X-7725

1977 AND 1978 MAINTENANCE MANUAL SUPPLEMENT

MOTORHOME

ZE06581, ZE06584

TRANSMODE

ZE06083, ZE06583

When reference is made in this manual to a brand name, number, or specific tool, an equivalent product may be used in place of the recommended item.

GMC

GMC TRUCK & COACH
DIVISION OF GENERAL MOTORS CORPORATION
PONTIAC, MICHIGAN 48053

Printed in U.S.A.

TABLE OF CONTENTS

SECTION O

GENERAL INFORMATION, PERIODIC MAINTENANCE, AND LUBRICATION

The information described in Maintenance Manual X-7525 (SECTION 0) is applicable to Models covered by this manual with the exception of the following:

CONTENTS

VEHICLE IDENTIFICATION NUMBER

Figure 1 is an explanation of the Vehicle Identification Number (VIN) for the models covered by this supplement. The VIN plate is located behind the right front access door. The VIN also appears on the Vehicle Certificate of Title and Registration.

(TYPICAL IDENTIFICATION NUMBER TZE167V100053)

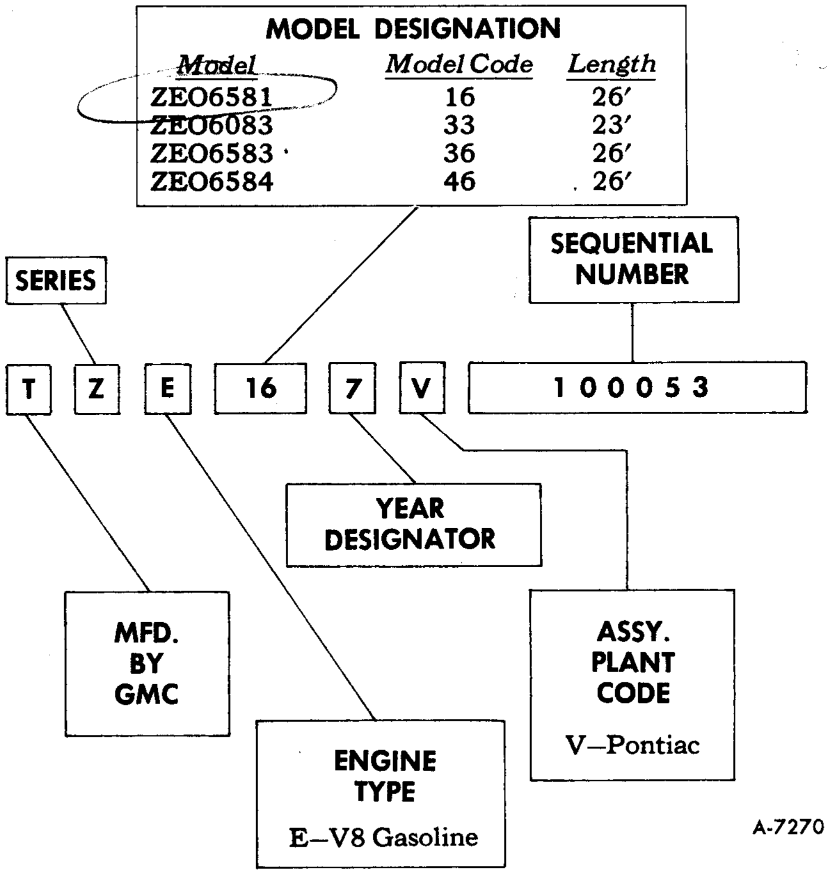


Figure 1—Vehicle Identification Number

ENGINE, CHASSIS, AND BODY MAINTENANCE SCHEDULE

LUBE AND GENERAL MAINTENANCE

When To Perform Services (Months or Miles, Whichever Occurs First)	Item No.	Services (For Details, See Numbered Paragraphs)
Every 3 months or 3,000 miles (4 800 km)	1	Chassis Lubrication
	2	Engine Oil–Change
	3	Air Compressor Wet Tank–Drain (If so equipped)
Every 6 months or 6,000 miles (9 600 km)	4	Fluid Levels–Check
	5	Air Conditioning–Check
	6	Air Compressor Air Filter-Clean (If so equipped)
Every 6,000 miles (9 600 km) (Check wheel nut torque after 1st 500 miles) (800 km)	7	Tire Rotation
At 1st oil change-then every 2nd	8	Engine Oil Filter-Replace
Every 12 months or 12,000 miles (19 200 km)	9	Automatic Transmission Fluid and Final Drive Lubricant-Change
	10	Cooling System-See Explanation of Maintenance Schedule
Every 24,000 miles (38 400 km)	11	Rear Wheel Bearings-Clean and Repack. 1978 Vehicles, Front Wheel Bearings-Clean and Repack
	12	Final Drive Boots & Output Shaft Seals-Check

SAFETY MAINTENANCE

Every 6 months or 6,000 miles (9 600 km)	13	Owner Safety Checks
	14	Tires, Wheels, & Disc Brakes-Inspection
	15	Exhaust System–Check
	16	Suspension and Steering–Check
	17	Brakes and Power Steering–Check
Every 12 months or 12,000 miles (19 200 km)	18	Engine Drive Belts–Check
	19	Drum Brakes and Parking Brake–Check
	20	Throttle Linkage–Check
	21	Underbody Flush & Check

EMISSION CONTROL MAINTENANCE
