPARK PLUGS

Worn or dirty plugs may give satisfactory operation at idling speed, but under operating conditions they frequently fail.

Faulty plugs are indicated in a number of ways: poor fuel economy, power loss, loss of speed, hard starting and general poor engine performance.

Spark plug failure, in addition to normal wear, may be due to carbon fouled plugs, excessive gap or broken insulator. (See Figure 7-38.)

Fouled plugs may be indicated by checking for black carbon deposits. The black deposits are usually the result of slow-speed driving and short runs where sufficient engine operating temperature is seldom reached. Worn pistons, rings, faulty ignition, over-rich carburetion and spark plugs which are too cold will also result in carbon deposits.

Excessive gap wear, on plugs of low mileage, usually indicates the engine is operating at high speeds or with loads that are consistently greater than normal or that a plug which is too hot is being used. In addition, electrode wear may be the result of plug overheating, caused by combustion gases leaking past the threads, due to insufficient torquing of the spark plug. Excessively lean carburetion will also result in excessive electrode wear.

Broken insulators are usually the result of improper installation or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench or an outside blow. The cracked insulator may not make itself evident immediately, but will as soon as oil or

moisture penetrates the fracture. The fracture is usually just below the crimped part of the shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and generally are visible. In fairly rare instances, this type of break may result from the plug operating too "hot," encountered in sustained periods of high-speed operation or under extremely heavy loads. When regapping a spark plug, to avoid lower insulator breakage, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators should always be replaced.

6.2L DIESEL GLOW PLUG ELECTRICAL SYSTEM GENERAL DESCRIPTION

In the diesel engine, air alone is compressed in the cylinder; then after the air has been compressed, a charge of fuel is sprayed into the cylinder and ignition occurs due to the heat of compression. Eight glow plugs are used to preheat the chamber as an aid to starting.

The glow plugs are heaters that turn on when the ignition key is turned to the run position prior to starting the engine. They remain pulsing a short time after starting, then automatically turn off.

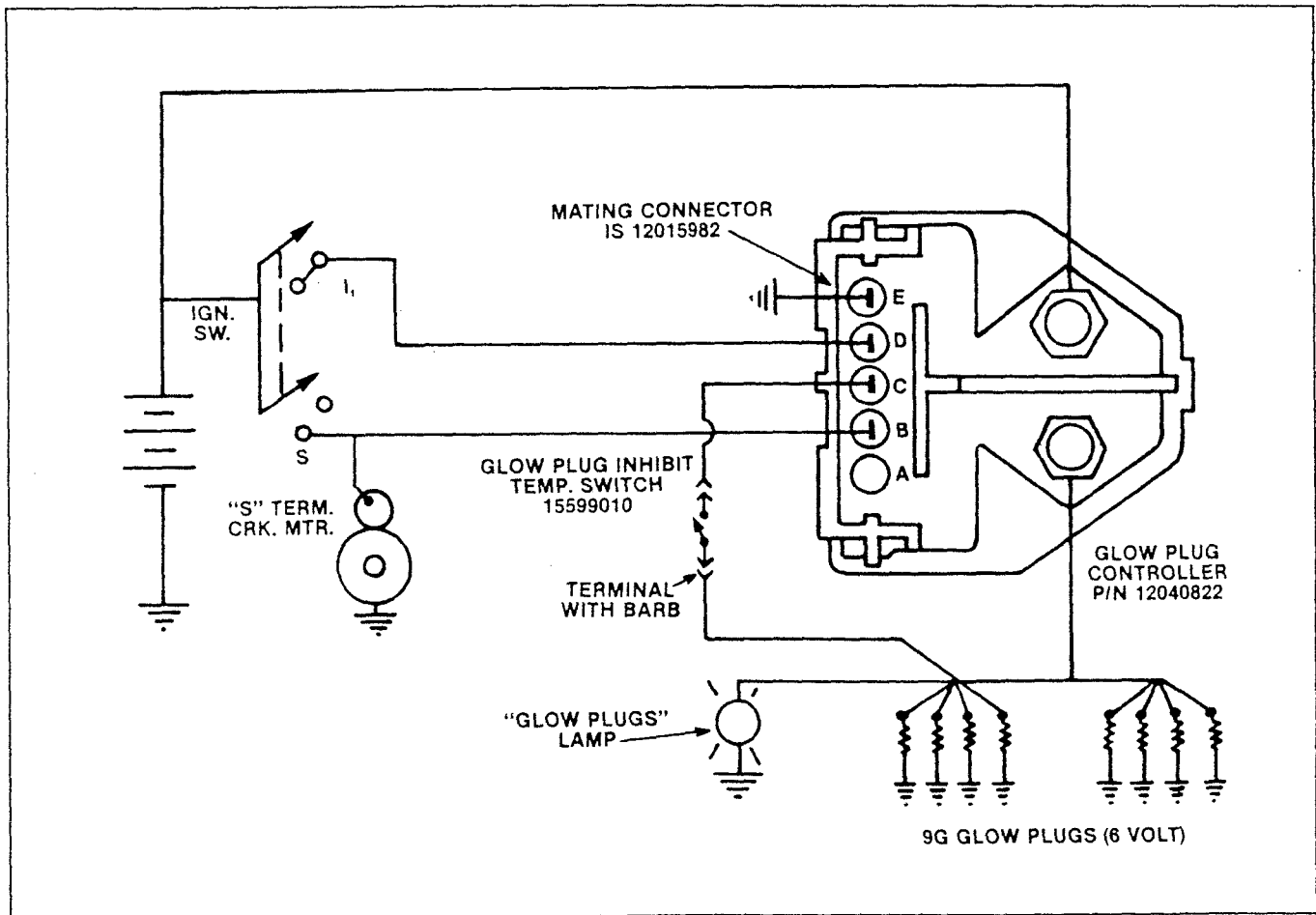


Figure 7-42 — Electronic Glow Plug Control System

SYSTEM COMPONENTS

The 6.2-liter diesel glow plug control system consists of a thermal controller, glow plug relay, 6-volt glow plugs and a "glow plugs" lamp. (See Figure 7-42.) Other components which have no function in controlling glow plug operation but are part of the electrical system, start-and-run operations are: fuel solenoid, fast idle and cold advance solenoids, cold advance temperature switch and the TCC, EGR (if equipped) and EPR solenoids. The electrical operation and diagnosis of the fuel solenoid, fast idle and cold advance solenoid and the cold advance temperature switch will be covered briefly here.

Controller

The thermal controller is mounted in the water passage at the rear of the engine.

Thermostatic elements within the controller are designed to open or close the ground circuit to the glow plug relay as necessary to control the preheat and afterglow cycles of glow plug operation.

Glow Plug Relay

The glow plug relay provides current to the glow plugs. The relay is pulsed on and off by the thermal controller.

NOTE: Do not bypass the glow plug relay. This relay is automatically controlled. Any attempt to bypass the relay with a jumper wire or rewire for manual control, may result in glow plug failure.

Glow Plugs

The glow plugs used in this system are 6-volt plugs which are operated at electrical system voltage (12 volts). The plugs are a "fast start" design capable of reaching 1,800°F in 7.5 to 9 seconds when the engine temperature is 0°F. They are not designed to burn continuously and are pulsed on and off as needed, by the thermal controller.

"Glow Plugs" Lamp

The "glow plugs" lamp is mounted in the instrument cluster. The lamp is wired across the glow plugs and is illuminated whenever the glow plugs are heated.

Fuel Solenoid

The fuel solenoid is activated whenever the ignition switch is on. The solenoid is located in the fuel injection pump housing cover.

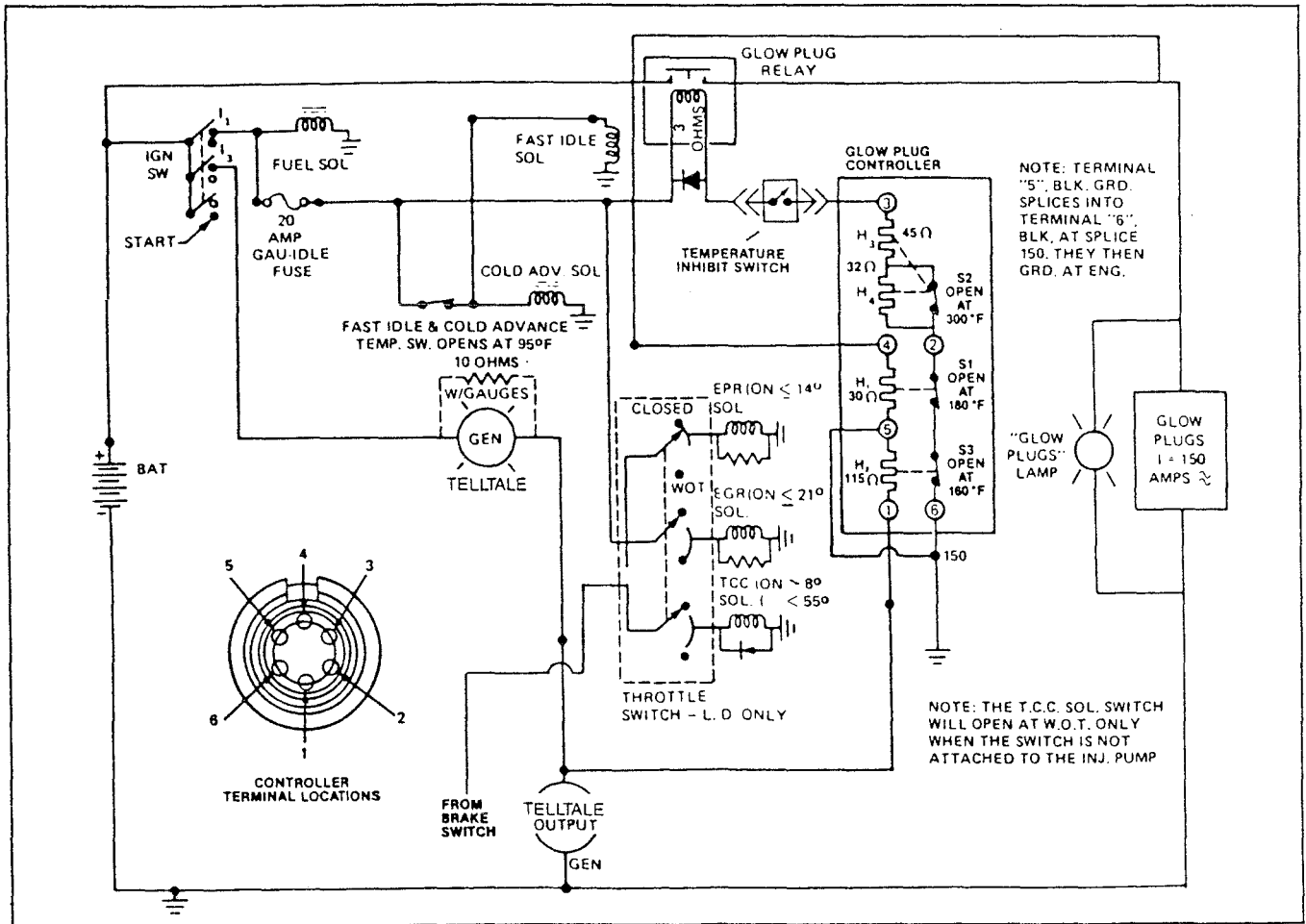


Figure 7-43 — Diesel Glow Plug Wiring Diagram

Cold Advance Solenoid

The cold advance solenoid, also located in the injection pump cover, is controlled by a cold advance temperature switch which activates this solenoid and the fast idle solenoid at a specified minimum temperature. The switch should be closed below 90°F and open above 122°F.

Instrumentation

Vehicles with the diesel engine have special instrumentation indicators to permit the operator to properly apply the starting procedure. A "glow plugs" light on the instrument panel provides this information on the engine starting conditions.

Also these vehicles have a "water-in-fuel" lamp and "low engine coolant" lamp.

Modifications Required for Diesel Starting

BATTERY—The diesel engine uses dual batteries to provide the extra power required to operate the glow plugs and the larger starter used on this engine.

A standard generator supplies charging current to both batteries at the same time. There are no switches or relays in the charging circuit.

STARTER—The starter is larger and designed to crank the engine to at least the 100 RPM required for starting.

Circuit Operation—Cold Start (See Figure 7-43)

With the ignition switch in "Run," the following events take place simultaneously:

1. The fuel solenoid is energized opening the fuel metering valve. The fuel heater is powered, provided the temperature is low enough to require heating of the fuel.
2. Battery voltage is applied to the fast idle solenoid and cold advance solenoid through the fast idle/cold advance temperature switch (when closed).
3. Battery current flows through the thermal controller circuits and through the glow plug relay coil to ground.
4. The glow plug lamp, which is wired across the glow plugs, comes on whenever the glow plugs are powered.
5. The thermal controller starts the glow plug's heating cycle.

Initially, the glow plugs are activated continuously for a period of 7.5 to 9 seconds at 0°F (Figure 7-44). The glow plugs then begin to pulse on and off at a rate determined by the thermal characteristics of the controller. The initial current brings the glow plug preheat chamber up to the temperature required for cold starting. The pulse cycle (on and off) acts to maintain chamber temperature to provide stable engine warm-up. As the engine warms up, the thermal controller turns off all current to the relay deenergiz-

ing the glow plugs completely. The controller is capable of varying glow plug operation as required (up to one minute) when the engine is started warm, and little or no heating is necessary.

Controller failure, as in the case of prolonged preheat (more than 9 seconds), would cause a circuit breaker in the controller to open, cutting off glow plug operation completely.

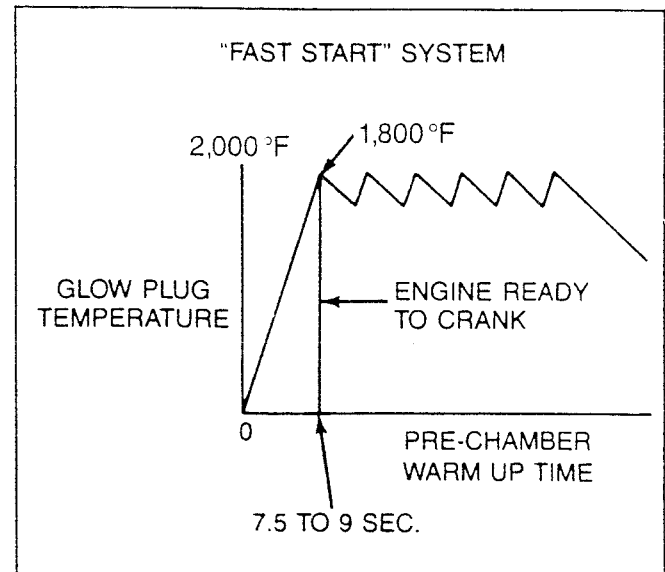


Figure 7-44 — Glow Plug Control

MAINTENANCE AND INSPECTION

No routine service is required for the diesel glow plug electrical system. However, should there be a problem with the system, it is wise to first inspect the system to ensure that all connectors are installed properly and that all connec-

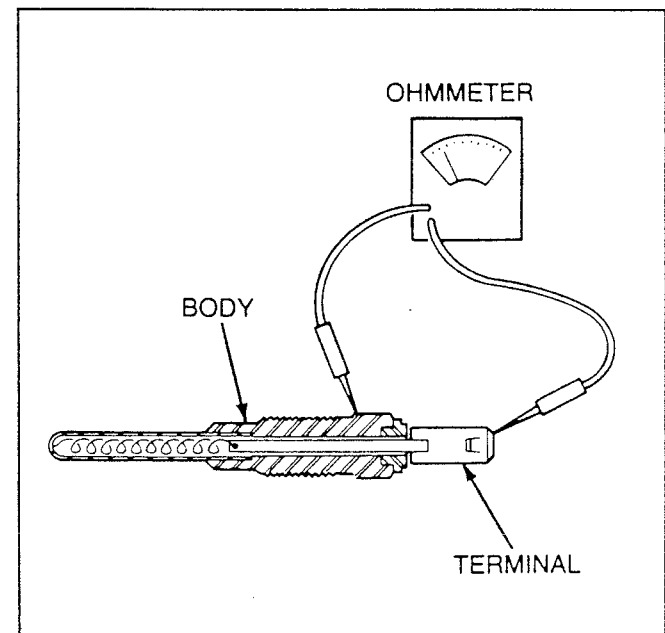


Figure 7-45 — Glow Plug Test

tions are clean and tight. The glow plugs can be checked for continuity with the procedure in this section. If the inspection and check do not reveal the problem, refer to the shop manual for the diagnosis procedure.

GLOW PLUG TEST

This test can be performed with the plugs either installed or removed from the engine. If the plugs are installed, the

engine should be off and the feed wire disconnected from each plug.

Using an ohmmeter, adjusted to a low-range scale, check for continuity between the terminal and body of each plug as shown in Figure 7-45. The ohmmeter reading should be approximately 0.5 ohm. If the reading is infinity, the glow plug coil is burned out or faulty and the plug should be replaced.

ENGINE ELECTRICAL SYSTEM

APPENDIX 7-8 — BATTERY SIZE AND CRANKING vs. TEMPERATURE

The following information is provided as an aid to the motor home owner in understanding battery size and cranking capacity in relationship to temperature.

The chart shown in Figure A7-8-1 explains why a battery of sufficient electrical size is essential if satisfactory cranking of the engine is to be achieved at low temperatures. At temperatures below zero, the capacity of the battery at full charge is about 30% of rated capacity at 80°F. At the same time, the load imposed on the battery by the engine is about 3-1/2 times the normal cranking load at 80°F. In effect, at lower temperatures the battery would seem "smaller" while the engine would appear to be "larger," as depicted in the figure.

The chart below (Figure A7-8-2) provides an example of the "shrinking" battery in terms of cold cranking amps (CCA) in relation to temperature.

Just as low winter temperatures can create cold-start cranking problems due to the electrical size and cranking capacity of a battery, the majority of winter engine failures

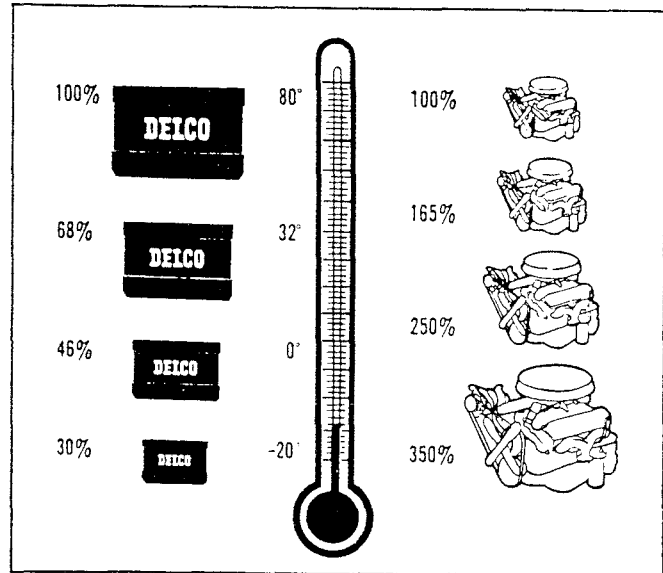


Figure A7-8-1 — Battery Cranking vs. Temperature

100% FULL-CHARGED BATTERY

	BASE BATTERY	HD BATTERY
	80 DEGREES = 100%	405 CCA
32 DEGREES = 68%	880 CCA	1413 CCA
0 DEGREES = 46%	598 CCA	960 CCA
-20 DEGREES = 30%	405 CCA	650 CCA
	264 CCA	423 CCA

65% CHARGED BATTERY - GREEN EYE VISABLE

	BASE BATTERY	HD BATTERY
	80 DEGREES = 100%	405 CCA
32 DEGREES = 68%	572 CCA	918 CCA
0 DEGREES = 46%	389 CCA	624 CCA
-20 DEGREES = 30%	263 CCA	422 CCA
	171 CCA	275 CCA

Figure A7-8-2 — Cold Cranking Amps vs. Temperature

APPENDIX 7-8 — BATTERY SIZE AND CRANKING vs. TEMPERATURE (CONT'D)

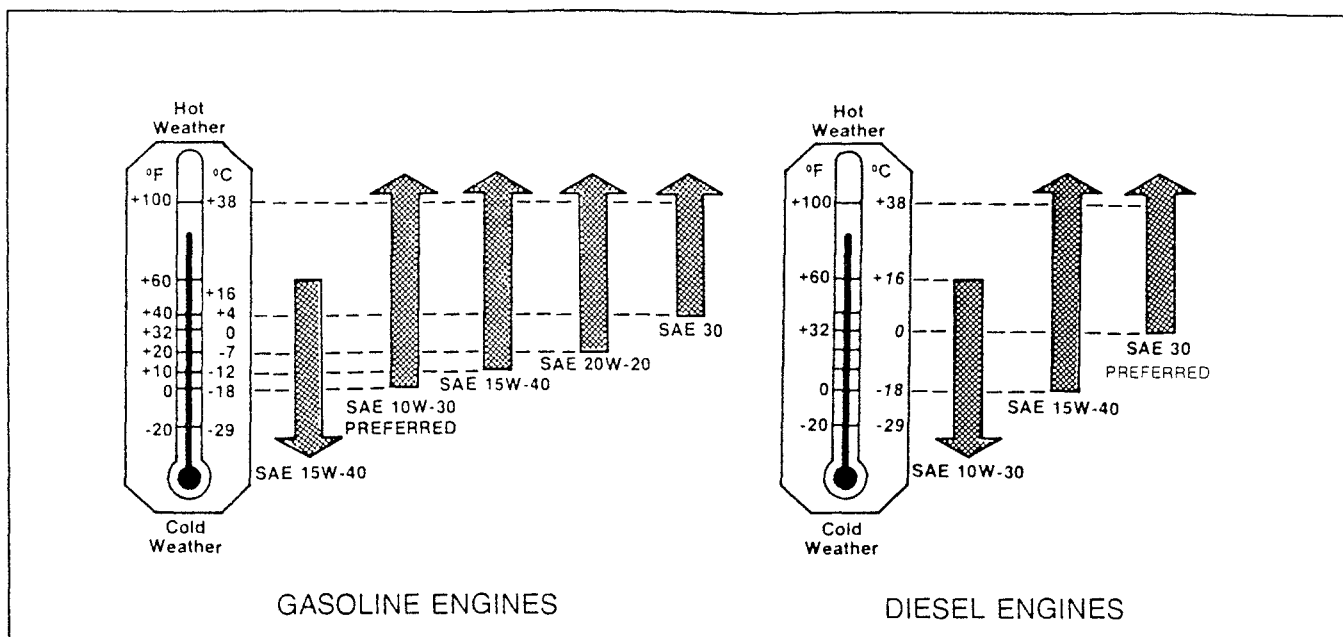


Figure A7-8-3 — Gasoline and Diesel Engine Oil Viscosity Charts

are skuff and bearing seizures that occur upon initial start-up. The reason for these problems is oil starvation from drain-off and the fact that the oil is too thick to pump quickly to the bearing surfaces.

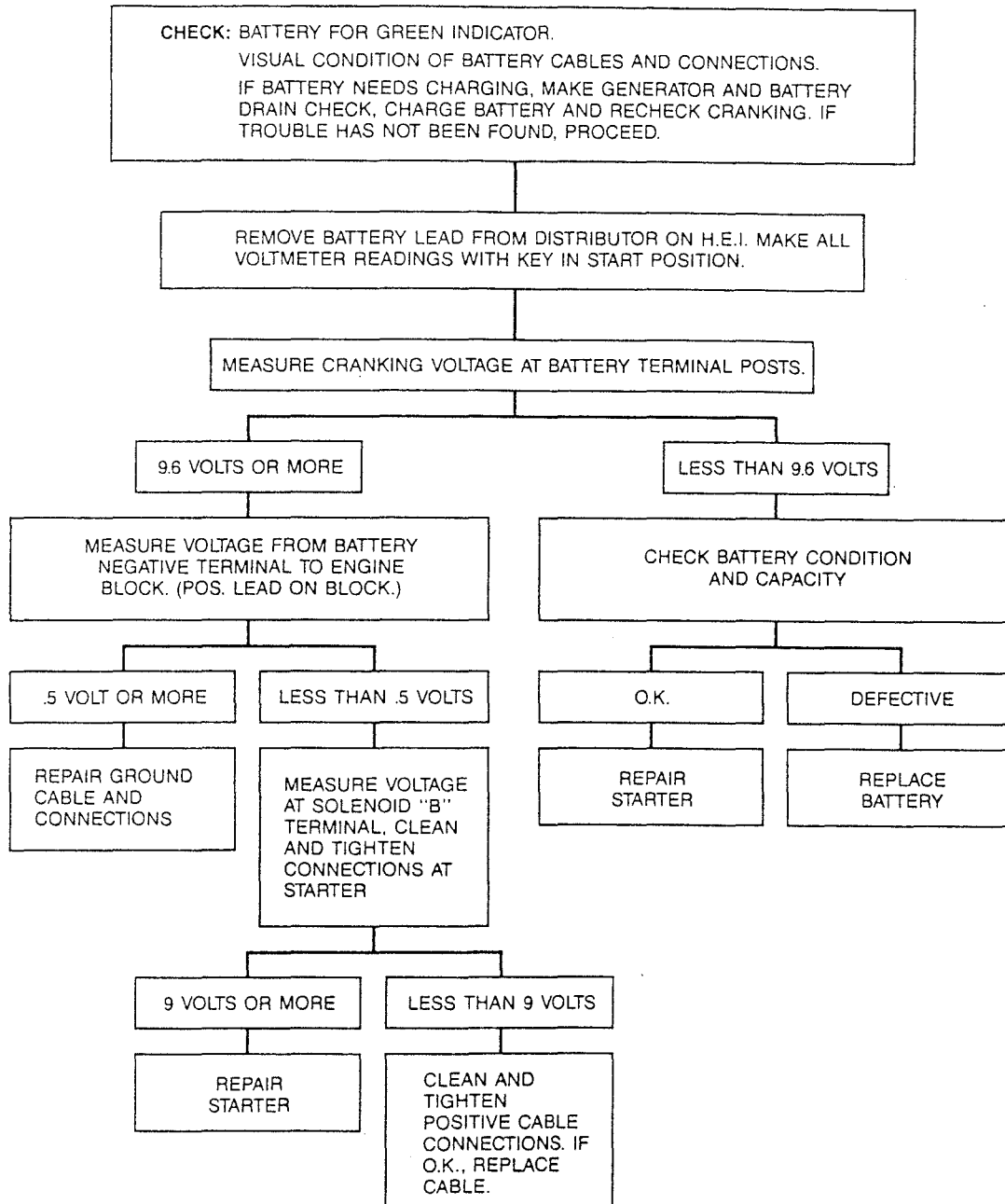
For best fuel economy and cold starting protection to engine surfaces, consider the range of temperature your vehicle will be operated in during the next oil change. Then, select the recommended oil viscosity from the applicable chart shown in Figure A7-8-3.

NOTE: THE GM MAINTENANCE SCHEDULE RECOMMENDS INSPECTION OF ALL ENGINE DRIVE BELTS AT EACH OIL CHANGE. DRIVE BELTS SHOULD BE INSPECTED FOR CRACKS, FRAYING AND WEAR. DRIVE BELTS SHOULD BE ADJUSTED OR REPLACED AS NEEDED. SEE APPENDIX 1—DRIVE BELTS AND TENSION SPECIFICATIONS AT THE BACK OF THIS MANUAL FOR ADDITIONAL INFORMATION.

APPENDIX 7-8 — BATTERY SIZE AND CRANKING vs. TEMPERATURE (CONT'D)

The following charts are provided to aid service personnel and the motor home owner for proper engine electrical diagnosis.

SLOW CRANKING, SOLENOID CLICKS OR CHATTERS



NOTE: THIS PROCEDURE IS DESIGNED FOR USE ON ENGINES AND BATTERIES AT ROOM OR NORMAL OPERATING TEMPERATURES. IT ALSO ASSUMES THERE ARE NO ENGINE DEFECTS WHICH WOULD CAUSE CRANKING PROBLEMS. TO USE IT UNDER OTHER CONDITIONS MIGHT RESULT IN MISDIAGNOSIS.

Figure A7-8-4 — Slow Cranking — Diagnosis Chart

APPENDIX 7-8 — BATTERY SIZE AND CRANKING vs. TEMPERATURE (CONT'D)

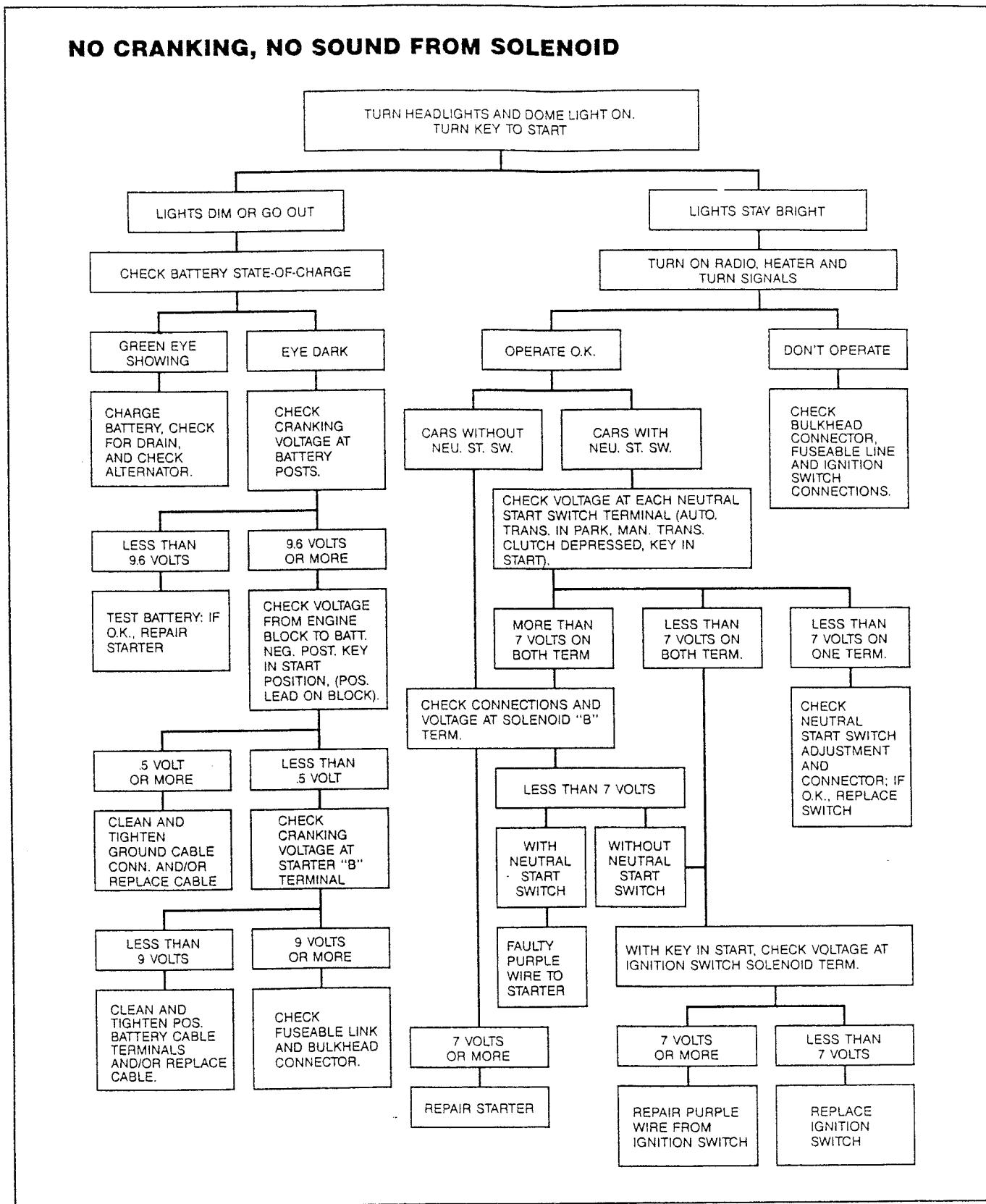


Figure A7-8-5 — No Cranking — Diagnosis Chart

ENGINE ELECTRICAL SYSTEM

APPENDIX 7-9 — ADD-ON (AUXILIARY) ELECTRICAL EQUIPMENT INSTALLATIONS

The following information has been extracted from a Chevrolet Dealer Service Technical Bulletin relating to add-on (auxiliary) electrical equipment installations for vehicles with side terminal batteries.

Reference: Chevrolet Dealer Service Technical Bulletin No. 85-17 (December, 1984)

The use of electronics on today's vehicles require that both power and ground connections for add-on (auxiliary) electrical equipment (mobile radios, light bars, etc.) be made at the battery.

The Side Terminal Adaptor Package (GM Part No. 1846855) when combined with the longer battery bolt (GM Part No. 12004188) and spacer (GM Part No. 12004189) will provide and maintain corrosion resistance and the electrical integrity designed into the Delco side terminal battery. (See Figure A7-9-1.) GM recommends that all service personnel and motor home owners involved in add-on (auxiliary) electrical equipment installations perform the following procedures.

The vehicle battery should be located and positioned to make use of the existing battery cables. If the battery

requires relocation and longer cables are required, a proportionately larger gauge wire must be used.

If in relocating the battery, the negative ground cable is attached to the frame rail, a cable of similar gauge must be provided between the frame rail and the engine. This is required due to the heavy electrical loads imposed by the starting circuit.

To ensure proper operation of the battery cables, the following chart on length, gauge and materials must be adhered to:

CABLE GAGE	COMBINED LENGTH OF POSITIVE AND NEGATIVE CABLE IN INCHES	
	COPPER	COPPER CLAD ALUMINUM
4	66	52
2	107	67
0	170	111

Figure A7-9-2 — Add-On Electrical Equipment — Wire Gauge and Materials Specifications

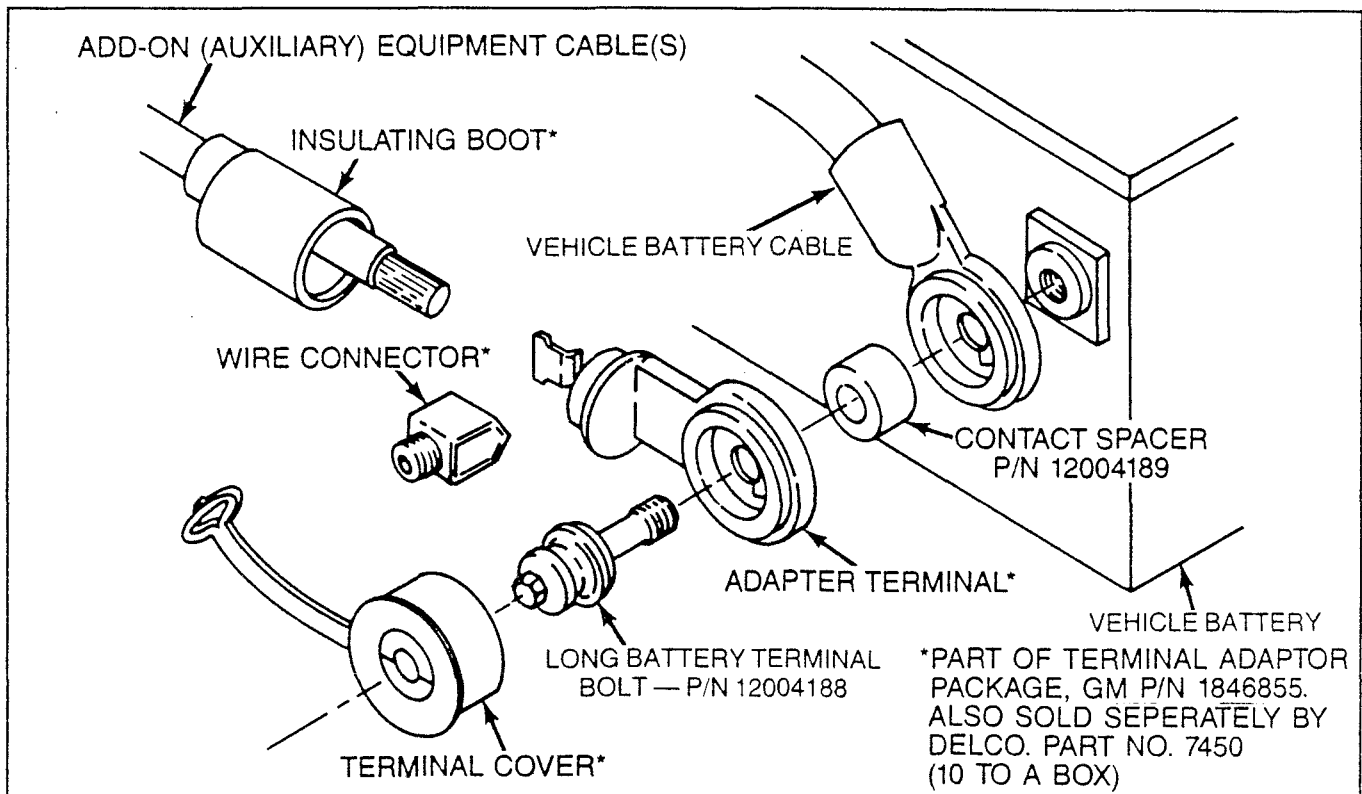


Figure A7-9-1 — Add-On Electrical Equipment — Typical Installation

ENGINE ELECTRICAL SYSTEM

APPENDIX 7-10 — "HOT START" PROBLEM CONDITIONS

The following information has been extracted from three GM Service Bulletins relating to "hot start" problems. The information begins with a discussion of the simple basics of loose connections, proceeds to the addition of heat shields and finally to adding a magnetic switch. Problem conditions and corrective procedures are described.

Reference: GMC Dealer Service Technical Bulletin No. 78-T-1 (October, 1977)

All Gasoline Engine Models

A hard "hot start" condition can be caused by heat expansion of the starter solenoid "S" terminal, resulting in an internal open circuit.

In order to overcome the excessive "S" terminal expansion, the following is recommended:

1. Remove ground cable from battery neg.(-) post.
2. Remove heat shield from starter motor (where applicable).
3. Disconnect wire from "S" terminal (see Figure A7-10-1), remove and discard existing nut which retains the stud to solenoid case and replace with flat washer, GM Part No. 131015 or equivalent, nut GM Part No. 2030900 or equivalent, and torque nut to 12 to 17 in. lbs.

4. Reconnect wire to "S" terminal with existing nut. Torque nut 12 to 17 in. lbs.
5. Reinstall heat shield (where applicable).
6. Reconnect ground cable to battery neg. (-) post.

The vehicle battery should be located and positioned to make use of the existing battery cables. If the battery requires relocation and longer cables are needed, larger gauge cables must be used to ensure proper voltage requirements.

To ensure proper operation of the battery cables, the following chart on length, gauge and materials must be strictly adhered to.

CABLE GAGE	COMBINED LENGTH OF POSITIVE AND NEGATIVE CABLE IN INCHES	
	COPPER	COPPER CLAD ALUMINUM
4	66	52
2	107	67
0	170	111

Figure A7-10-2 — Battery Cable Gauge Specifications

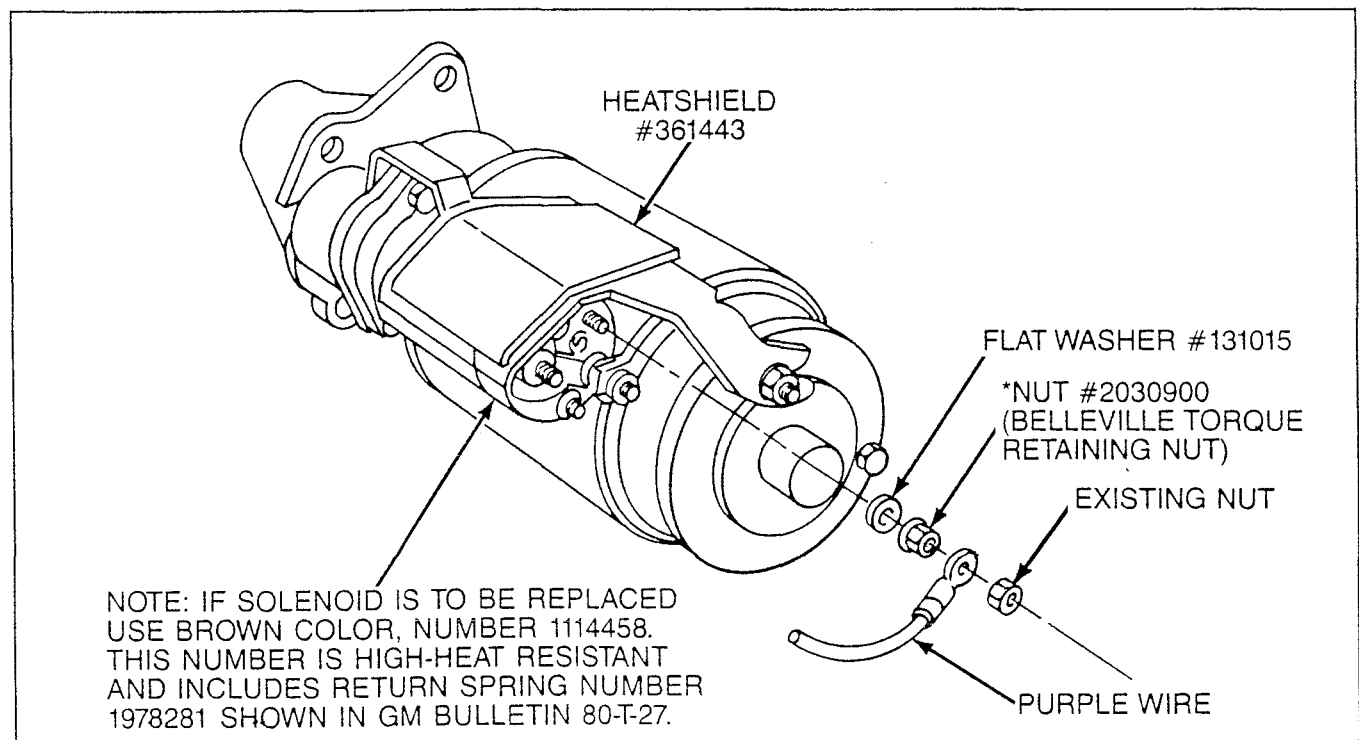


Figure A7-10-1 — "Hot Start" Problems — Starter Solenoid

APPENDIX 7-10 — "HOT START" PROBLEM CONDITIONS (CONT'D)

Reference: Chevrolet Dealer Service Technical Bulletin No. 78-T-28 (April, 1978)

P-Series Motor Homes with Mark IV Engines

The generic term "hot start" is applied loosely to an array of causes which can lead to an inability to crank. Typical "hot start" symptoms involve failure to crank after a 20-minute "hot soak" period with the engine off. Restarts are obtained by waiting for engine compartment cool down, or in some cases, by energizing the starter solenoid directly with a screwdriver across the "S" and B+ terminals.