(1977 CERTIFIED 455 CUBIC INCH ENGINE)*

At 1st 6 months or 6,000 miles, (9 600 km) then at 12 month/12,000 mile (19 200 km) intervals thereafter	22	Thermostatically Controlled Air Cleaner–Check
	23	Carburetor Choke–Check
	24	Engine Idle Speed and Mixture Adjustment
	25	Carburetor and Intake Manifold Mounting Torque
Every 6,000 miles (9 600 km)	26	Spark Plug Replacement
Every 12 months or 12,000 miles (19 200 km)	27	Carburetor Fuel Filter Replacement
	28	Thermal Fuel Filter Replacement
	29	PCV System Check
	30	Air Cleaner Element Replacement
	31	Spark Plug Wires–Check
	32	Engine Timing Adjustment & Distributor–Check
Every 24 months or 24,000 miles (38 400 km)	33	ECS System Check & Filter Replacement
	34	Fuel Cap, Tanks and Lines–Check

ENGINE, CHASSIS, AND BODY MAINTENANCE SCHEDULE

EMISSION CONTROL MAINTENANCE
(1977 AND 1978 CERTIFIED 403 CUBIC INCH ENGINE)*

At 1st 3,000 miles (4 800 km)	35	Carburetor Mounting Torque
At 3,000 miles (4 800 km), 12,000 miles (19 200 km) then at 12,000 mile (19 200 km) mile intervals	36	Idle Speed Adjustment
Every 12 months or 12,000 miles (19 200 km)	37	Thermostatically Controlled Air Cleaner—Check
	38	Carburetor Choke—Check
	39	Carburetor Fuel Filter—Replace
	40	PCV System—Check
	41	Spark Plug Wires—Check
	42	Air Cleaner Element—Replace
	43	Thermal Vacuum Switch & Hoses—Check
	44	Throttle Return Control—Check
	45	Engine Timing Adjustment & Distributor Check
	46	Carburetor Vacuum Break Adjustment **
Every 12,000 miles (19 200 km)	47	Spark Plugs—Replace
Every 24 months or 24,000 miles 38 400 km)	48	ECS System Check & Filter Replace
	49	Fuel Cap, Tank & Lines—Check

* To determine year engine was certified, refer to emission control decal on engine valve cover.

** 1978 Certified 403 engine ONLY

EXPLANATION OF MAINTENANCE SCHEDULE

Presented below is a brief explanation of each of the services listed in the Maintenance Schedule.

NORMAL VEHICLE USE—The maintenance instructions contained in this maintenance schedule are based on the assumption that the vehicle will be used as designed:

- To carry passengers and cargo within the limitations indicated on the Vehicle Identification Number plate, located behind the right front access door.
- On reasonable road surfaces within legal operating speeds.
- On unleaded or regular grade leaded gasoline.

Unusual operating conditions will require more frequent vehicle maintenance as specified in the respective sections included below.