High ambient and/or underhood temperatures can lead to component overheating. The two starting system components, most vulnerable to adverse thermal effects, are the battery and the starter motor solenoid as follows:

1. Batteries subjected to long-term storage or operating conditions which do not keep the battery adequately charged may be marginal because of sulfation. When operated in high ambients, electrolyte temperatures may be excessive. During engine-off hot soak periods, marginal batteries adjacent to radiators may approach the boiling point of the electrolyte, (about 230°F) depending on state of discharge.

NOTE: Some motor home body builders install batteries in a tray near the radiator, while others use a sliding shelf away from engine temperatures. The trade-off, however, is longer battery cables and a higher voltage drop. Battery thermal guards or heat shields, reflective paints, and/or battery relocation are appropriate where evidence indicates battery thermal problems.

2. The starter motor solenoid, in close proximity to the exhaust pipe, is subject to radiant heating which ultimately increases coil resistance. The resistance increase, decreases current flow to the point where the coil cannot be energized with the available applied voltage.

In some cases, the battery voltage available for solenoid operation is adequate when the coil is relatively cool, but insufficient when the coil is hot. Typically, the voltage drop across the ignition switch, neutral start switch circuit, to the solenoid, should not exceed 2 volts. This, normally, would allow approximately 8 volts for solenoid operation. Unfortunately, the ignition/start circuit voltage drop can exceed 4 volts, due to switch contact resistance, wire lengths, etc. Since the solenoid requires a minimum of 7 volts for positive operation, a marginal or "no start" situation can occur.

On "hot start" complaint vehicles that exhibit symptoms related to inoperative solenoids, the use of magnetic switch, GM Part No. 001486 or No. 114537 (or equivalent) is recommended. It is, in effect, a high-current relay whose contacts are connected across the solenoid "S" and B+ terminals. (See Figure A7-10-3.) The coil of the magnetic switch is connected in series with the ignition/neutral start switch circuit. Maximum available voltage is, therefore, applied to the solenoid, since the voltage drop in the magnetic switch contact circuit is virtually zero.

Installation and connection of the magnetic switch can be accomplished as follows:

1. Drill two holes in the oil dipstick tube bracket. Use holes in magnetic switch mount as a template for hole location. Removal of bracket will facilitate drilling. (See Figure A7-10-4.)

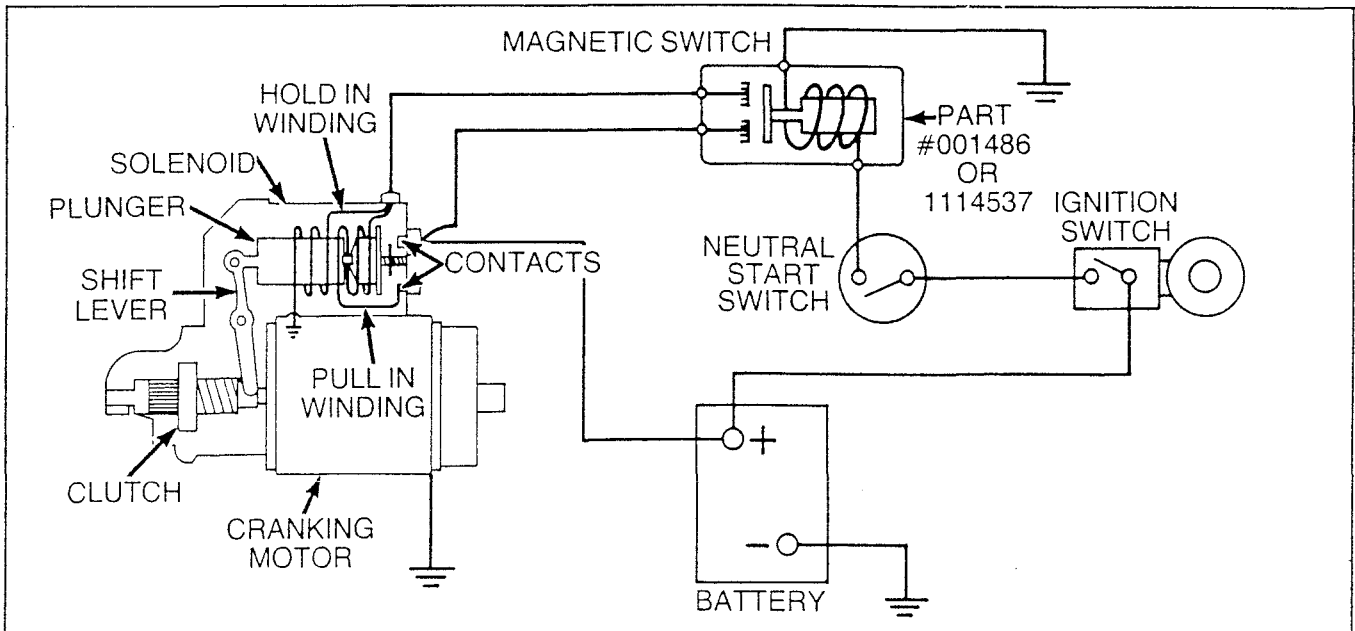


Figure A7-10-3 — Magnetic Switch/Starter Schematic

APPENDIX 7-10 — “HOT START” PROBLEM CONDITIONS (CONT'D)

2. Mount magnetic switch to dipstick (tube) bracket using locking fasteners.
3. Unwrap harness tape, from engine harness wire bundle (approximately one foot) in area adjacent to magnetic switch.
4. Locate the No. 12 AWG wire with purple insulation. This wire connects the neutral start switch to the starter motor solenoid “S” terminal.
5. Cut the wire at a point which will allow connection of the severed ends to the magnetic switch.
6. Identify the cut end of the wire which connects to the “S” terminal of the starter motor solenoid. Terminate this wire with an appropriate lug for connection to one of the “large” studs on the magnetic switch.
7. Terminate the other end of the cut wire with an appropriate lug for connection to one of the “small” studs on the magnetic switch.
8. Disconnect all of the wires from the B+ junction block and attach them to the remaining “large” stud on the magnetic switch.
9. Connect the remaining “small” stud on the magnetic switch to a secure chassis ground.
10. Run a functional/electric check to assure system operation.

In field situations where it is impractical to install a magnetic switch, use of reflective paint to reduce heat absorption is an alternative. Remove dirt from the starter motor and solenoid. With the starter motor installed on the engine, apply reflective paint—Krylon No. 1402 High Temperature (1,200°F) Aluminum Paint, or equivalent—to all accessible surface areas of the starter motor and solenoid. This is a temporary measure since any accumulation of dirt will reduce its effectiveness.

Reference: Chevrolet Dealer Service Technical Bulletin No. 80-T-27 (March, 1980)

G- and P-Series Models Produced Prior to March 15, 1980—Approx.

On some 1979-80 vehicles, the starter motor may not engage after the engine has been turned off and allowed to “hot soak” for a short period of time (10-15 minutes). This condition can result from increased starter solenoid resistance when the solenoid temperature increases. Increased resistance causes reduced current flow to a point where the solenoid may not “pull-in.” The symptoms are “no clicking noise” and no cranking when the ignition key is turned to the start position.

If normal diagnosis of battery or wiring does not disclose any out-of-line conditions, the problem may be caused by the solenoid return spring. This problem can be corrected by installing a new shorter return spring, GM Part No. 1978281 or equivalent. Or, install a new high-heat resistant solenoid, GM Part No. 1114458 (brown color) or equivalent, which incorporates the shorter return spring.

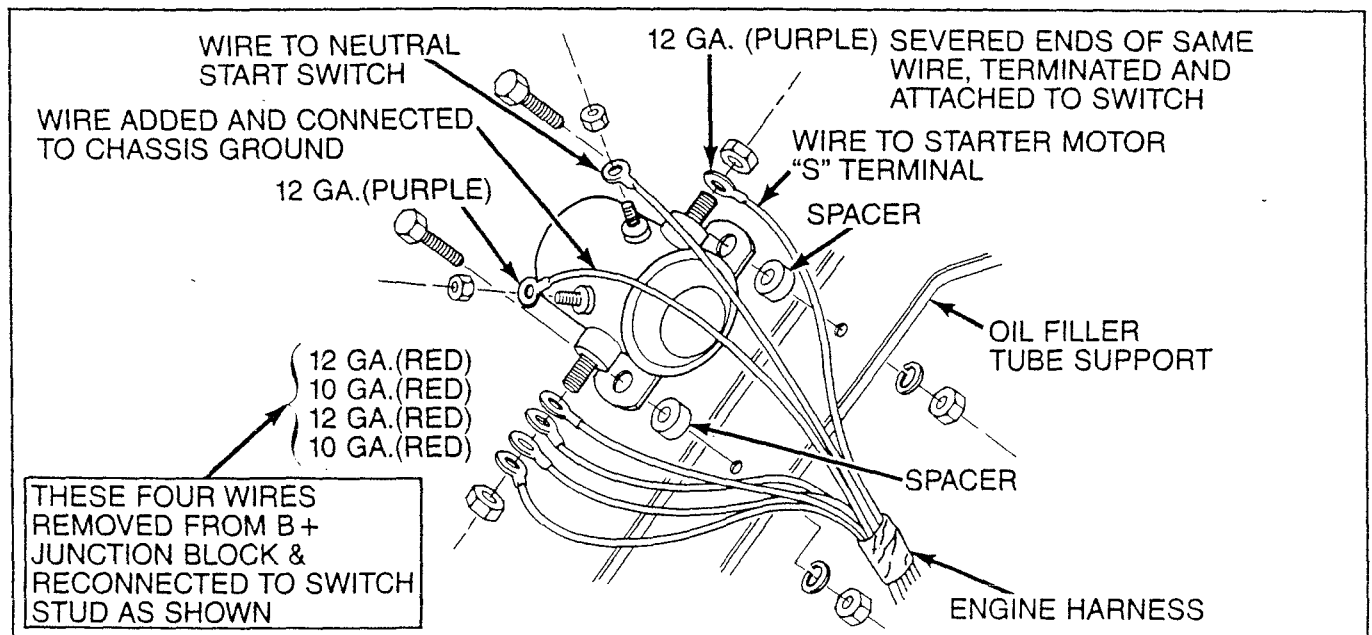


Figure A7-10-4 — Magnetic Switch Mounting and Connection

ENGINE ELECTRICAL SYSTEM

APPENDIX 7-11 — STARTER MOTOR ENGAGEMENT AFTER INITIAL START-UP

The following information has been extracted from a Chevrolet Dealer Service Technical Bulletin concerning the starter motor relay for 7.4L engines. Problem conditions and corrective procedures are described.

Reference: Chevrolet Dealer Service Technical Bulletin No. 84-41 (December, 1983)

1983-84 Motor Home Chassis

The starter motor on some motor home vehicles may re-engage after the engine has been started. This may result from the starter motor relay being energized after the initial start-up. Starter damage could result if this should happen.

To correct the situation, replace the starter relay with a magnetic switch. (See Figure A7-11-1.) Remove the relay connector on the existing engine harness and reterminate

the wires with the appropriate size ring terminals.

This change was incorporated into production vehicles after 1984.

NOTE: A square box electrical relay (GM Part No. 356284) was used in production starting October 28, 1982 with the first serial number of 302886. This relay was used until March 3, 1984. Beginning with serial number 328810, production was switched back to a magnetic switch (GM Part No. 1114535). Both switch types are mounted in the same general location. If a problem arises with electrical relay No. 356284, it should be replaced with either magnetic switch No. 1144537 or No. 001486 (interchangeable GM Part numbers). Other 4-post, non-GM switches may be electrically and functionally similar.

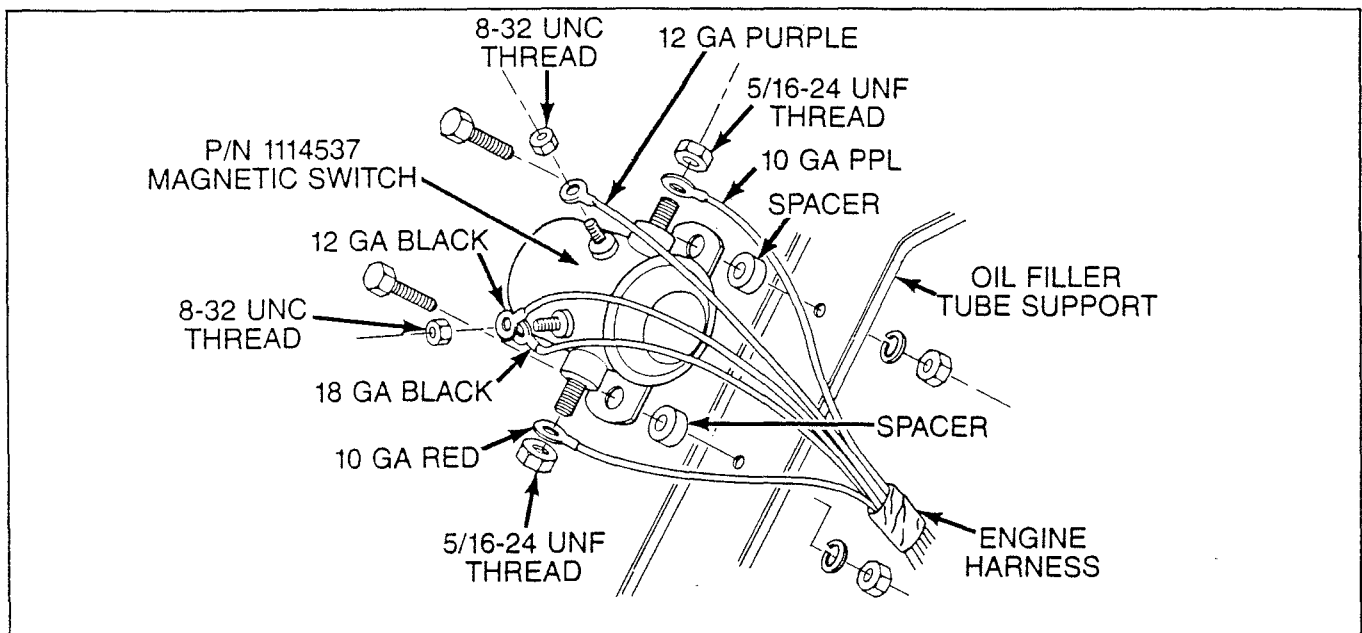


Figure A7-11-1 — Starter Motor Relay Connections

ENGINE ELECTRICAL SYSTEM

APPENDIX 7-12 — ALTERNATOR BELT USAGE ON 6.2L DIESEL ENGINES

The following information has been extracted from a Chevrolet Dealer Service Technical Bulletin concerning alternator belt usage for 6.2L engines.

Reference: Chevrolet Dealer Service Technical Bulletin No. 83-103 (November, 1983)

Belts installed during production were developed to withstand the characteristics of the 6.2L diesel engine.

Usage of substitute belts (with the same dimensions but not construction) will not give the same performance and may wear prematurely, even while operating at the prescribed belt tension.

To obtain optimum belt life, the following belts and tension settings are recommended to be used with the 6.2L diesel engine.

BELT USAGE	RECOMMENDED BELT	BELT TENSION	
		NEW	USED
Alternator	P/N 14050449 (.380 HiRide x 48)	175 lbs.	55-100 lbs.
A/C Belt*	P/N 14033869 (.380 HiRide x 60)	175 lbs.	55-100 lbs.
P.S. Belt	P/N 14050459 (.380 HiRide x 45½)	175 lbs.	55-100 lbs.
1985 A/C Belt	P/N 476406 (.380 HiRide x 61)	175 lbs.	55-100 lbs.
1985 Alternator	P/N 15592119 (.380 HiRide x 48)	175 lbs.	55-100 lbs.

* Motor Home does not have factory air conditioning

NOTE: The alternator/vacuum pump belt for 1984 G- and P-Series is #14071081. This is a cog type belt, 49" x 3/8".

Figure A7-12-1 — 6.2L Diesel Engine Belt Usage

ENGINE ELECTRICAL SYSTEM

APPENDIX 7-13 — TORSIONAL ISOLATOR

The 6.2L torsional isolator is now available from GM Parts Division. The isolator is installed in place of the present crankshaft pulley. The isolator should be installed to correct

situations/complaints of short belt life. New bolts and washers are required to install the isolator.

PART NUMBER	MODEL	YEAR
15592125	P With Air Conditioning C, K, G With Air Conditioning G With Air Conditioning	1982-85 1982-84 1985
15592127	C, K, G, P Without Air Conditioning	1982-85
15592128	C, K With Air Conditioning	1985
Also required: 4 - Bolts, P/N 11500937 4 - Washers, P/N 9438083		

Figure A7-13-1 — Torsional Isolator Parts Identification

SECTION 7 — ENGINE

ENGINE EMISSION CONTROLS

VEHICLE EMISSION CONTROL INFORMATION LABEL

The Vehicle Emission Control Information Label (Figure 7-46), is located in the engine compartment (fan shroud, radiator support, hood underside, etc.) of every vehicle produced by General Motors Corporation. The label contains important emission specifications and setting procedures, as well as a vacuum hose schematic with emission components identified.

When servicing the engine or emission system, the Vehicle Emission Control Information Label should be checked for up-to-date information.

EMISSION CONTROLS — SYSTEMS AND COMPONENTS

GENERAL DESCRIPTION

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM — GASOLINE ENGINE

Because small amounts of combustion gases seep past the piston rings, all engines have a closed Positive Crankcase Ventilation System to provide more complete scavenging of crankcase vapors (Figure 7-47).

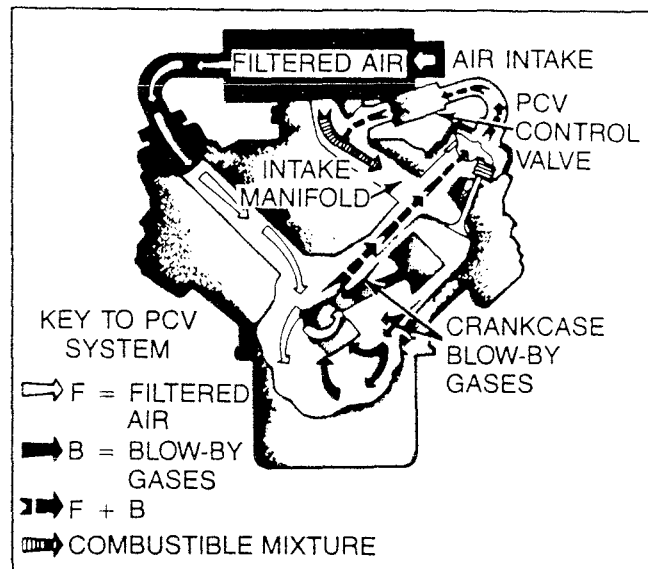


Figure 7-47 — PCV System — Gasoline Engine — Typical

Ventilation air is drawn from the dirty air side of the air cleaner, through a hose, down into the crankcase, up through the ventilator valve, through a hose and into the intake manifold. Intake manifold vacuum draws any fumes from the crankcase to be burned in the engine.