LUBE AND GENERAL MAINTENANCE

1. CHASSIS—Lubricate all grease fittings in front and rear suspension and steering linkage. Also lubricate transmission shift linkage, brake pedal spring, parking brake cable guides and linkage.

2. ENGINE OIL—Change each 3 months or 3,000 miles (4 800 km), whichever occurs first.

3. AIR COMPRESSOR WET TANK—Drain the wet tank (if so equipped) at 3 month or 3,000 mile intervals (4 800 km).

NOTE: More frequent drain intervals should be made if driving conditions and habits result in excessive air compressor operation.

4. FLUID LEVELS—Check level of fluid in brake master cylinder, power steering pump, all batteries, engine, final drive, transmission, and windshield washer. The engine coolant should be checked for proper level and freeze protection to at least $-20^{\circ}F$ ($-29^{\circ}C$) or to the lowest temperature expected during the period of vehicle operation. Proper engine coolant also provides corrosion protection.

Any significant fluid loss in any of these systems or units could mean that a malfunction is developing and corrective action should be taken immediately. A low fluid level in the brake master cylinder front reservoir could also be an indicator that the disc brake pads need replacing.

5. AIR CONDITIONING—Check condition of automotive air conditioning system hoses and refrigerant charge at sight glass. Replace hoses and/or refrigerant if need is indicated. If equipped with roof mount air conditioner(s), clean filter(s).

6. AIR COMPRESSOR—Filter (if so equipped) should be washed with soap and water solution or replaced.

7. TIRES—To equalize wear, rotate tires and adjust tire pressures. Have wheel-nut torque checked after 1st 500 miles and 500 miles (800 km) after every wheel replacement thereafter.

8. ENGINE OIL FILTER—Replace at the first oil change and every 2nd oil change thereafter.

9. AUTOMATIC TRANSMISSION FLUID AND FINAL DRIVE LUBRICANT—Change the transmission fluid and filter; change final drive lubricant. Under unusual conditions such as heavy traffic (stop and go driving) during hot weather or where the engine idles for long periods, the transmission fluid should be changed at 6,000 mile intervals (9 600 km).

10. COOLING SYSTEM—At 12-month or 12,000-mile intervals (19 200 km), wash radiator cap and filler neck with clean water, pressure test system and radiator cap for proper pressure holding capacity. (Tighten hose clamps and inspect condition of all cooling and heater hoses.) Replace hoses if checked, swollen or deteriorated.

Also each 12 months or 12,000 miles (19 200 km), clean exterior of radiator core and air conditioning condenser. Every 24 months or 24,000 miles (38 400 km), drain, flush, and refill the cooling system with a new coolant solution.

11. WHEEL BEARINGS—Clean and repack wheel bearings with lubricant specified in the "Recommended Fluids and Lubricants" chart.

12. FINAL DRIVE AXLE BOOTS AND OUTPUT SHAFT SEALS—Check for damaged, torn or leaking boots on drive axles and for leaking output shaft seal. Replace defective parts as necessary.

SAFETY MAINTENANCE

13. OWNER SAFETY CHECKS—The maintenance schedule folder in the glove box lists several items the owner should check and have repaired if not correct.

14. TIRES, WHEELS AND DISC BRAKES—Check disc brake pads for wear and surface condition of rotors while wheels are removed during tire rotation. Check tires for excessive wear or damage. Make certain wheels are not bent or cracked and that wheel nuts have been tightened to the specified torque value. Check tire inflation pressure (including the spare tire) when the tires are "cold" at least monthly, or more often if daily visual inspection indicates the need.

15. EXHAUST SYSTEM—Check complete exhaust system and nearby body areas of vehicle engine and motor-generator system for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the passenger compartment may be an indication of a problem in one of these areas. Any necessary corrections should be made immediately. To help ensure continued integrity, exhaust system pipes rearward of the muffler must be replaced whenever a new muffler is installed.

16. SUSPENSION AND STEERING—Check for damaged, loose or missing parts, or parts showing visible signs of excessive wear or lack of lubrication in front and rear suspension and steering system. Questionable parts noted should be replaced without delay.

17. BRAKES AND POWER STEERING—Check lines and hoses for proper attachment, binding, leaks, cracks, chafing, deterioration, etc. Any questionable parts noted should be replaced or repaired immediately. When abrasion or wear is evident on lines or hoses, the cause must be corrected.

18. ENGINE DRIVE BELTS—Check belts driving fan, generator, power steering pump and air conditioning compressor for cracks, fraying, wear and tension. Adjust or replace as necessary.

19. DRUM BRAKES AND PARKING BRAKE—Check drum brake linings for wear or cracks and other internal brake components at each wheel (drums, wheel cylinders, etc.). Parking brake adjustment also should be checked whenever drum brake linings are checked.

NOTE: More frequent checks should be made if driving conditions and habits result in frequent brake application.

20. THROTTLE LINKAGE—Check for damaged or missing parts, interference or binding. Any deficiencies should be corrected without delay.

21. UNDERBODY—Corrosion materials used for ice and snow removal and dust control accumulate on the underbody. If allowed to remain, these materials can result in accelerated rusting and deterioration of underbody components such as fuel lines, frame, floor, exhaust system, etc. At least once each year, preferably after a winter's exposure, these corrosive materials should be removed by flushing the underbody with plain water. Particular attention should be given to cleaning out those areas where mud and other foreign materials collect.

EMISSION CONTROL MAINTENANCE

(1977 CERTIFIED 455 CUBIC INCH ENGINE)

To determine year engine was certified, refer to emission control decal on engine valve cover.

22. THERMOSTATICALLY CONTROLLED AIR CLEANER—Inspect installation to make certain that all hoses and ducts are connected and correctly installed. Also check valve for proper operation.

23. CARBURETOR CHOKE AND HOSES—Check choke mechanism for free operation. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor choke hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary.

24. ENGINE IDLE SPEED AND MIXTURE — Adjust engine idle speed accurately (following the specifications shown on the label attached to the engine rocker cover) at the first 6 months or 6,000 miles (9 600 km) of operation, then at 12 month or 12,000 mile intervals (19 200 km). Adjustment must be made with test equipment known to be accurate.

At 12 month or 12,000 mile intervals (19 200 km) or in case of major carburetor overhaul, or when poor idle quality exists, the idle mixture should be adjusted by use of a CO meter when an accurate meter is available, or the alternate mechanical method (lean drop) should be used to adjust the idle mixture.

25. CARBURETOR AND INTAKE MANIFOLD MOUNTING—Torque carburetor and intake manifold attaching bolts and/or nuts at first 6 months or 6,000 miles (9 600 km) —then at 12 month/12,000 mile intervals (9 600 km).

26. SPARK PLUGS—Replace at 6,000 mile intervals (9 600 km) when operating with leaded fuels, or at 12,000-mile intervals (19 200 km) when using unleaded fuels. Use of leaded fuels results in lead deposits on spark plugs and can cause misfiring at mileages less than 12,000 miles (19 200 km). Where misfiring occurs prior to 6,000 miles (9 600 km) spark plugs in good condition can often be cleaned, tested, and reinstalled in an engine with acceptable results.

27. CARBURETOR FUEL FILTER — Replace filter at 12-month/12,000-mile intervals (19 200 km) or more frequently if clogged.

28. THERMAL VACUUM SWITCH AND HOSES—Check for proper operation. A malfunctioning switch must be replaced. Check hoses for proper connection, cracking, abrasion or deterioration and replace as necessary.

29. POSITIVE CRANKCASE VENTILATION SYSTEM (PCV)—Check the PCV system for satisfactory operation at 12,000-mile intervals (19 200 km), and clean filter (located in rocker cover). Replace the PCV valve at 24,000-mile intervals (38 400 km) and blow out PCV valve hose with compressed air. Replace deteriorated hoses.

30. AIR CLEANER ELEMENT—Replace the engine air cleaner element under normal operating conditions every 12,000 miles (19 200 km). Operation of vehicle in dusty areas will necessitate more frequent element replacement.

CAUTION: *Do not operate the engine without the air cleaner unless temporary removal is necessary during repair or maintenance of the vehicle. When the air cleaner is removed, backfiring can cause fire in the engine compartment.*

31. SPARK PLUG WIRES—Clean exterior of wires; remove any evidence of corrosion on end terminals. Inspect spark plug wires for evidence of checking, burning, or cracking of exterior insulation and tight fit at distributor cap and spark plugs or other deterioration. If corrosion cannot be removed or other conditions above are noted, replace wire.