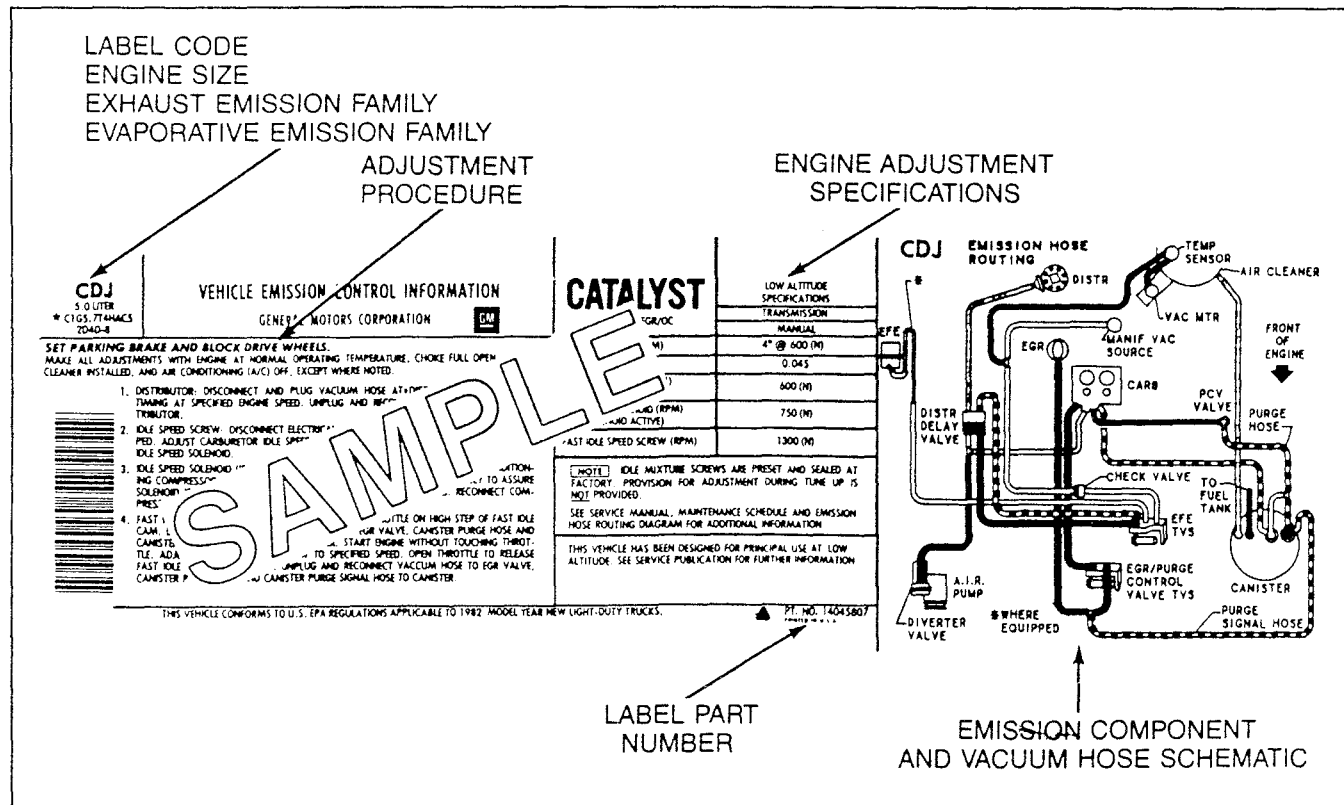


Figure 7-46 — Vehicle Emission Control Information Label

CRANKCASE VENTILATION — DIESEL ENGINE

A Crankcase Depression Regulator Valve is used to regulate (meter) the flow of crankcase gases back into the engine. The Crankcase Depression Regulator Valve (CDRV) is designed to limit vacuum in the crankcase as the gases are drawn from the valve cover through the CDRV and into the intake manifold (air crossover).

Fresh air enters the engine through the combination filter, check valve and oil fill cap. The fresh air mixes with blow-by gases and enters the right cover. The gases pass through a filter on the valve cover and are drawn into the connecting tubing.

The intake manifold vacuum acts against a spring-loaded diaphragm to control the flow of crankcase gases.

Higher intake vacuum levels pull the diaphragm closer to the top of the outlet tube. This reduces the amount of gases being drawn from the crankcase and decreases the vacuum level in the crankcase. As the intake vacuum decreases, the spring pushes the diaphragm away from the top of the outlet tube allowing more gases to flow to the intake manifold.

EARLY FUEL EVAPORATION (EFE) SYSTEM — GASOLINE ENGINE

The EFE system is used to provide a source of rapid heat to the engine induction system during cold driveaway. Rapid heating is desirable because it provides for quick fuel evaporation and more uniform fuel distribution to aid cold drivability. It also reduces the length of time carburetor choking is required, making reductions in exhaust emission levels possible.

EFE systems may use a valve which increases the exhaust gas flow under the intake manifold during cold engine operation. The valve is vacuum-operated and is controlled by a thermal vacuum switch (TVS) which applies vacuum when the coolant temperature is below the calibration valve.

THERMOSTATIC AIR CLEANER (THERMAC) — GASOLINE ENGINE

The Thermostatic Air Cleaner (THERMAC), shown in Figure 7-48, uses a damper door in the air cleaner inlet, controlled by a vacuum diaphragm motor to mix preheated and nonpreheated air entering the air cleaner to maintain a controlled air temperature into the carburetor. The vacuum motor is modulated by a temperature sensor in the air cleaner. The preheating of the air cleaner inlet air allows leaner carburetor and choke calibrations resulting in lower emission levels, while maintaining good drivability.

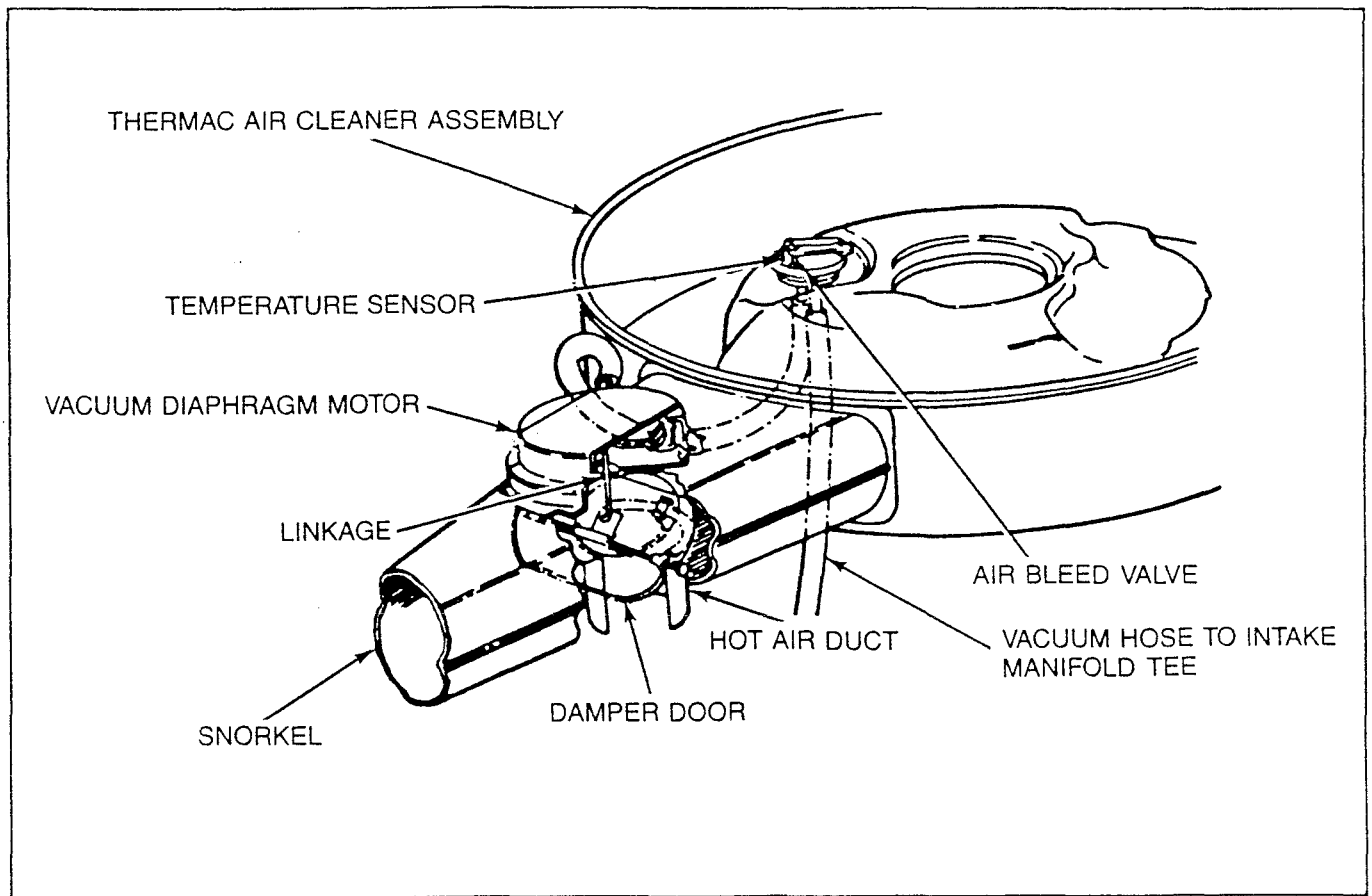


Figure 7-48 — Thermac Air Cleaner — Typical

The preheated air is obtained by drawing inlet air through a stove attached to the exhaust manifold.

On vehicles which have been converted to burn LPG- or CNG-type fuel, by the motor home body manufacturer, the GM air cleaner and Thermoac system may have been removed. This can result in a cold engine stumble especially at cold temperatures, when operating on gasoline as opposed to LPG- or CNG-type fuels.

MAINTENANCE AND INSPECTION POSITIVE CRANKCASE VENTILATION (PCV) — GASOLINE ENGINE

An engine which is operated without any crankcase ventilation can be damaged seriously. Therefore, it is important to replace the PCV valve (Part No. 6487779; AC CV774C or equivalent — 5.7L and Mark IV engines) at the recommended intervals.

If an engine is idling too slowly or roughly this may be caused by a clogged ventilator valve or plugged hose; therefore, never adjust the carburetor idle without first checking the PCV valve and hose.

With this system any blow-by in excess of the system capacity (from a badly worn engine, sustained heavy load, etc.) is exhausted into the air cleaner and is drawn into the engine.

Proper operation of the PCV System is dependent on a sealed engine. If oil sludging or dilution is noted, and the PCV System is functioning properly, check engine for possible cause and correct to ensure that system will function as intended.

Checking the PCV System

1. Remove PCV valve from intake manifold or rocker arm shaft cover.
2. Run the engine at idle.
3. Place your thumb over end of valve to check for

vacuum. If there is no vacuum at valve, check for plugged hoses or valve. Replace plugged and/or deteriorated hoses.

4. Shut off engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve. If valve does not rattle, replace valve (Figure 7-49). Remove PCV valve from rubber hose and look up the end of the hose using a flashlight. If the hose appears coated "oil wet", replace PCV valve.
5. After installing a new PCV valve, readjust engine idle if necessary.

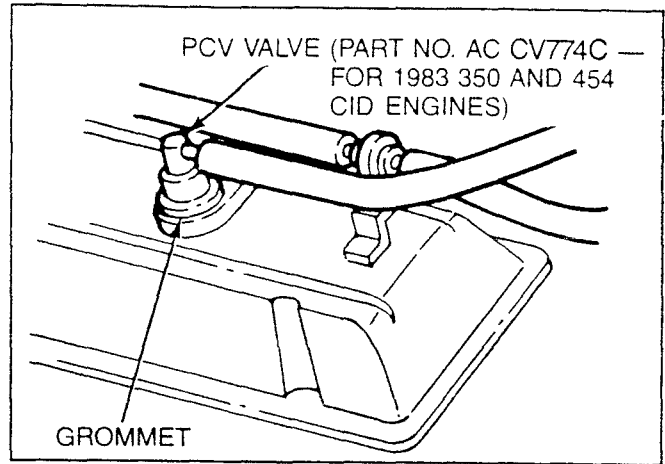


Figure 7-49 — PCV Valve

EARLY FUEL EVAPORATION (EFE) Inspection

- Visually inspect the exhaust heat valve (Figure 7-50) for damage or binding linkage.
- Check that the linkage is connected and the vacuum hoses are properly routed and connected.
- Move exhaust heat valve by hand. If binding or stuck, free it with manifold heat valve lubricant, GM Part No. 10504022 or equivalent. If the valve cannot be freed, replace the valve.

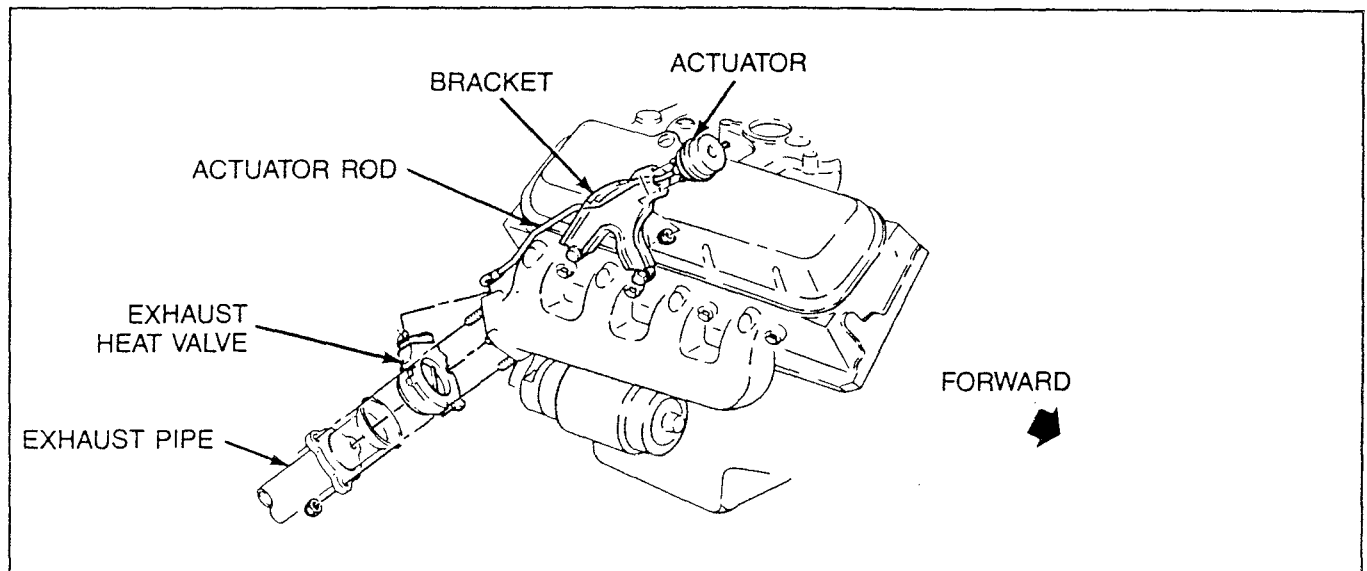


Figure 7-50 — Exhaust Heat Valve — EFE System

Checking EFE System

1. With the engine cold, position the transmission in neutral or park and apply parking brake.
2. Start the engine and observe movement of the actuator rod and exhaust heat valve. Valve should move to its closed position.
3. If the valve does not close, disconnect the hose at the actuator and check for vacuum.
 - If there is vacuum, replace the actuator.
 - If there is no vacuum, disconnect the hose at the TVS to vacuum source.
 - If there is vacuum at the hose, replace the TVS.
 - If there is no vacuum, check for deteriorated hose and vacuum source to determine the lack of vacuum.
4. When the coolant reaches 180°F, the exhaust heat valve should move to its open position.
5. If the valve does not move, disconnect the hose at the actuator and check for vacuum.
 - If there is vacuum, replace the TVS.
 - If there is no vacuum, replace the actuator.

AIR INJECTION REACTOR (A.I.R.) SYSTEM — GASOLINE ENGINE

The Air Injection Reactor (A.I.R.) System (Figure 7-51) consists of: an air injection pump (with necessary brackets and drive attachments), an air diverter valve, a check valve, and an air pipe assembly for each exhaust manifold, and connection hoses.

Inspection

Accelerate the engine to approximately 1,500 RPM and observe air flow from the hose(s). If the air flow increases as the engine is accelerated, the pump is operating satisfactorily. If the air flow does not increase or is not present, proceed as follows:

1. Check for proper drive belt tension. The A.I.R. system is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases.

To determine if excessive noise is the fault of the system, operate the engine with the pump drive belt removed. If excessive noise does not exist with the belt removed, proceed as follows:
2. Check for a seized air injection pump. Do not oil the pump.
3. Check hoses, pipes and all connections for leaks and proper routing.
4. Check diverter valve attaching screws for tightness.
5. Check injection pump for proper mounting and bolt torque.
6. Repair irregularities in these components as necessary.
7. If no irregularities exist and the air injection pump noise is still excessive, remove and replace the pump.

Air Pump Drive Belt Adjustment and Replacement

1. Inspect drive belt for wear, cracks and deterioration.
2. Loosen the generator adjustment bolt.
3. Replace the belt if required.

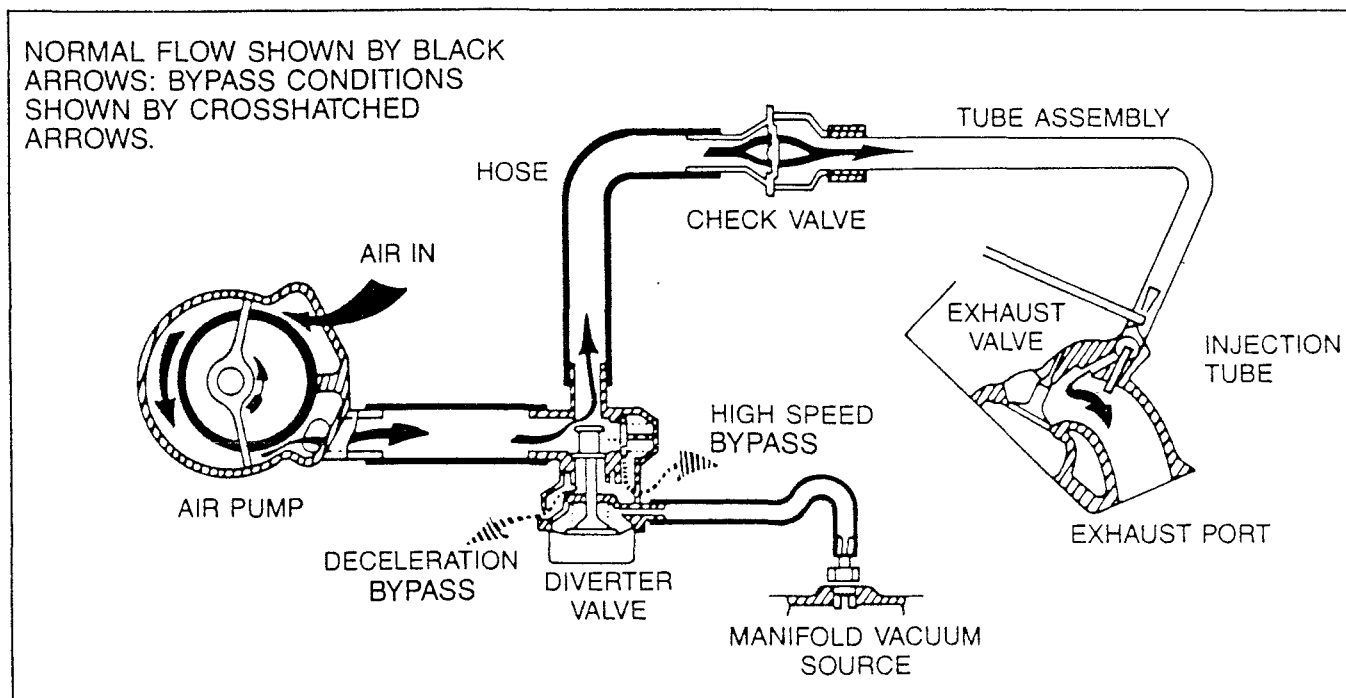


Figure 7-51 — Air System — Typical

4. Move the generator or pump until the drive belt is at the proper tension, then retighten bolts. See Appendix 1 — Drive Belts and Tension Specifications at the back of this manual for specifications.
5. Check the belt tension using a belt tension gage.
9. Reinstall the air cleaner. As the engine warms up, the damper door should start to allow outside air and heated air to enter the carburetor.
10. If the air cleaner fails to operate as described above or if the correct operation of the air cleaner is still in doubt, perform a thermometer check of sensor.

CHECK VALVE INSPECTION

1. The check valve should be inspected whenever the hose is disconnected from the check valve or whenever check valve failure is suspected. (A pump that had become inoperative and had shown indications of containing exhaust gases in the pump would indicate check valve failure.)
2. Blow through the check valve (toward the cylinder head) then attempt to suck back through check valve. Flow should only be in one direction (toward the exhaust manifold). Replace valve which does not function this way.

THERMOSTATIC AIR CLEANER

Checking Thermac Air Cleaner

1. Inspect the system to be sure all hoses and tubes are connected. Check for kinked, plugged or deteriorated hoses.
2. If the engine is warm above 80°F, remove the air cleaner. Allow it to cool to room temperature, below 80°F. Placing a cool wet rag on the temperature sensor will aid in cooling.
3. Install the cooled air cleaner with cold air intake disconnected from snorkel (if equipped).
4. Observe the damper door before starting the engine. It should be in the open snorkel position (hot air duct covered.)
5. Start the engine. Watch the damper door in the air cleaner snorkel. When the engine is first started, the damper door should close. As the air cleaner warms up, the damper door should open slowly.
6. If the damper door does not close when the engine is started, remove the air cleaner.
7. Apply at least 7 in. of vacuum to the vacuum diaphragm motor through the hose disconnected at the temperature sensor. The damper door should completely block off the snorkel passage when vacuum is applied. If not, check to see if the linkage is hooked up correctly.
8. With the vacuum still applied, trap vacuum in the vacuum diaphragm motor by bending hose. The damper door should remain closed; if not, replace the vacuum diaphragm motor assembly. (Failure of the vacuum diaphragm motor assembly is more likely to be caused by binding linkage or a corroded snorkel than by a failed diaphragm. This should be checked first, before replacing the diaphragm.)

Thermometer Check of Sensor

1. Start test with the air cleaner temperature below 80°F. If the engine has been run recently, remove the air cleaner and place the thermometer as close as possible to the sensor. Let the air cleaner cool until the thermometer reads below 79°F, about 5 to 10 minutes. Reinstall the air cleaner on the engine and continue to Step 2 below.
2. Start and idle engine. The damper door should move to close the snorkel passage immediately if engine is cool enough. When the damper door starts to open the snorkel passage (in a few minutes), remove the air cleaner cover and read the thermometer. It must read between 100°F and 130°F.
3. If the damper door does not start to open up the snorkel passage at the temperature indicated, the temperature sensor is malfunctioning and must be replaced.

Air Cleaner Element Replacement

PAPER ELEMENT —

1. Remove the air cleaner cover.
2. Remove the element.
3. Install a new element in the air cleaner with either end up.
4. Reinstall the air cleaner cover. Do not overtighten wing nut.

POLYWRAP ELEMENT (P SERIES) —

1. Remove the air cleaner cover.
2. Remove the element.
3. Remove the polywrap band from the paper element and discard the element (Figure 7-52).
4. Clean the bottom section of the air cleaner and inspect the cover seal for tears or cracks. Replace the seal if damaged.
5. Inspect the band for tears and replace if damaged.
6. If the band is serviceable, wash it in kerosene or mineral spirits and squeeze out the excess solvent.

NOTE: Never use a hot degreaser or any solvent containing acetone or similar solvent; also, never shake, swing or wring the element to remove excess solvent as this may tear the polyurethane material. Instead, "squeeze" the excess solvent from the element. Squeezing will avoid damaging the element material.

7. Dip the band into light engine oil and squeeze out the excess oil.

8. Install the band around the outer surface of the new paper element.

9. Install the element in the bottom section of the air cleaner with either end up.

10. Install the air cleaner cover. Do not over-torque the wing nut(s).

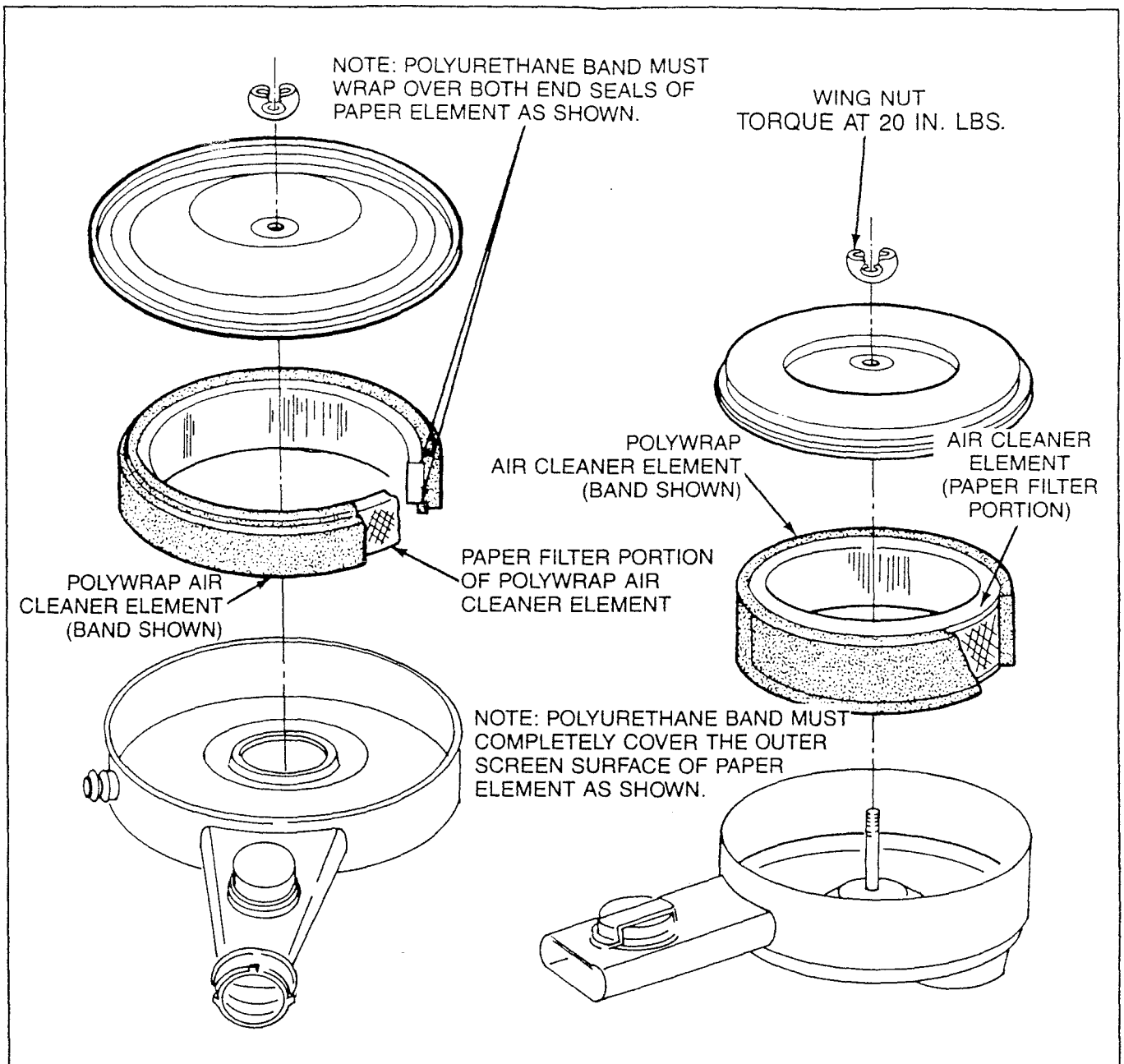


Figure 7-52 — Polywrap Air Cleaner

ENGINE EMISSION CONTROLS

APPENDIX 7-14 — H5D EMISSION SYSTEM

On vehicles equipped with the H5D emission system (vehicles rated over 8,600 GVW and built after January 1, 1985), the "CHECK ENGINE" light may light up to inform the motor home owner of a possible problem while a problem does not actually exist. The following diagnostic procedure should be followed in correcting this condition.

NOTE: The "CHECK ENGINE" light will normally come on when the ignition is turned to the "ON" position and the engine is **NOT** running. This is provided as a bulb check.

The illumination of the "CHECK ENGINE" light indicates that there is a malfunction in the A.I.R. solenoid control module or wiring. (See Figure A7-14-1.) Perform the following corrective procedure:

1. Check the A.I.R. solenoid and A.I.R. modulated connectors for a proper connection.
2. With ignition on, disconnect each solenoid connector and with a test light, check for a light across the terminals. (See Figure A7-14-2.)
3. If O.K. (light on), check solenoid coil resistance and if less than 20 ohms, replace the solenoid and valve.
4. If not O.K. (light off), connect the solenoid connector(s) and disconnect connector at module. With a test light, check for a light between terminal "A" and "B."
5. If not O.K. (light off), check for an open circuit to the module.
6. If O.K. (light on), replace the module. (See parts listing in Figure A7-14-4.)

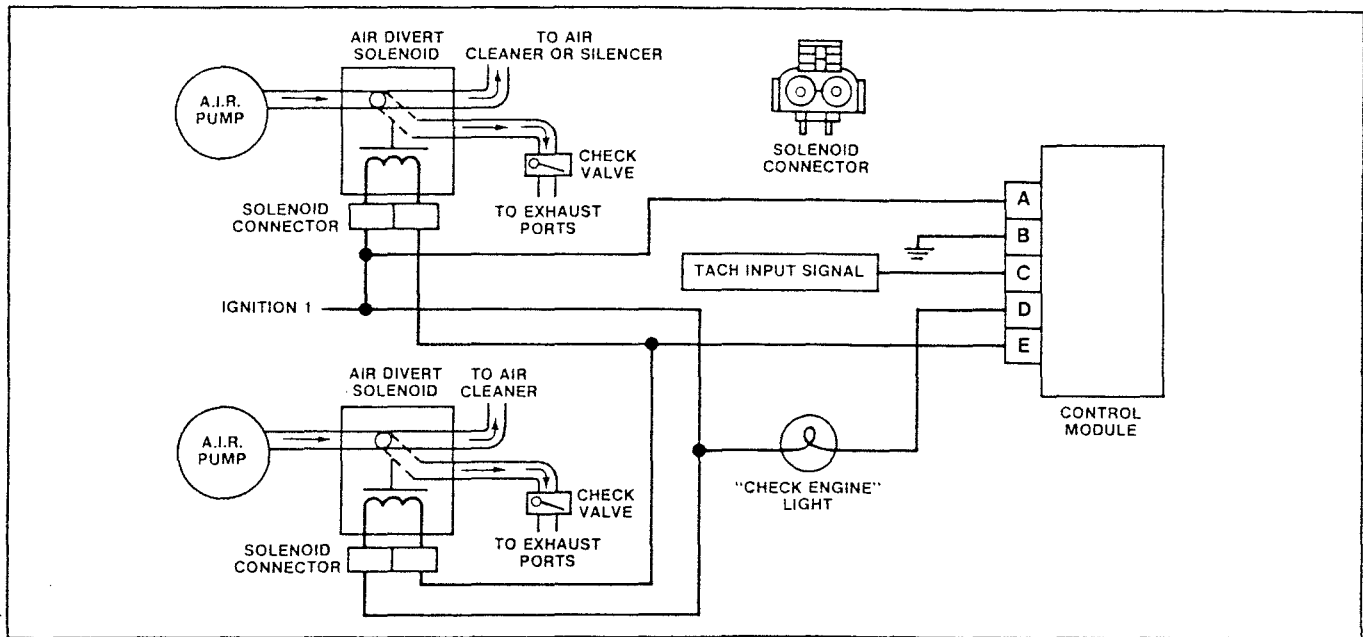


Figure A7-14-1 — A.I.R. Connector Diagram

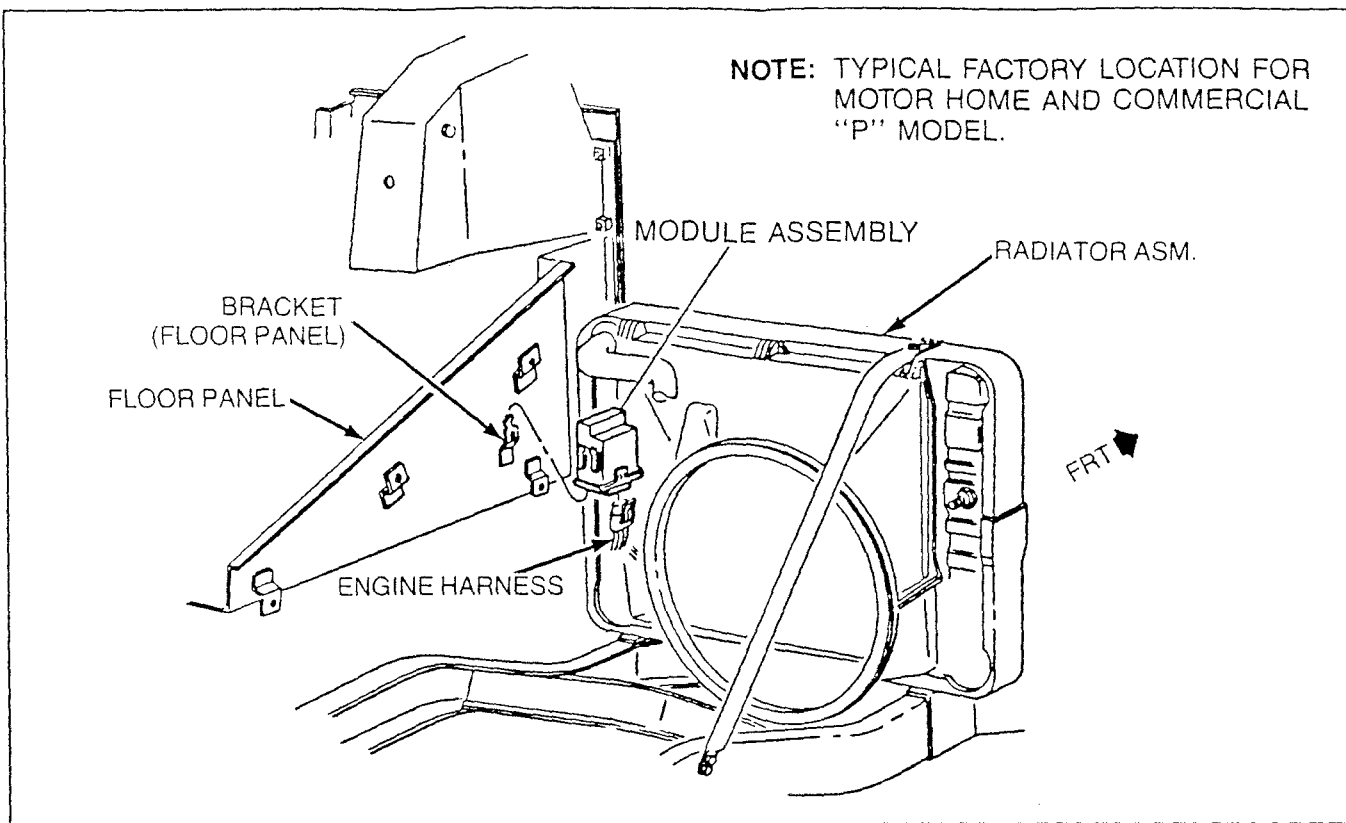


Figure A7-14-2 — A.I.R. Connector Module

APPENDIX 7-14 — H5D EMISSION SYSTEM (CONT'D)

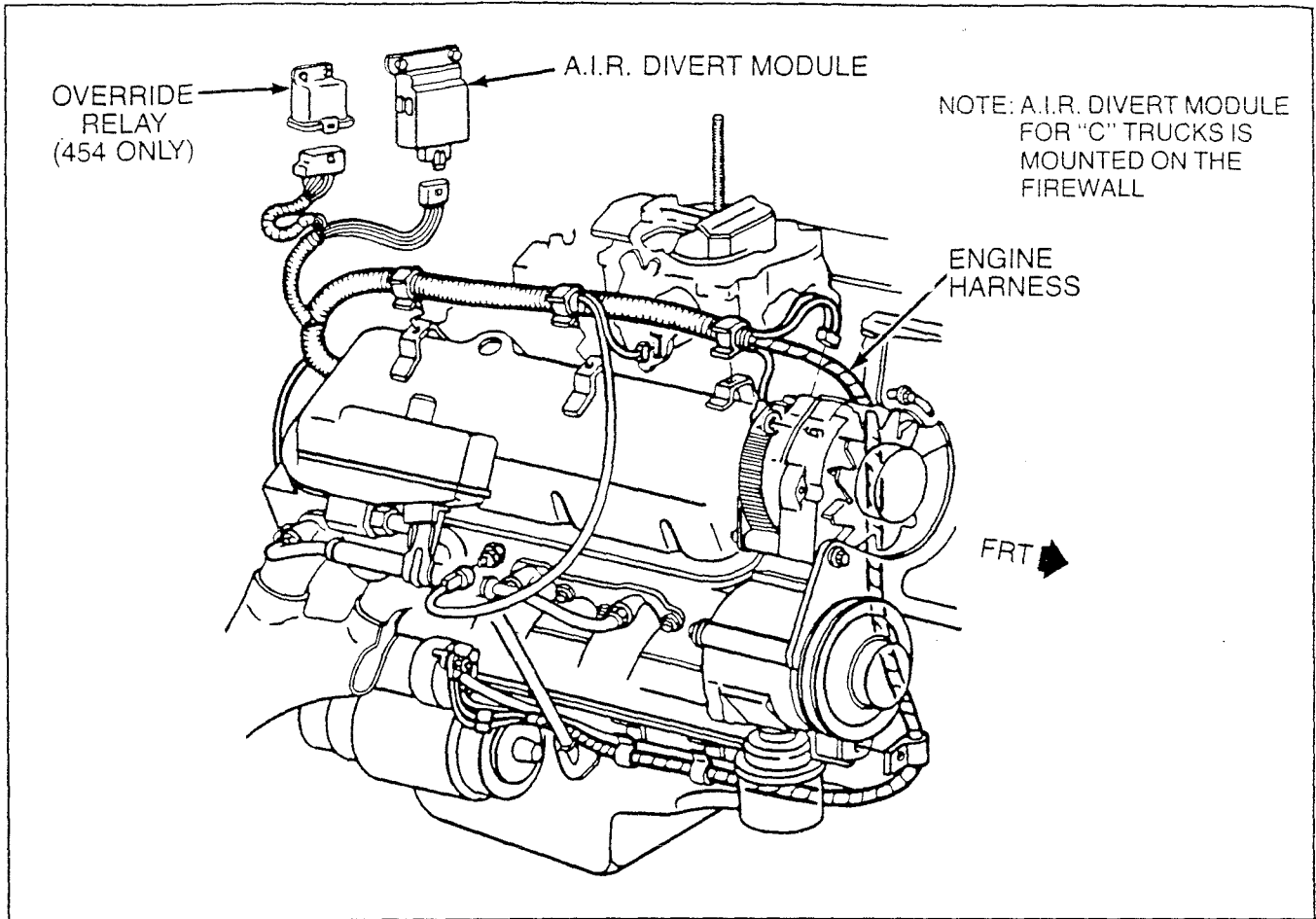


Figure A7-14-3 — H5D Override Relay

NOTE: 1985-86 models equipped with the LE8 (454) and H5D have an override relay. (See Figure A7-14-3.) This relay is necessary due to the lower cranking speed of the LE8 (454) engine. If the relay fails, the CEL will come on.

If it becomes necessary to replace the relay or the module, use the part numbers listed in Figure A7-14-4.

P/N	DESCRIPTION & APPLICATION				QUANTITY
14087500	Module	1985-86	W/LE8	454	1
14087500	Module	1985	W/LT9	350	1
14102010	Module	1986	W/LT9	350	1
14100876	Module	1985-86	W/L25	292	1
14094774	Relay	1985-86	W/LE8	454	1

Figure A7-14-4 — LE8 (454) and H5D Override Relay Parts List

SECTION 8 — TRANSMISSION

GENERAL DESCRIPTION

The transmission (Figure 8-1) is mounted behind the engine. Its function is to convert the power output of the engine into usable power for the drive wheels of the motor home. By activating different gears within the transmission, the speed at which the output shaft of the transmission turns in relation to the speed of the engine crankshaft can be changed to meet the different driving load conditions.

MODELS 350C AND 400-475 SERIES

Chevrolet motor homes are equipped with one of two different automatic transmissions, the 350C (G-Series) and the 400-475 (P-Series). Both are fully automatic units which use a three-element hydraulic torque converter.

The 350 automatic transmission, in addition to the torque converter, uses two planetary gear sets. Four multiple-disc clutches, two roller clutches, and an intermediate overrun and provide the friction elements required to obtain the desired function of the two planetary gear sets.

The 400-475 Series automatic transmission uses a compound planetary gear set along with the torque converter. Three multiple-disc clutches, one gear unit, one roller clutch, and two bands provide the friction elements required to obtain the desired function of the compound planetary gear set.

The three-element torque converter consists of a pump or driving member, a turbine or driven member, and a stator assembly. It is filled with fluid and is attached to the engine crankshaft at the flywheel (or flexplate). The torque converter, which always rotates at engine speed, couples the engine to the planetary gears through the fluid and provides hydraulic torque multiplication when required.

TORQUE CONVERTER CLUTCH

A torque converter clutch assembly is also used on some models. The converter clutch is splined to the turbine assembly, and when operated, applies against the converter cover providing a mechanical direct drive coupling of the engine to the planetary gears. Converter clutch operation is determined by a series of controls and by drive range selection. The transmission must be in drive range, and the vehicle must have obtained a preset speed depending on the engine and transmission combination.

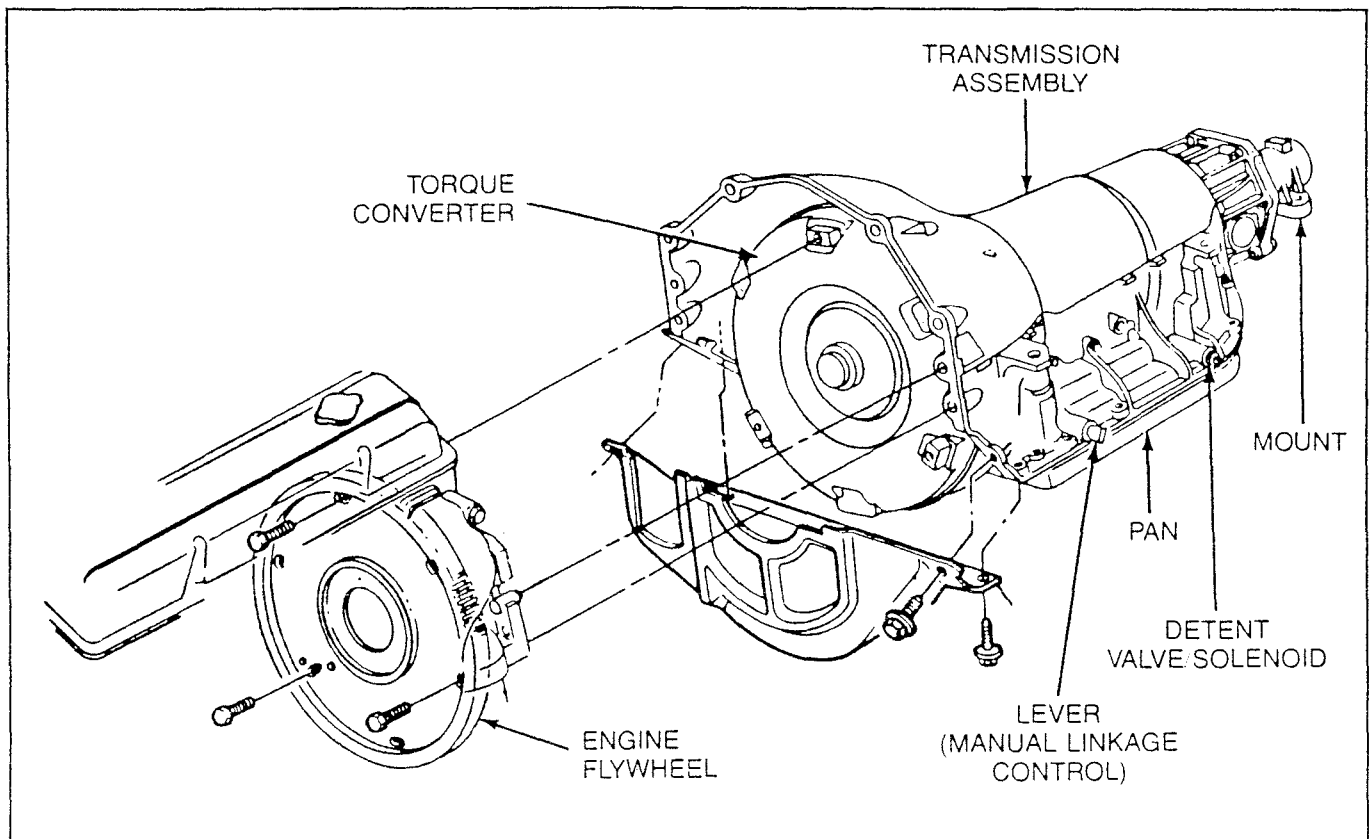


Figure 8-1 — Automatic Transmission — Typical

Aside from the torque converter, the hydraulic system within the transmission is pressurized by a gear-type pump and provides the working pressure required to operate the friction elements and automatic controls.