32. TIMING AND DISTRIBUTOR CAP—Adjust ignition timing following the specification on label attached to the engine rocker cover.

Also, carefully inspect the interior and exterior of the distributor cap and rotor for cracks, carbon tracking and terminal corrosion. Clean or replace as necessary.

33. EVAPORATION CONTROL SYSTEM (ECS)—Check all fuel and vapor lines and hoses for proper connections and correct

routing as well as condition. Remove canister(s) and check for cracks or damage. Replace damaged or deteriorated parts as necessary. Replace filter in lower section of canister.

NOTE: If vehicle is equipped with two canisters, filter is located in the lower canister only.

34. FUEL CAP, FUEL LINES AND FUEL TANKS—Inspect the fuel tank cap and lines for damage which could cause leakage. Inspect fuel cap for correct sealing ability and indications of physical damage. Replace any damaged or malfunctioning parts.

EMISSION CONTROL MAINTENANCE

(1977 AND 1978 CERTIFIED 403 CUBIC INCH ENGINE)

To determine year engine was certified, refer to emission control decal on engine valve cover.

35. CARBURETOR MOUNTING—Check carburetor attaching bolt torque at the first 3,000 miles (4 800 km), only. If torque on any bolt is less than 48 in. lbs., tighten all bolts to 120 in. lbs. using the following tightening sequence:

a—Left Rear Bolt c—Right Rear Bolt
b—Right Front Bolt d—Left Front Bolt

36. ENGINE IDLE SPEED—Adjust engine idle speed accurately (following the specifications shown on the label attached to engine air cleaner) at 3,000 miles (4 800 km) of operation, 12,000 miles, then at 12,000-mile intervals (19 200 km) thereafter. Adjustments must be made with test equipment known to be accurate.

AIR CLEANER—Inspect installation to make certain that all hoses and ducts are connected and correctly installed. Also check valve for proper operation.

38. CARBURETOR CHOKE AND HOSES—Check choke mechanism for free operation. Any binding condition which may have developed due to petroleum gum formation on the choke shaft or from damage should be corrected. Check carburetor choke hoses for proper connection, cracking, abrasion or deterioration and correct or replace as necessary.

39. CARBURETOR FUEL FILTER — Replace filter at 12-month/12,000-mile intervals (19 200 km) or more frequently if clogged.

40. POSITIVE CRANKCASE VENTILATION SYSTEM (PCV)—Check the PCV system for satisfactory operation at 12 month or 12,000-mile intervals (19 200 km), and clean filter (located in rocker cover). Replace the PCV valve and filter at 24 month or 24,000-mile intervals (38 400 km) and blow out PCV valve hose with compressed air. Replace deteriorated hoses. The PCV valve should be replaced at 12 month or 12,000 mile intervals (19 200 km) when the vehicle is used in operations involving heavy dust, extensive idling, and short trip use at freezing temperatures where engine does not become thoroughly warmed up.

41. SPARK PLUG WIRES—Clean exterior of wires with a clean cloth or soft bristle brush and a solution of mild detergent and warm water. Remove any evidence of corrosion on end terminals. Inspect spark plug wires for evidence of checking, burning, or cracking of exterior insulation and tight fit at distributor cap and spark plugs or other deterioration. If corrosion cannot be removed or other conditions above are noted, replace wire.

42. AIR CLEANER ELEMENT—Replace the engine air cleaner element under normal operating conditions every 12,000 miles (19 200 km). Operation of vehicle in dusty areas will necessitate more frequent element replacement.

CAUTION: *Do not operate the engine without the air cleaner unless temporary removal is necessary during repair or maintenance of the vehicle. When the air cleaner is removed, backfiring can cause fire in the engine compartment.*

43. THERMAL VACUUM SWITCH AND HOSES—Check for proper operation. A malfunctioning switch must be replaced. Check hoses for proper connection, cracking, abrasion or deterioration and replace as necessary.

California engines are equipped with an additional low temperature thermal vacuum switch.