CONTROLS

For proper operation of the transmission, certain controls from outside of the transmission are required. These include:

1. Manual Linkage—To select the desired operating range.
2. Engine Vacuum—To operate the vacuum modulator.
3. Downshift Control
 - Cable to operate the detent valve (350C)
 - Electrical circuit to operate the detent solenoid (400-475 Series)

MANUAL LINKAGE

The manual linkage is connected between the selector lever on the steering column, and the transmission. It is through this linkage that the vehicle driver can control the transmission operating range.

VACUUM MODULATOR SYSTEM

A vacuum modulator is used to automatically sense any change in torque input to the transmission. The vacuum modulator transmits this signal to the pressure regulator, which controls line pressure, so that all torque requirements of the transmission are met and smooth shifts are obtained at all throttle openings.

DOWNSHIFT (DETENT) CABLE SYSTEM — 350C TRANSMISSION — G-SERIES

The detent valve is activated by the downshift (detent) cable which is connected to the carburetor linkage. When the throttle is half open, the detent valve is actuated, causing a part throttle downshift at speeds below 50 mph. When the throttle is fully opened, the detent valve is actuated causing the transmission to downshift. The 3-1 detent downshift may be obtained when vehicle speed is approximately 6 to 12 mph below the maximum throttle 1-2 upshift point. The 3-2 detent downshift may be obtained when vehicle speed is approximately 4 to 8 mph below the maximum throttle 2-3 upshift point.

DETENT DOWNSHIFT ELECTRICAL CIRCUIT — 400-475 SERIES TRANSMISSION

The detent solenoid is activated by an electric switch on the accelerator linkage. When the throttle is fully opened, the switch is closed, activating the detent solenoid and causing the transmission to downshift for passing speeds.

MAINTENANCE AND INSPECTION

The automatic transmission fluid level should be checked regularly (at each engine oil change) and changed at the intervals recommended in the Maintenance Schedule for your vehicle. Typically, the recommended interval for

changing the fluid and service screen is every 24,000 miles (Heavy-Duty Emissions equipped vehicles) or every 12,000 miles if the vehicle was subjected to severe use.

In addition, the oil (fluid) cooler lines, electrical lines, vacuum lines, control linkage and transmission should be checked periodically for leaks, damage or deterioration.

NOTE: Transmission problems can be the result of poor engine performance. If the engine requires a tune-up, this should be done before checking the transmission.

FLUID LEVEL AND APPEARANCE

When checking the fluid level, follow the appropriate procedure listed below. It is also important to know what appearance the fluid should have. Many times a transmission malfunction can be traced to an incorrect fluid level or improper reading of the dipstick. A fluid level which is too high or too low can cause overheating and clutch plate damage. In addition, overheating can be caused by excessive clutch plate slippage which can result from improperly installed plates, an out-of-adjustment selector linkage or the manner in which the vehicle is operated. Due to the transmission fluid that is now being used it may appear to be darker and have a stronger odor. This is normal, and not a positive sign of required maintenance or transmission failure.

Also when the dipstick is removed, it should be noted whether the fluid is devoid of air bubbles or not. Fluid with air bubbles gives an indication of an air leak in the suction lines, which can cause erratic operation and slippage. Water or ethylene glycol antifreeze in the fluid imparts a milky, gray or pink cast to the fluid and can cause spewing of fluid from the transmission breather. Coolant in the fluid, whether water or antifreeze, can cause damage to the nylon parts or clutch plates in the transmission. If the fluid becomes contaminated with coolant, the most common cause is a leaking transmission cooler core. In addition to finding and fixing the leak, the transmission should be disassembled, cleaned and the clutch plates replaced with new ones.

Glycol test kits on the market can be used to detect antifreeze in the transmission fluid. While generally reliable, certain kits may produce positive test results because of additives used in some transmission fluids. The kit manufacturer's instructions should be followed closely.

Capacity

The fluid capacities of both transmissions are listed in the Lubrication section of this manual. To bring fluid level from "ADD" mark to "FULL" mark requires one pint of fluid. Fluid level should be checked at every engine oil change.

Fluid level should be to the "FULL" mark with transmission fluid at normal operating temperature of 200°F. With fluid at room temperature, 70°F, level will be between the two dimples on the dipstick. The normal operating temperature is obtained only after at least 15 miles of highway-type driving. (See Figure 8-2.)

Checking and Adding Fluid

TRANSMISSION AT OPERATING TEMPERATURE—The automatic transmission is designed to operate at the "FULL HOT" mark on the dipstick at normal operating temperatures of 190°-200°F and should be checked under these conditions. The normal operating temperature is obtained only after at least 15 miles of highway-type driving.

CAUTION: WITH NORMAL OPERATING TEMPERATURES, THE DIPSTICK WILL BE EXTREMELY HOT TO TOUCH. USE CARE TO AVOID BURNS.

To determine proper level, proceed as follows:

1. Apply the parking brake and block the vehicle wheels.
2. With the selector level in the PARK position, start the engine. **DO NOT RACE ENGINE.** Move the selector lever through each range.
3. Immediately check the fluid with the selector lever in PARK, engine running at SLOW IDLE and the car on a LEVEL surface. The fluid level on the dipstick should be at the "FULL HOT" mark.
4. If additional fluid is required, add sufficient fluid to bring the level to the "FULL HOT" mark on the dipstick.

TRANSMISSION AT ROOM TEMPERATURE (65° to 85°F)—Automatic transmissions are frequently overfilled because the fluid level is checked when the fluid is cold and the dipstick indicates fluid should be added. However, the low reading is normal since the level will rise as the fluid temperature increases (Figure 8-2). A level change of over 3/4 inch will occur as fluid temperature rises from 60° to 180°F.

Overfilling can cause foaming and loss of fluid through the vent. With too much fluid, the planetary gearing churns it, producing aeration which reduces the fluid's cooling effectiveness. Slippage and transmission failure can result.

Fluid level too low can result in transmission charging pump cavitation, a loss of main and lubrication oil pressure and clutch plate damage. It can cause slipping, particularly when the transmission is cold or the vehicle is on a hill.

Check the transmission fluid level with the engine running, the shift lever in PARK, and the vehicle level.

If the vehicle has recently been operated for an extended period at high speed or in city traffic in hot weather or the vehicle is being used to pull a trailer, an accurate fluid level cannot be determined until the fluid has cooled down, usually about 30 minutes after the vehicle has been parked.

Remove the dipstick and touch the transmission end of the dipstick cautiously to find out if the fluid is cool, warm or hot.

Wipe the dipstick clean and reinsert it until the cap seats. Remove the dipstick and note reading.

1. If the fluid feels cool, about room temperature (65°-85°F), the level should be between the two dimples below the "ADD" mark.
2. If it feels warm the level should be close to the "ADD" mark (either above or below).
3. If it feels hot (cannot be held comfortably), the level should be between the "ADD" and "FULL" marks.

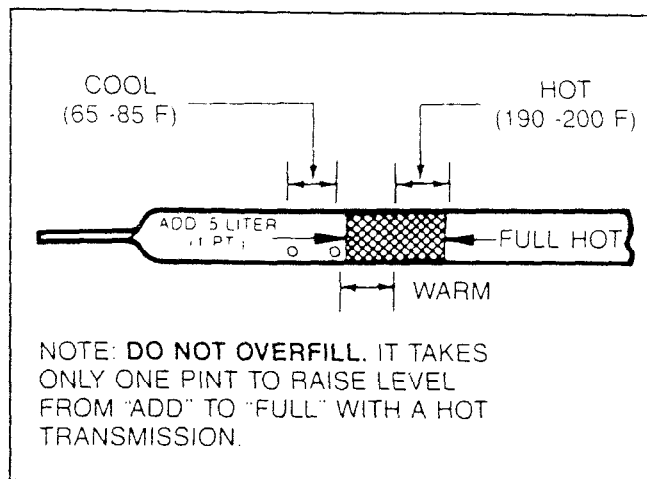


Figure 8-2 — Transmission Dipstick — Fluid Levels at Varying Temperatures

Changing Fluid

1. Raise the vehicle.
2. With a drain pan placed under the transmission oil pan, remove the oil pan attaching bolts from the front and side of the pan.
3. Loosen pan rear attaching bolts approximately four (4) turns.
4. Carefully pry the transmission oil pan loose with a screwdriver, allowing the fluid to drain.
5. Remove the remaining bolts and remove the oil pan and gasket.
6. Drain the fluid from the oil pan. Clean the pan with solvent and dry thoroughly with clean compressed air.
7. If required, remove the screen/filter-to-valve body bolts. Remove screen/filter and gasket.
8. Thoroughly clean screen assembly in solvent and dry thoroughly with clean compressed air. Paper or felt-type filters should be replaced.
9. Install, as required, a new gasket or O-ring onto the screen/filter assembly. Lubricate O-rings with petrolatum. If required, install the screen/filter attaching bolts and torque.

10. Install a new gasket on the oil pan and install the pan. Torque the attaching bolts to 13 ft. lbs. (350C transmission), 12 ft. lbs. (400-475 Series transmission).
11. Lower the vehicle and add the proper amount of DEXRON II automatic transmission fluid or its equivalent through the filler tube.
12. With the selector lever in PARK position, apply the parking brake, start the engine and let idle (carburetor off fast idle step). DO NOT RACE ENGINE.
13. Move the selector lever through each range and, with the selector lever in PARK range, check fluid level.
14. Add additional fluid to bring the level between the dimples on the dipstick (cool level).

Automatic Transmission Manual Linkage

When the manual linkage (Figure 8-3) is properly adjusted, the engine will start in the PARK and NEUTRAL positions only.

The selector lever and manual linkage should move freely and not bind. Also, the pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

Check the linkage to be sure that the connections are secure and that there is no binding. If there are indica-

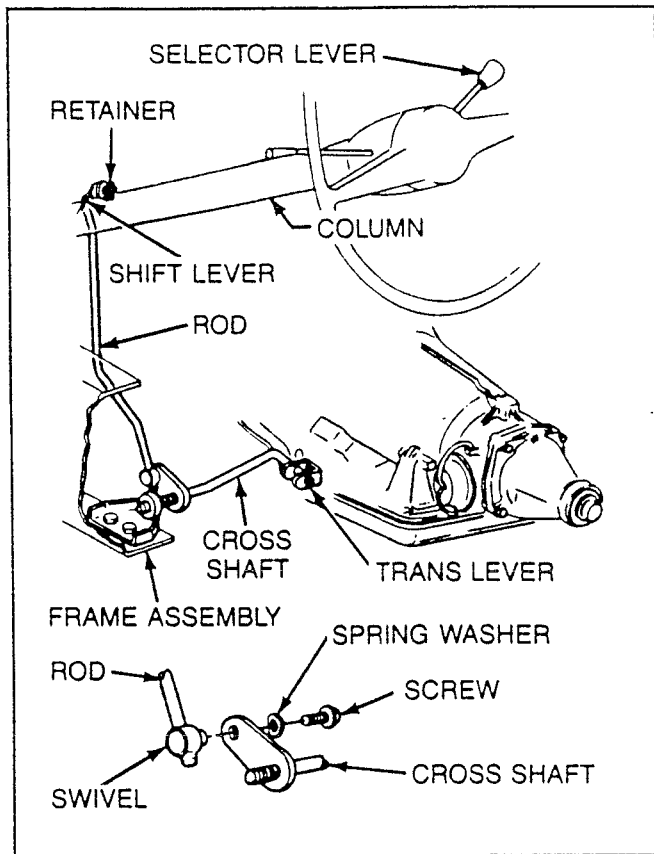


Figure 8-3 — Transmission Manual Linkage—Typical

tions that the linkage needs adjustment, take the vehicle to a qualified shop for service. If the linkage is not adjusted properly, an internal leak could occur at the manual valve which could cause a clutch and/or band failure.

Oil (Fluid) Cooler Pipes

If replacement of transmission steel tubing cooler lines (Figure 8-4) is required, use only wrapped and brazed steel tubing meeting GM specifications 123M or equivalent. Under no condition use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory fatigue durability to withstand normal vehicle vibrations. Steel tubing should be flared using the double flare method.

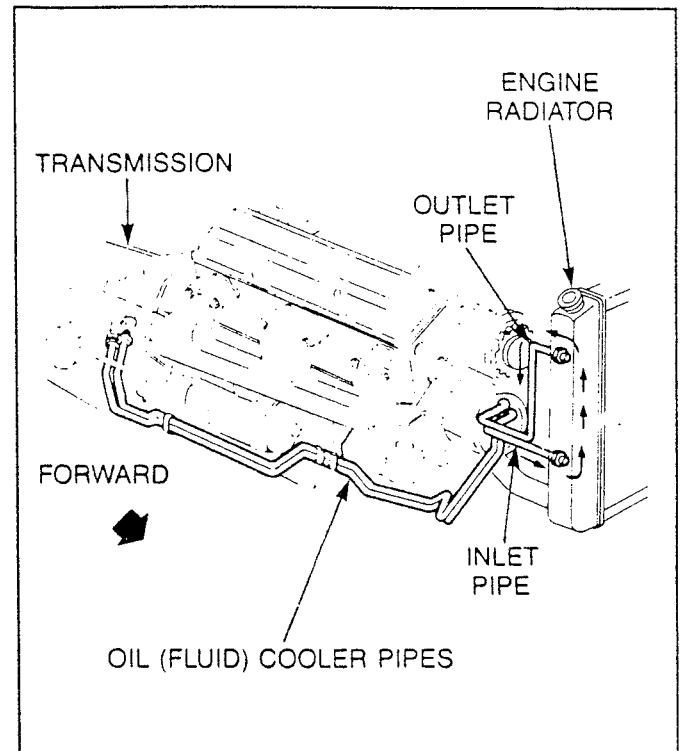


Figure 8-4 — Automatic Transmission Oil (Fluid) Cooler Lines — Typical

Transmission Mount

A loose transmission mount can cause a vibration in the driveline. To check for this condition, push up and pull down on transmission tailshaft while observing the transmission mount. If rubber separates from the metal plate of the mount or if the tailshaft moves up but not down (mount bottomed out), replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the transmission or crossmember (Figure 8-1).

Transmission Shifting

If problems are encountered with the transmission shifting (upshift or downshift), refer to the appropriate shop manual for the diagnosis and adjustment procedures, or take the vehicle to a qualified service shop.

TRANSMISSION

APPENDIX 8-1 — TRANSMISSION FLUIDS AND COOLER TIPS

OIL TEMPERATURE MEASURED AT CONVERTER OUTLET TO COOLER

300°F is the maximum temperature. This is the normal place to install a temperature gage or signal. The temperature in this location will vary significantly with each vehicle start-up or hill. If the temperature reaches 300°F, reduce throttle. To lower the transmission temperature with the transmission in neutral, run the engine at 1,200 RPM for 2-3 minutes to cool the oil. Do not allow the converter outlet temperature to exceed 300°F. Keep a close check to prevent the engine cooling system from overheating. 300°F or higher would be typical of rocking the vehicle in mud, snow, or sand, or a transmission in stall (full throttle, no vehicle movement). When the transmission is in stall, the transmission will develop heat at a rate of one degree per second of stall.

OIL TEMPERATURES MEASURED IN THE SUMP OR OIL PAN

150°F—Minimum operating temperature. It is possible in low ambient temperature to overcool the transmission with oil to air-type coolers; it is hard to overcool if used in conjunction with oil to water coolers installed in most standard automotive radiators.

190°-200°F—Proper oil level checking temperature.

200°F—Maximum oil level checking temperature. Beyond this, readings are not reliable because of expansion.

285°F—Maximum sump/oil pan temperatures for short duration, such as a long hill climb.

300°F—Metal parts inside the transmission begin to warp and distort in varying degrees, seals melt rapidly, and transmission fluid life is extremely short due to oxidation and distress.

AUTOMATIC TRANSMISSION FLUID OXIDATION

Automatic transmission fluid can provide up to 100,000 miles of service before oxidation occurs under normal operating temperatures of about 170°F. Above normal operating temperatures, the oxidation rate doubles (useful life of the fluid is cut in half) with each 20 degree increase in temperature.

The approximate life expectancy at various temperatures is as follows:

DEGREES F	MILES
175	100,000
195	50,000
212	25,000
235	12,000
255	6,000
275	3,000
295	1,500
315	750
335	325
355	160
375	80
390	40
415	Less than 30 Minutes

Figure A8-1-1 — Transmission Fluid—Life Expectancy/ Temperature Relationship

This information shows why the various maintenance change intervals and/or oil coolers are recommended for severe usage.

AUTOMATIC TRANSMISSION FAILURE IMMEDIATELY AFTER SERVICING

If there was no known prior abuse, the new transmission fluid is not at fault. What has probably happened is that a certain amount of highly oxidized fluid remained in the transmission converter and cooler lines. The old fluid and new fluid will not mix. They settle out as sludge or varnish, causing valves to stick and/or plug oil passages and screens. When this happens, the transmission may malfunction or fail completely. The best way to prevent the problem is to follow the manufacturer's drain intervals for severe operating conditions such as trailer towing, mountain driving, and stop-and-go city driving.

AUTOMATIC TRANSMISSION FAILURE IMMEDIATELY AFTER OVERHAUL

Assuming proper workmanship and assembly, failure can often be caused by metal particles or clutch debris trapped in the oil circuit. Unless the converter, oil cooler, and cooler lines are thoroughly flushed during overhaul, the leftover contaminants will return through the cooler return lines to the transmission lube supply and cause a second failure. To prevent this, be certain all the transmission components, cooler lines, and cooler are cleaned prior to reassembly. **DO NOT TAKE SHORTCUTS.**

APPENDIX 8-1 — TRANSMISSION FLUIDS AND COOLER TIPS (CONT'D)

DEXRON VERSUS TYPE F TRANSMISSION FLUID

Type F fluid must never be used where a Dexron or Dexron II is specified. The difference in the fluids relates to their friction properties. GM transmissions are designed to shift smoothly with hardly a trace of shift feel which requires a low-static fluid such as Dexron II. On the other hand, transmissions that require Type F transmission fluid are designed to shift more harshly, providing more shift feel. Type F fluid is a highly static fluid, and provides more friction than Dexron. If Type F fluid is used in a GM-designed transmission, shifting will become more harsh. In turn, harsh shifts apply higher shock loads to components that weren't designed for high-shock loads, and transmission failure is almost certain. Clutch plate slippage will occur if Dexron is used in a Type F application.

DEXRON FLUID COLOR CHANGE AND STRONG ODOR

These two "tests" are **no longer** satisfactory criteria for recommending a fluid drain and refill. With the Dexron fluid, rapid loss of the red color and darkening of the new fluids is normal and **DOES NOT** affect their performance. Contrary to past performance, the service technician **should not consider a dark appearance or burnt odor** as the signal to change fluid. The only accurate method for determining a fluid's serviceability or effectiveness is through a laboratory analysis. Short of a laboratory analysis the owner's manual drain recommendation should be followed.