44. THROTTLE RETURN CONTROL (TRC) —Check hoses for cracking, abrasion or deterioration and replace as necessary. Check system for proper operation and adjust as necessary.

45. TIMING AND DISTRIBUTOR CAP—Adjust ignition timing following the specification on label attached to the engine rocker cover (1977 engines).

NOTE: On 1978 engine the label is located on the air cleaner.

Also, carefully inspect the interior and exterior of the distributor cap and rotor for cracks. Clean or replace as necessary.

46. CARBURETOR VACUUM BREAK (1978 Certified Engine ONLY)—Inspect vacuum break linkage for proper operation. A binding condition must be corrected. Check hose for proper connection, cracking, abrasion or deterioration. Replace parts as necessary. Adjust vacuum break at 12 month or 12,000 mile intervals (19 200 km).

47. SPARK PLUGS—Replace at 12,000 mile intervals. Where misfiring occurs prior to 12,000 miles (19 200 km), spark plugs in good condition can often be cleaned, tested and reinstalled in the engine with acceptable results.

48. EVAPORATION CONTROL SYSTEM (ECS)—Check all fuel and vapor lines and hoses for proper connections and correct routing as well as condition. Remove canister(s) and check for cracks or damage. Replace damaged or deteriorated parts as necessary. Replace filter in lower section of canister.

NOTE: If 1977 vehicle is equipped with two canisters, filter is located in the lower canister only. If 1978 vehicle is equipped with two canisters, a filter is located in the lower portion of each canister.

49. FUEL CAP, FUEL LINES AND FUEL TANKS—Inspect the fuel tank cap and lines for damage which could cause leakage. Inspect fuel cap for correct sealing ability and indications of physical damage. Replace any damaged or malfunctioning parts.

RECOMMENDED FLUIDS AND LUBRICANTS

USAGE	FLUID/LUBRICANT	CAPACITIES U.S.	CAPACITIES IMPERIAL
Engine oil	High quality SE oil	5 Qts. 6 w/filter	4¼ Qts. 5 w/filter
Motor generator	High quality oil meeting both SE and CC requirements	4 Qts. 4½ w/ filter	3¼ Qts. 3-3/4 w/ filter
Power steering system and pump reservoir. Includes windshield wiper motor	GM power steering fluid Part No. 1050017 or equivalent		
Final drive	SAE 80W or SAE 80W-90 GL-5 gear lubricant (SAE 80W GL-5 in Canada)	4 Pts.	3¼ Pts.
Brake system and master cylinder	Delco Supreme 11 or, DOT-3 fluid or equivalent		
Transmission shift linkage	Engine oil		
Chassis lubrication	Lithium soap multi-purpose chassis grease meeting requirements of GM 6031-M		
Transmission	DEXRON II automatic transmission fluid	4 Qts. *	3¼ Qts.*
Parking brake cables	Chassis grease		
Front Wheel Bearings	High-melting point lubricant Part No. 1051344		

RECOMMENDED FLUIDS AND LUBRICANTS

USAGE	FLUID/LUBRICANT	CAPACITIES U.S.	CAPACITIES IMPERIAL
Rear wheel bearings	Lithium soap multi-purpose chassis grease meeting requirements of GM 6031-M		
Body door hinge pins, hinges and latches at the front access doors, external utilities generator/storage and LP gas doors. Gas fill door hinge	Engine oil		
Windshield washer solvent	GM Optikleen washer solvent Part No. 1050001 or equivalent		
Batteries	Colorless, odorless, drinking water		
Engine coolant	Mixture of water and a high quality Ethylene Glycol base type anti-freeze conforming to GM Spec. 1899-M.	21 Qts. (TransMode) 23 1/2 Qts. (Motorhome)	17½ Qts. 19 1/2 Qts.

*12 U.S. Qts. (10 Imperial Qts.) after complete overhaul.