INSTALLATION OF A MANUAL WATER SHUT-OFF VALVE IN THE HEATER LINE

DO NOT install a manual water shut-off valve in the heater line. The heater water return is routed to the radiator outlet tank and continuous coolant flow is necessary to control oil temperatures during closed thermostat (warm-up) operation. (See Figure A8-1-2.) Shutting off this portion of the

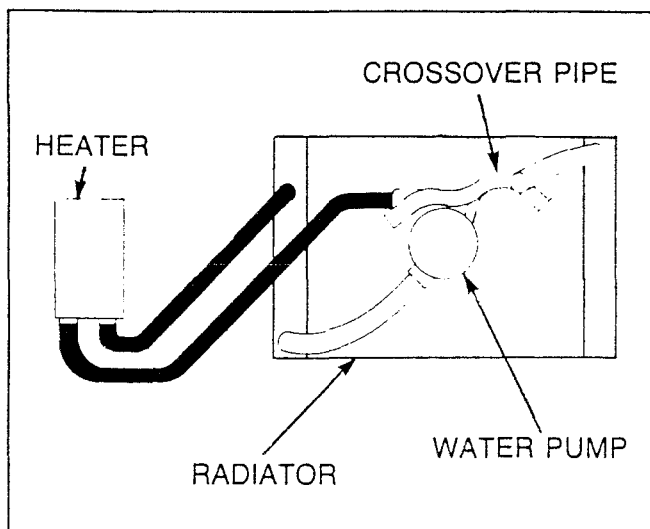


Figure A8-1-2 — Deaeration Cooling System

heater flow destroys the engine's deaeration system and may result in premature engine or transmission failure. A transmission warms up faster than the engine and it is not advisable to have the radiator transmission oil cooler exposed to air. A bubble cavitating in the engine water pump could cause engine hot spots. A water shut-off valve is permissible in the rear-seat heater line.

ADDING AN EXTERNAL OIL COOLER

Before adding an external oil cooler consideration should be given to many factors:

- Initial cost
- Need
- Potential extra leak points (For example: A tee added into the line is not one leak potential but three. A coupling provides two leak point possibilities—the cooler has two ends plus the cooler itself.)
- Lines have potential for fatigue and rubbing or chafing
- Quality of the installation.

The transmission dipstick itself might be considered a major factor for adding an external oil cooler. Current dipsticks have several dots at the low end of the operating range that would be a valid fluid level if checked cool at 65°-85°F. This low reading is normal since the level will rise as the fluid temperature increases. A level change of over 3/4 inch will occur as fluid temperature rises from 60° to 180°F. If starting with the lower dot and, after driving, the level did not go over the maximum high of the hash marks, an extra cooler would be difficult to justify. For this condition, all that's needed is to consider fluid and filter change intervals per the owner's manual dealing with severity of service. If in doubt, change the fluid and filter. If after heavy driving or trailer pulling, the fluid level rises above the hash marks, an external cooler may remove enough extra heat to help stay within the operating hash marks. (See Figure A8-1-3.)

With oil coolers, the hot oil enters the bottom of the cooler and the cooled oil exits out of the top of the cooler for better heat dissipation. This is the reverse of the engine radiator.

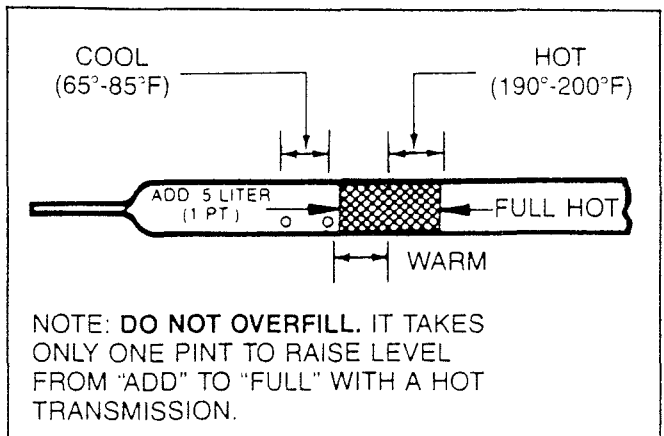


Figure A8-1-3 — Fluid Levels at Varying Temperatures

APPENDIX 8-1 — TRANSMISSION FLUIDS AND COOLER TIPS (CONT'D)

Overfilling can cause foaming and loss of fluid through the vent. With too much fluid, the gearing "churns" the fluid and produces aeration and foam, and reduces the fluid's cooling effectiveness. Slippage and clutch failure often

result. A low fluid level can result in causing pump cavitation and loss of main and lubrication oil pressures. This can result in slipping and clutch damage, particularly when cold or when on a hill. (See Figure A8-1-4.)

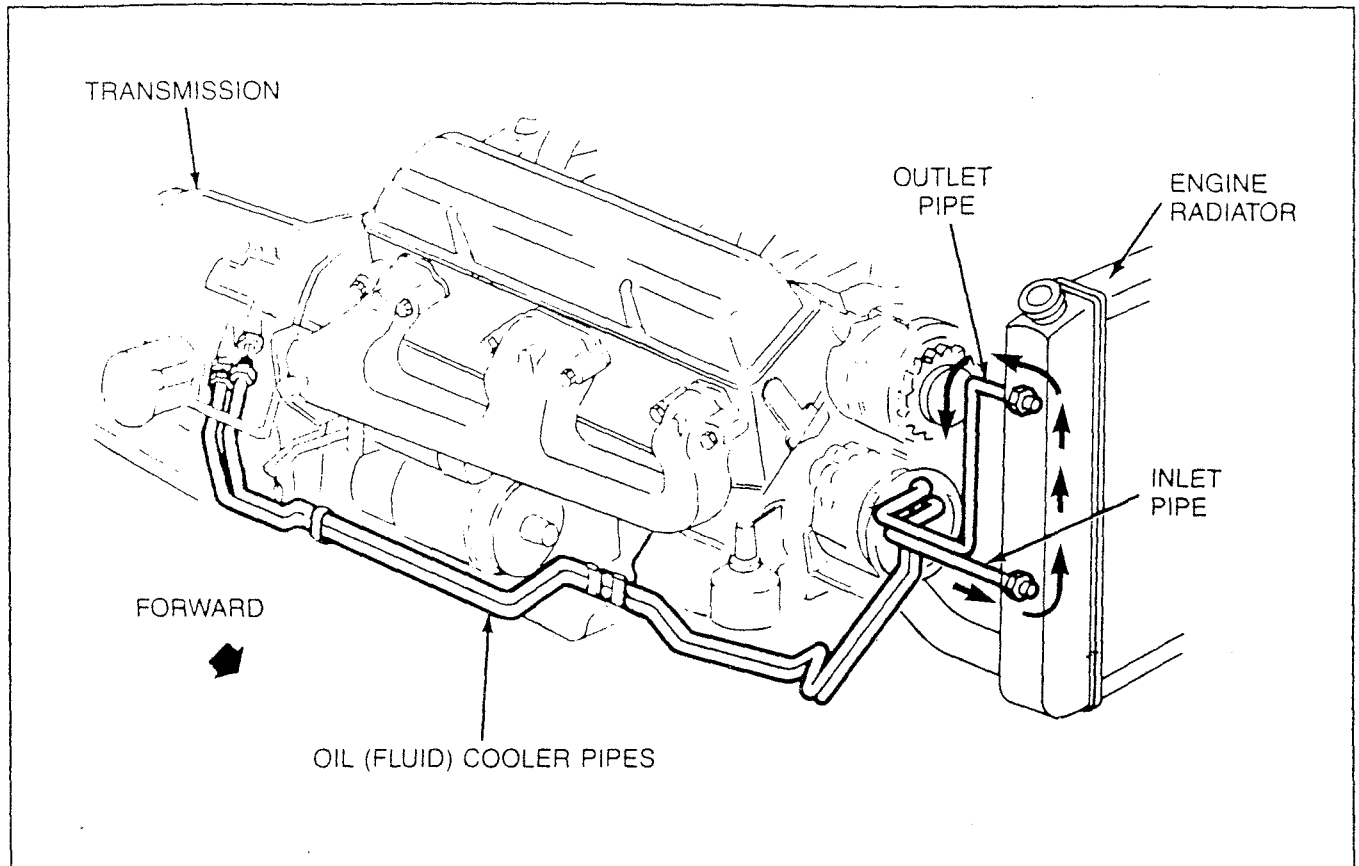


Figure A8-1-4 — Typical Oil Cooler Lines

NOTE: After-market transmission temperature gage should be installed in the lower (hot) oil line as viewed entering the radiator.

After-market external oil to air cooler should be installed in series with the GM transmission cooler installed in the radiator. The lower (hot) oil line should go first through the after-market oil to air cooler then returning into the lower fitting on into the GM radiator. This assures all of the oil must go through both coolers and will maintain proper minimum temperature of the transmission in low ambient temperatures.

After-market external filter should be installed in the lower (hot) oil line to prevent any debris from reaching the radiator cooler in the event of a transmission failure. If a external filter is to be installed in conjunction with a transmission failure and overhaul, it should be installed in the upper or cooled return oil line to prevent any metal particles or clutch debris trapped in the cooler from returning into the transmission lube supply.

TRANSMISSION

APPENDIX 8-2 — GEARED ROAD SPEED DETERMINATION

Geared road speed is the maximum theoretical speed of a vehicle based on engine RPM, transmission and axle gear ratios, and tire size. In actual use the vehicle may or

may not have enough horsepower to attain this speed. To determine geared road speed the formula is as follows:

GEARED ROAD SPEED = $\frac{\text{RPM} \times 60}{R \times M}$

RPM = Engine speed at selected Net Horsepower. (To determine maximum geared road speed use engine RPM where maximum horsepower is developed.)

R = Ratio. Transmission gear x axle ratio = R

M = Tire revolutions per mile.

Example: A truck with 8-19.5 tires (613 revolutions per mile). 5.83 axle ratio, 4.8 liter (292) engine (3,400 RPM)

$\frac{3,400 \times 60}{5.83 \times 613} = \frac{204,000}{3,574} = 57 \text{ MPH}$

NOTE: See the Wheel and Tire section of this manual for typical motor home tire revolutions per mile. Nonlisted tire size revolutions per mile can be obtained from local tire dealer catalogs.

AUTOMATIC											
Model & RPO Number		200 MXI		350 MXI		400 MXI		475 MXI		700R4 MXO	
Torque Converter		Lock-up	Break-away	Lock-up	Break-away	Lock-up	Break-away	Lock-up	Break-away	Lock-up	Break-away
Gear Ratios	First	2.74	6.08	2.52	5.29	2.48	5.70	2.48	5.46	3.06	6.73
	Second	1.57	3.49	1.52	3.19	1.48	3.40	1.48	3.26	1.63	3.58
	Third	1.00	2.22	1.00	2.10	1.00	2.30	1.00	2.20	1.00	2.20
	Fourth	—	—	—	—	—	—	—	—	.70	1.50
	Reverse	2.07	4.60	1.94	4.07	2.10	4.83	2.10	4.62	2.29	5.03

Figure A8-2-1 — Geared Road Speed Formulas

NOTE: Typical Class A motor home will be equipped with a model 475 transmission. Typical Class C will be equipped with a 350 transmission.

As shown in the above chart, the breakaway ratio includes the transmission torque converter ratio. For example: In the 475 transmission, the mechanical first speed gearing is 2.48 to 1 times the torque multiplication of the torque converter ratio of 2.20 to 1, which equals the breakaway ratio of 5.46. Breakaway is shown in third gear primarily to show converter ratio. Third gear at normal road speeds can be considered a 1 to 1 ratio.

NOTE: For best engine life and economy an engine should cruise at a continuous 80% to 90% of rated RPM. Shift points at rated RPM are acceptable. (Figure A8-2-2.)

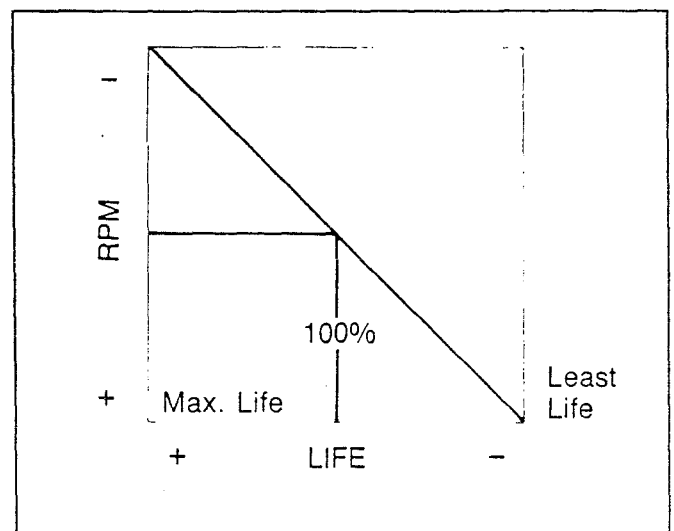


Figure A8-2-2 — Engine Speed vs. Rated Life Expectancy

TRANSMISSION

APPENDIX 8-3 — CHECKING GEAR RATIOS SINGLE DRIVE AXLES

The method outlined below may be used whenever it is desirable to check or verify the gear ratio of a rear axle. Two-speed axles may be checked by repeating the procedure in both high and low axle ratios.

1. Jack up a drive wheel on one side of the vehicle. Shift the transmission into neutral.
2. Mark the pinion flange or yoke of the drive unit at some convenient reference point. Mark the tire of the drive wheel that is off the ground. Turn this drive wheel two complete revolutions noting the number of revolutions of the marked pinion flange or yoke. The number of revolutions of the pinion flange or yoke indicates the gear ratio of this axle. For example:

Two revolutions of the drive wheel and $7\frac{2}{3}$ (7.66) revolutions of the flange or yoke means the gear ratio of this axle is 7.66:1.

When only one drive wheel is free to turn, the action of the differential gear assembly requires that the drive wheel be given two complete revolutions to obtain the proper gear ratio by this method.

You could expect as a typical Class A or C motor home 4.10, 4.56 or 4.88 axle ratios.

APPENDIXES

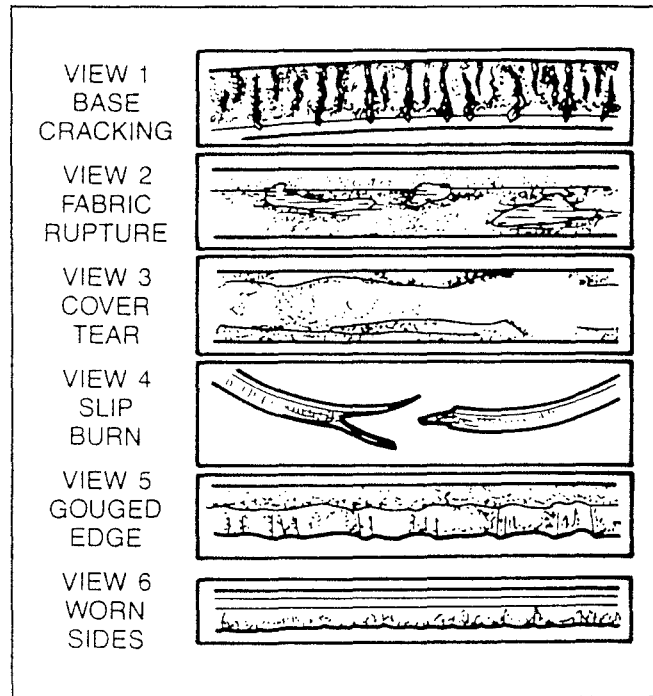
APPENDIX 1 — DRIVE BELTS AND TENSION SPECIFICATIONS

Proper care and maintenance of drive belts is an important part of good engine maintenance. Proper belt tension and the condition of the pulley grooves are of primary concern.

Since belts and pulleys wear with use, look at all frictional surface areas for signs of wear. Normal wear can be recognized as even wear, both on the belt and the grooves of the pulley. It is the unusual signs of wear that indicate some corrective action is necessary.

When checking, remember failed or partially failed belts shown to be defective may have been damaged by a bad pulley, a misaligned drive or by some faulty mechanical component.

UNUSUAL WEAR CONDITIONS



BASE CRACKING

Excessive cross-checking (View 1) extending into the rubber on the base of a belt and showing little or no side wear indicates that it must be replaced. Small cracks only in the cover material do not indicate belt failure.

If the belt fails after three or four seasons of use, the belt should not be classified as being defective. However, if the base of the belt also shows cross-checking, the belt has been exposed to weather to the extent that the inner fabric is beginning to rot.

FABRIC RUPTURE

A fabric rupture (View 2) can be caused by operating a belt over a badly worn pulley, by too much tension which forces the belt down into the groove, or by foreign objects falling into the pulley groove while the drive is operating.

COVER TEAR

A tear in the cover of a belt (View 3) is normally a result of the belt accidentally coming into contact with some part of the application. It is no fault of the belt or its construction.

Cover tears are usually caused by belts running too loosely allowing them to "throw-out" centrifugally and rub other parts of the application. Proper belt tension will prevent this from happening.

NOTE: A slight raveling of the belt covering at the splice location does not indicate imminent belt failure. Simply cut off loose raveling.

SLIP BURN

This belt (View 4) was ruined by operating too loosely. The belt slipped under load. And when it finally grabbed, it snapped.

Proper belt tension would have avoided this failure.

GOUGED EDGE

A gouged edge in a belt (View 5) can be caused by a damaged pulley or interference with some part of the application.

Check the condition of the pulley. Make sure the belt does not rub on any part of the application while operating.

WORN SIDES

Badly worn belt sides (View 6) result from long operation without enough tension. The sides will be worn and slightly burned around the entire circumference.

Check for proper belt tension. Also check the pulleys for incorrect alignment.

APPENDIX 1 — DRIVE BELTS AND TENSION SPECIFICATIONS (CONT'D)

DEFECTIVE BELTS EXCESSIVE STRETCH

A belt that stretches excessively is one that stretches beyond the adjustment provided to take up normal belt stretch.

LUMPY BELTS

Lumpy belts usually occur and are more noticeable on variable speed drives and other high-speed belt installations. The result is excessive vibration. If belts are not relieved of tension while the engine or vehicle is stored, they will often cause temporary vibration upon start-up. Give them time to straighten out.

INTERNAL CORD FAILURE

Failure of one or more of the internal tension cords will result in the belt rolling out of the pulley groove. Cords can be broken by prying the belt over the pulley.

IMPROPER LENGTH

It is possible that an improper length belt could accidentally be installed on an engine. Always check to be certain that the belt length is correct before the belt is installed.

BELT INSTALLATION

Use the following procedure when installing new belts:

1. Move the belt tension adjustment to the position where it provides the most slack. In some cases it may be necessary to remove the accessory to install the belt.

2. Examine pulleys for chips, cracks, bent sidewalls, rust, corrosion or other damage.
3. Check pulley alignment.
4. Place belts in the pulley grooves by hand.

NOTE: Never pry or force a belt onto the pulley with a screwdriver, crowbar, wedge, etc., since both belt and drive can be damaged.

BELT REPLACEMENT

Here are a few service tips for replacing belts.

REPLACE BELTS IN MATCHED SETS

Never replace just one belt on a 2-groove, single pulley set-up.

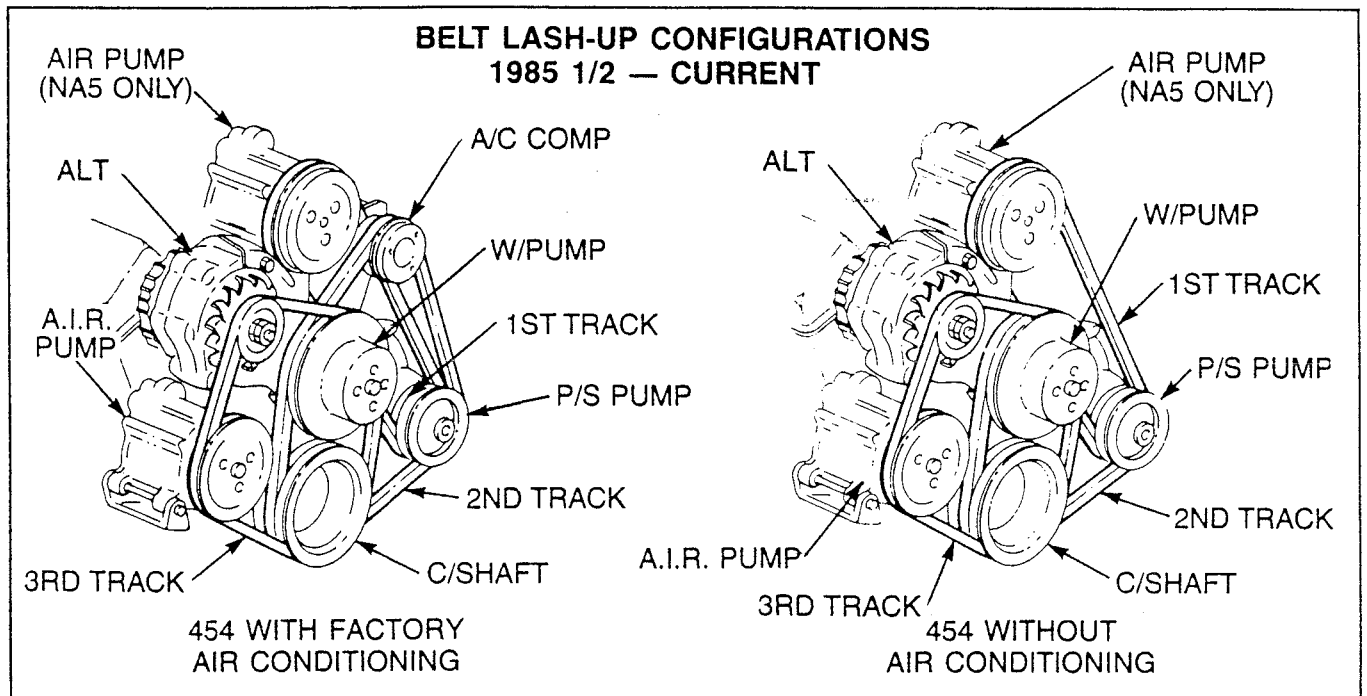
Never install only one belt from a different set of matched belts. Install a complete, matched belt set.