SECTION 1

BODY, HEATING AND AIR CONDITIONING

This section is sub-divided into two parts:

SECTION 1A

BODY

The information described in Maintenance Manual X-7525 under the heading BODY, HEATING AND AIR CONDITIONING (SEC. 1) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

MOTORHOME AND TRANSMODE PAINT CODES

1977 EXTERIOR PAINT CODES

COLOR	RPO	MODEL USAGE	FISHER NO.	DITZLER NO.	DUPONT REFINISH NO.
Beige	534	Eleganza II	WUEK-4527	2646	42807U
Frosted Mint	553	Palm Beach	WUEK-5254	45197	44017U
Cameo White	558	All	WUEK-3967	2058	5338U
Yellow	580	TransMode	WUEK-5269	82277	44365U
Cream White	585	Birchaven TransMode Crestmont	WUEK-5222	90070	44570U
Santa Fe Tan	581	Kingsley	WUEK-5236	2777	43486A*

MOTORHOME AND TRANSMODE PAINT CODES

1978 EXTERIOR PAINT CODES

PAINT RPO CODE & COLOR*	RPO	MODEL USAGE	FISHER NO.	DITZLER NO.	DUPONT REFINISH NO.
39P White	641	Kingsley	WUEK-5252	90035**	43976U
36S Saffron			WUEK-6205	24575**	45558U
38P Frost Beige	697	Eleganza II	WUEK-6201	24573**	45554U
35S Medium Beige			WUEK-6202	24574**	45555U
41P Frost Green	698	Palm Beach	WUEK-6203	45399**	45556U
37S Medium Green			WUEK-6204	45400**	45557U
42P Cameo White		TransMode	WUEK-3967	2058**	5338U
42S Cameo White					
38P Frost Beige		TransMode	WUEK-6201	24573**	45554U
38S Frost Beige					

*Must specify both Primary & Secondary Color.
**Paint available in urethane, acrylic lacquer and acrylic enamel, by using following prefix with Ditzler No.

DU - Urethane DDL - Acrylic Lacquer DAR - Acrylic Enamel

1977 & 1978 INSTRUMENT PANEL PAINT CODES

COLOR	RPO	MODEL USAGE	FISHER NO.	DITZLER NO.	PONTIAC COATINGS CODE NO.	DUPONT REFINISH NO.	DETROIT AUTOBODY NO.
Midnight Neutral	690	Sequoia	W25A-4300	UCV2-183	----------	9994LH	4300**
	692	Painted Desert	"	"	"	"	"
	693	Glacier	"	"	"	"	"
	695	Canyon Lands	"	"	"	"	"
	---	TransMode-(Pre 1977)	"	"	"	"	"
Dark Amber	696	Eleganza SE	W25A-4530	UCV2-214	---	42911LH	4530**
Dark Saddle	697	Eleganza II	WOA-4098	UCV 152	GMT-544*	----	4098**
	681	Glenbrook	"	"	"	"	"
	641	Kingsley	"	"	"	"	"
	---	TransMode 1977	"	"	"	"	"
Avocado	698	Palm Beach	WOA-4926	UCV2-405	GMT-551*	10049LH	---

*Vinyl Coating manufactured by: Pontiac Coatings, Inc.
30 Brush Street, Box 45
Pontiac, MI 48056

**Vinyl coating manufactured by: Detroit Autobody Equipment Company
(Requires No. 4000 non-glare clear top coat)
Box 717
Royal Oak, MI 48068

NOTE: Lacquer should not be used to repair body finish on these vehicles.