CHECK CONDITION OF PULLEYS

Always check the condition of pulleys before replacing belts. Inspect the pulleys for chips, cracks, bent sidewalls, rust, corrosion, etc. Replace any pulleys found to be defective.

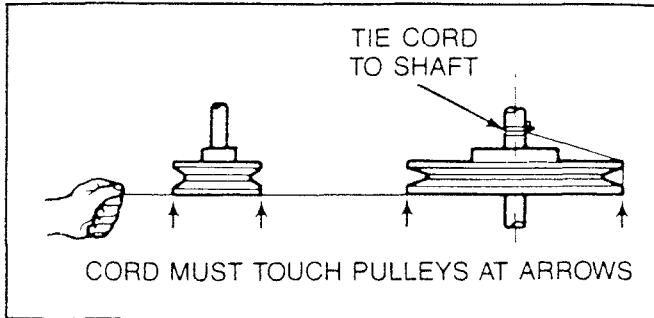
CHECK PULLEY ALIGNMENT

Misaligned pulleys result in shortened belt life. Check the alignment between pulleys as follows:



APPENDIX 1 — DRIVE BELTS AND TENSION SPECIFICATIONS (CONT'D)

1. Position a straightedge or cord line to touch both pulleys at all points. The shafts must be parallel.
2. Rotate each pulley a half revolution and note whether the contact of either pulley with the straightedge or cord line is disturbed. If so, this indicates a bent shaft or warped pulley.



BELT TENSION ADJUSTMENT

To carry their full load, belts must grip the entire area of contact with the pulley. When operated too loosely, belts can slip, heat, burn, or grab and snap. More belts fail from under-tightening than from overtightening.

When operated too tightly, belts can damage the engine by causing side loading on the crankshaft, crankshaft bearings, and accessory bearings. Excess tension also stretches and weakens belts.

Proper Belt Tension (V-Belts): When installing V-belts, keep the following in mind:

Adjust the belt tension so that a firm push with the thumb at a point midway between two pulleys will depress the belt no more than ¼-inch (Chevrolet engine). If a V-belt tension gage is available, adjust the belt tension as outlined in the belt tension chart below.

ALL V8 ENGINES EXCEPT DIESEL		
Alternator A.I.R. Pump P/S Pump	50 Lb. Min.	Adjust to 75 ± 5 Lbs. Used Adjust to 125 ± 5 Lbs. New
A/C Compressor	65 Lb. Min.	Adjust to 95 ± 5 Lbs. Used Adjust to 140 ± 5 Lbs. New
6.2L — V8 DIESEL		
Alternator P/S Pump	70 Lb. Min.	Adjust to 75 ± 5 Lbs. Used Adjust to 110-140 Lbs. New
A/C Compressor	80 Lb. Min.	Adjust to 90 ± 5 Lbs. Used Adjust to 135-165 Lbs. New

NOTE: When installing or adjusting accessory drive belts, be sure the bolts in the accessory adjusting pivot point and in the adjusting slot are tightened properly.

New drive belts will stretch after the first few hours of operation. Run the engine for 15 seconds to seat the belts, then check belt tension again. Retighten fan drive, pump drive and battery-charging alternator drive belts after ½ hour or 15 miles and again after 8 hours or 240 miles of operation. Thereafter, check the tension of the drive belts every 200 hours or 6,000 miles and adjust them if necessary.

Belt tension tools such as those shown in the Steering, Suspension, Wheels and Tires section of this manual (see Figure 3-9) are available from several tool manufacturers, as listed below:

No. J-23600

Manufacturer:
Kent Moore Tool Division
28635 Mound Road
Warren, Michigan 48092

No. BT-7825

Manufacturer:
Boroughs Tool and Equipment Company,
2429 North Burdick Street,
Kalamazoo, Michigan 49007-1897

No. 91107

Manufacturer:
Gates Rubber Company
999 South Broadway
Denver, Colorado 80217

DO NOT USE BELT DRESSING

Belt dressing is not recommended for belts at any time. Most dressings contain chemicals which tend to soften belts. While this softening process does increase the friction between the belt and pulley grooves, the result is only temporary.

BELT CLEANING INSTRUCTIONS

Remove all grease and oil as quickly as possible before they can penetrate the belt and cause deterioration.

Clean the belts by wiping them with a clean cloth. Use a nonflammable cleaner or solvent to remove excess grease and oil. Water and a detergent soap can also be used, but they are not as satisfactory as a nonflammable cleaner.

CAUTION: TO REDUCE THE RISK OF PERSONAL INJURY, DO NOT ATTEMPT TO CLEAN THE BELTS WHILE THE ENGINE IS RUNNING AND NEVER USE FLAMMABLE CLEANING SOLVENTS!

APPENDIX 1 — DRIVE BELTS AND TENSION SPECIFICATIONS (CONT'D)

APPLICATION CHART — BELTS & HOSES for P-30 (32) Series Motor home with 454 CID Engine

Year	Remarks	Part No.
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Fan Belt, Alternator Belt

1979-85		9433752
1985 1/2	Poly V, 6 Rib 55.98 inches (1422.0 mm)	14087540 (Production No. & Service No.)

Power Steering Pump Belt

1979-85	Without A/C	9433745
1985 1/2	Without A/C .47 inch x 45.5 inches	14087507 (Production No.) 10034695 (Service No.)
1985 1/2	With A/C, Hi Ride 3/8 inch x 41 inches GM Code: XL	14082454 (Production No.) 9433735 (Service No.)

A.I.R. Pump Belt

1985 1/2	With and Without A/C All Federal Jobs, Hi Ride .47 inch x 45.00 inches GM Code: CNA	14092344 (Production No.) 10034695 (Service No.)
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Air Conditioning Belt (GM-ARA)

1985 1/2	Hi Ride 3/8 inch x 60.5 inches GM Code: GA	15598439 (Production No.) 14033869 (Service No.)
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Year	Remarks	Part No.
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Radiator Hose

73-81	Upper Hose Vertical Radiator 350 Engine 1 1/2 ID Ident 6259952	6259952
73-81	Upper Hose Vertical Radiator 454 Engine 1 1/2 ID Ident 6259953	6259953
82-86	Upper Hose Horizontal Radiator 454 Engine Varies by Model & Option	14049401 15599363
83-86	Upper Hose Horizontal Radiator 6.2 Diesel	14049497
73-81	Lower Hose Vertical Radiator 350 and 454 Engine 1 3/4 ID Ident 343414	343414
82-	Lower Hose Horizontal Radiator 350 Engine Same as 73-81 Vertical Radiator	343414
82-86	Lower Hose Horizontal Radiator 454 Engine	14049500
82-86	Lower Hose Horizontal Radiator 6.2 Diesel Varies by Model/Option	14042372 14049500

APPENDIX 2 — PREPARING THE MOTOR HOME FOR STORAGE

Special consideration may be required when conditions of high humidity, extreme temperatures or outdoor storage are encountered. Local experience will dictate any additional protective measures for such conditions.

- Check battery/batteries and inspect test hydrometer on Delco Freedom or maintenance-free batteries and charge if green dot is not visible to avoid freezing and deterioration. Both battery cables should be disconnected at the battery/batteries to prevent gradual discharge, and the possibility of fire due to short circuits. On conventional batteries, check electrolyte specific gravity and charge if below 1.255.
- Fill gasoline tank/tanks as full as possible to limit condensation buildup.
- Keep chassis windows closed. Make sure all covers are in place.
- Remove trees in parking area to eliminate potential damage from tree sap or bird droppings. Remove high weed growth which affects paint by attracting insects or causes stains.
- Rinse, wash and wipe horizontal surfaces of motor home at least once per week when stored outside to remove accumulations which settle on flat surfaces.
- Leave parking brake in "OFF" position.
- Unit should be parked on level surface or with front of chassis higher than rear if level surfaces are not available. This is to prevent gasoline draining into engine over a long period causing possible damage to engine by "hydrostatic lock" when started.
- Check engine coolant and, if necessary, increase antifreeze.
- Check and secure all caps to prevent water, snow and dirt from entering engine.
- Check and keep tires inflated to recommended tire pressure.
- Remove windshield wiper arms and blades and store in vehicle.
- Start and run engine until completely warm. Drain engine oil and replace filter element, refill with fresh oil. If vehicle is equipped with air conditioning, the unit should be operated during this final engine warm-up to lubricate compressor seal.

- **Gasoline Engines Only** — After the oil has been replaced, remove air cleaner and pour ½ to 1 pint of 10W or lighter oil into carburetor air intake with engine running. Pour slowly at first, then rapidly using last quarter to stall engine. Replace air cleaner.

REACTIVATING VEHICLE AFTER EXTENDED STORAGE

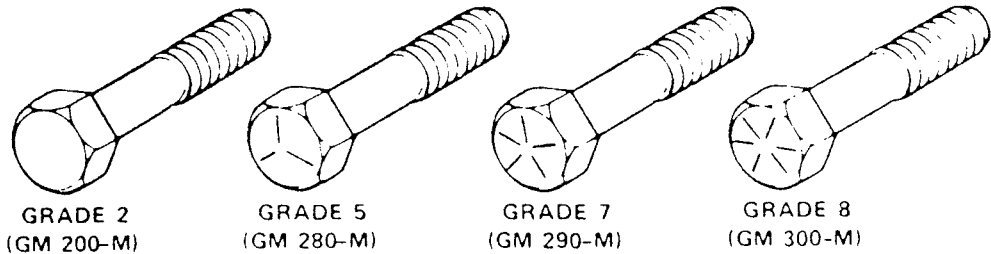
- Check oil and fluid levels and replenish as necessary in the following components: engine, radiator, crankcase, transmission and differential. Check gasoline supply. If the vehicle is equipped with air conditioning, refer to the procedure which follows below.
- Check under hood and under vehicle for nesting creatures and evidence of leakage of oils or fluids or physical damage.
- Inflate tires to recommended pressure.
- Clean battery end of cables and install fully charged battery.
- Lubricate chassis suspension and steering components.
- Check brake operation and fluid level. Bleed and adjust brakes if necessary.
- Remove spark plugs and clean and gap (gasoline engines).
- Check and clean carburetor air filter assembly.

IF VEHICLE IS EQUIPPED WITH AIR CONDITIONING

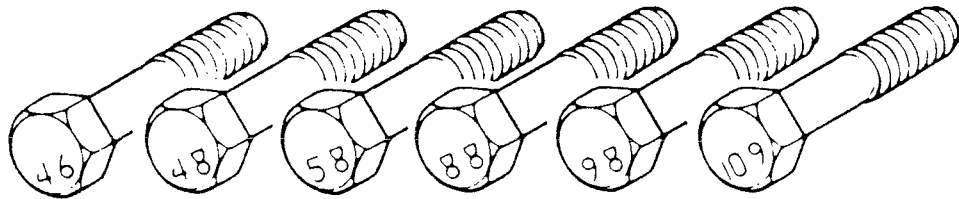
- Disconnect the compressor clutch wires before attempting to start vehicle.
- Check to see if compressor hub and clutch driver can be turned by hand. If not, the unit should be broken loose by manually turning the shaft with a wrench on the shaft lockout on the clutch driver plate. A few "rocking" turns should be sufficient so that the shaft can be turned by hand.
- Reconnect coil wires and check belt tension. Run engine with air conditioning on for a minute or two to reseat system.
- Check the refrigerant. This can be done by checking for air bubbles in the sight glass on the top of the receiver-dehydrator (on vehicles so equipped).

APPENDIX 3 — BOLT AND NUT IDENTIFICATION

Common metric fastener strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grade 2 to 8 with line identification embossed on each bolt head. Markings correspond to two lines less than the actual grade (i.e. grade 7 bolt will exhibit 5 embossed lines on the bolt head). Some metric nuts will be marked with single-digit strength identification numbers on the nut face. The following figure illustrates the different strength markings.



Customary (inch) bolts - Identification marks correspond to bolt strength - Increasing numbers represent increasing strength.

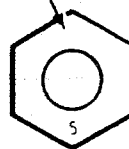


Metric Bolts - Identification class numbers correspond to bolt strength - Increasing numbers represent increasing strength.

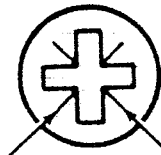
MANUFACTURERS
IDENTIFICATION



NUT STRENGTH
IDENTIFICATION



POSIDRIV
SCREW HEAD



IDENTIFICATION MARKS (4)

APPENDIX 4 — WEIGHT DISTRIBUTION AND HELPFUL CONVERSIONS

Weight distribution of any special equipment item can be determined if the centerline (CL) or the center of gravity point is known in relation to the centerline of the axle. Once this dimension is known, divide this dimension by the wheelbase dimension.

The same rule applies if the centerline or center of gravity point is outside the wheelbase (such as a liftgate, snowplow or front-mounted winch).

Determine the distance from the closest axle and divide by the wheelbase. When the center of gravity point is outside the wheelbase, it results in negative weight distribution. In other words, the total amount of weight outside the axle is added to the closest axle plus the amount of weight that is taken off the opposite axle.

As an example, the body-payload weight distribution might be 9/91% for a 14-foot body with a 167-inch WB (wheelbase)—102-inch CA (cab-to-axle).

Substituting the correct figures in the formula would result in the following:

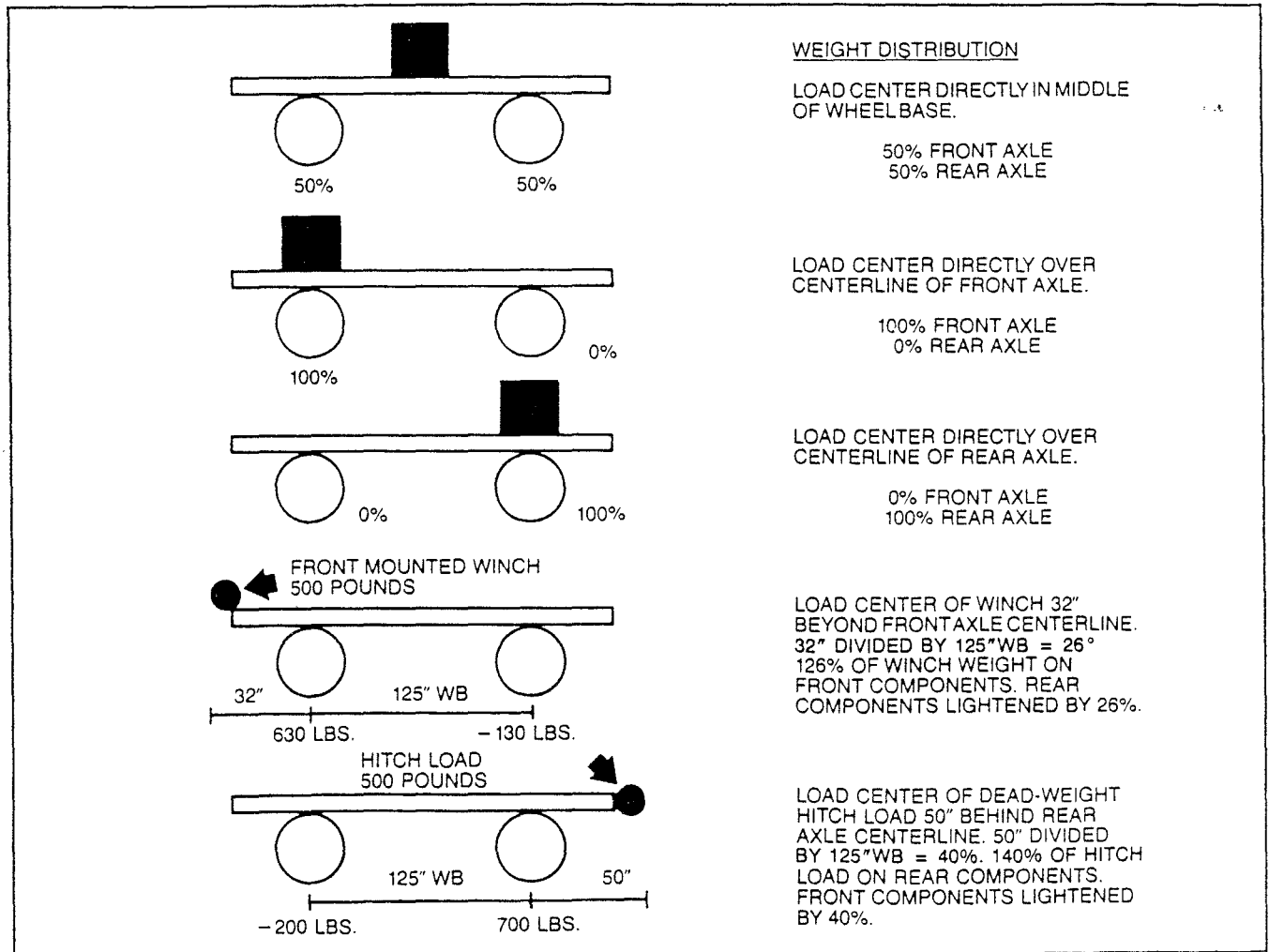
$$\frac{102 - 3 - 84}{167} = \frac{15}{167} = 8.98 \text{ or } 9\%$$

9% front, 91% rear

The 15" listed above means that the centerline (CL) of the body is 15" forward of the centerline (CL) of the rear axle.

Examples of weight distribution showing various factors appear on the following chart.

WEIGHT DISTRIBUTION FACTORS



APPENDIX 4 — WEIGHT DISTRIBUTION AND HELPFUL CONVERSION (CONT'D)

HELPFUL CONVERSIONS AND CONSTANTS

MULTIPLY	BY	TO OBTAIN
Gallons	231.0	Cubic Inches
Gallons	3.785 4	Liters
Cubic Feet	1728.0	Cubic Inches
Cubic Feet	7.480	Gallons

1 Cubic foot = 7.4805 Gallons
 1 Cubic foot = 1728 Cubic Inches
 Pi = 3.1416

To Determine
VOLUME OF A CYLINDER = Pi times radius squared times length or height.
 Most RV hot water tanks are 6 gallons, figure 50 to 55 pounds to include water in the plumbing.
 Propane tanks are never filled more than 80% by law to allow 20% expansion chamber for temperature changes.

To Determine
VOLUME OF A BOX = Length times height times depth.

To Determine
WEIGHT DISTRIBUTION INSIDE WHEELBASE = Number of inches behind front wheel divided by wheelbase. Example 36" divided by 178" wheelbase equals 20% weight added to rear wheels, 80% to front axle.

WEIGHT DISTRIBUTION OUTSIDE WHEELBASE = Determine the distance from the closest axle and divide by the wheelbase. Example, a hitch 144" behind the axle divided by wheelbase of 178" equals 80% or 180% of hitch load on rear axle, the excess over 100% being removed from the front axle.

Typical Weights

Water	8.328 pounds per gallon
Diesel fuel	7.0 pounds per gallon
Gasoline fuel	6.0 pounds per gallon
Propane C ₃ H ₈	4.23 pounds per gallon

APPENDIX 4 — WEIGHT DISTRIBUTION AND HELPFUL CONVERSION (CONT'D)

METRIC — ENGLISH CONVERSION TABLE

MULTIPLY	BY	TO GET EQUIVALENT NUMBER OF:	MULTIPLY	BY	TO GET EQUIVALENT NUMBER OF:
LENGTH					
Inch	25.4	millimeters (mm)	Foot/sec ²	0.304 8	meter/sec ² (m/s ²)
Foot	0.304 8	meters (m)	Inch/sec ²	0.025 4	meter/sec ² (m/s ²)
Yard	0.914 4	meters (m)	TORQUE		
Mile	1.609	kilometers (km)	Inch pound	0.112 98	newton-meters (N•m)
AREA			Foot pound	1.355 8	newton-meters
Inch ²	645.2	millimeters ² (mm ²)	POWER		
	6.45	centimeters ² (cm ²)	Horsepower	0.746	kilowatts (kw)
Foot ²	0.092 9	meters ² (m ²)	PRESSURE OR STRESS		
Yard ²	0.836 1	meters ² (m ²)	Inches of water	0.249 1	kilopascals (kPa)
VOLUME			Pounds/sq. in.	6.895	kilopascals (kPa)
Inch ³	16 387.	mm ³	ENERGY OR WORK		
	16.387	cm ³	BTU	1 055.	joules (J)
	0.016 4	liters (l)	Foot pound	1.355 8	joules (J)
Quart	0.946 4	liters (l)	Kilowatt-hour	3 600 000.	joules (J = one W's)
Gallon	3.785 4	liters (l)		or 3.6 x 10 ⁶	
Yard ³	0.764 6	meters ³ (m ³)	LIGHT		
MASS			Foot candle	1.076 4	lumens/meter ² (lm/m ²)
Pound	0.453 6	kilograms (kg)	FUEL PERFORMANCE		
Ton	907.18	kilograms (kg)	Miles/gal	0.425 1	kilometers/liter (km/l)
Ton	0.907	tonne (t)	Gal/mile	2.352 7	liters/kilometer (l/km)
FORCE			VELOCITY		
Kilogram	9.807	newtons (N)	Miles/hour	1.609 3	kilometers/hr. (km/h)
Ounce	0.278 0	newtons (N)			
Pound	4.448	newtons (N)			
TEMPERATURE					
Degree Fahrenheit (F)	-32 ÷ 1.8 =	degree Celsius (C)			