GLASS

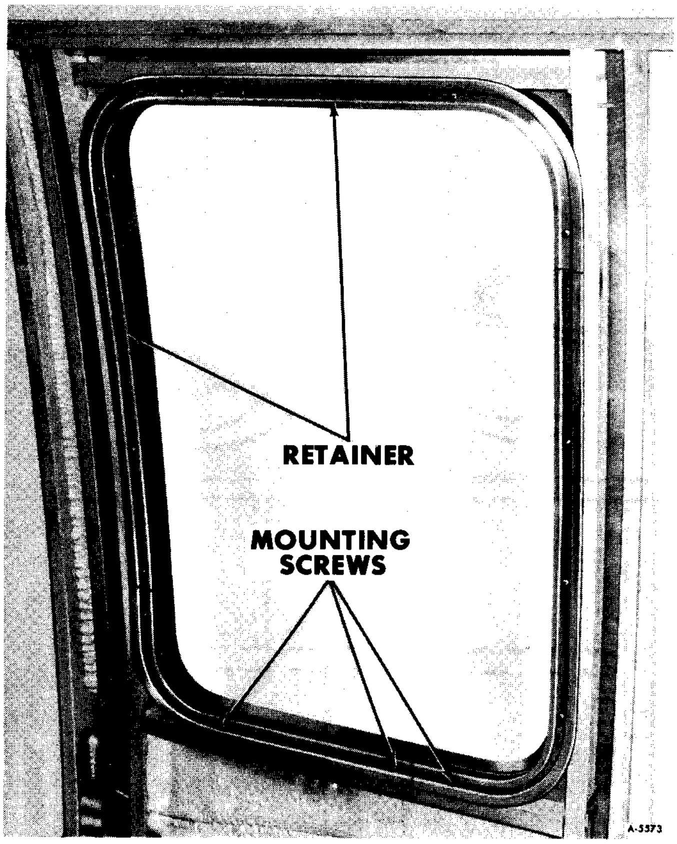


Figure 1—Sash Retainer

"HEHR" LIVING AREA WINDOW ASSEMBLIES

"Hehr" living area window assemblies have formed retainers that screw directly to the sash assembly (figure 1). The trim molding has been redesigned (figure 2), and installs directly into the sash retainer. No mounting screws are needed. These new features do not affect

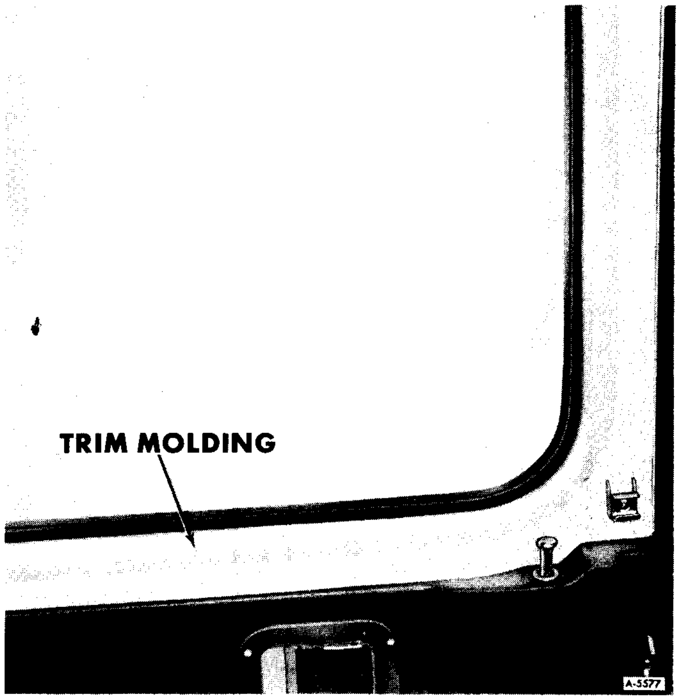


Figure 2—Window Trim

removal and installation procedures as outlined in "Screen and Vent Assembly", Section 1, Maintenance Manual X-7525.

REAR WINDOW REPLACEMENT

Rear windows are made of solid tempered glass. Care is necessary in handling and installation. If glass clearance of replacement window is too small, adjustment may be made by "trimming" fiberglass flange around window. Do not attempt to grind tempered glass. Grinding may cause glass to shatter.

WINDSHIELD WIPER SYSTEM

CAUTION: *When replacing the windshield wiper motor, correct routing of the power steering hoses is very important. Although sequence of assembly is not vital, the power steering hoses, when installed, must not be twisted, kinked, or tightly bent. The hoses should have sufficient natural curvature in the routing to absorb movement and hose shortening in operation. They should also be free of twist under strain. All fittings must be held while tightening or loosening nuts.*

ALUMINUM AND FIBERGLASS REPAIR

The aluminum and fiberglass panels on the body may be repaired if damaged. Refer to Sec. 1, Maintenance Manual X-7525 for fiberglass repair procedure. Filler putty can be used for minor dents, scratches and scrapes on the aluminum panels. However, major damage to a panel (fiberglass or aluminum) will require removal and replacement of the panel. Before

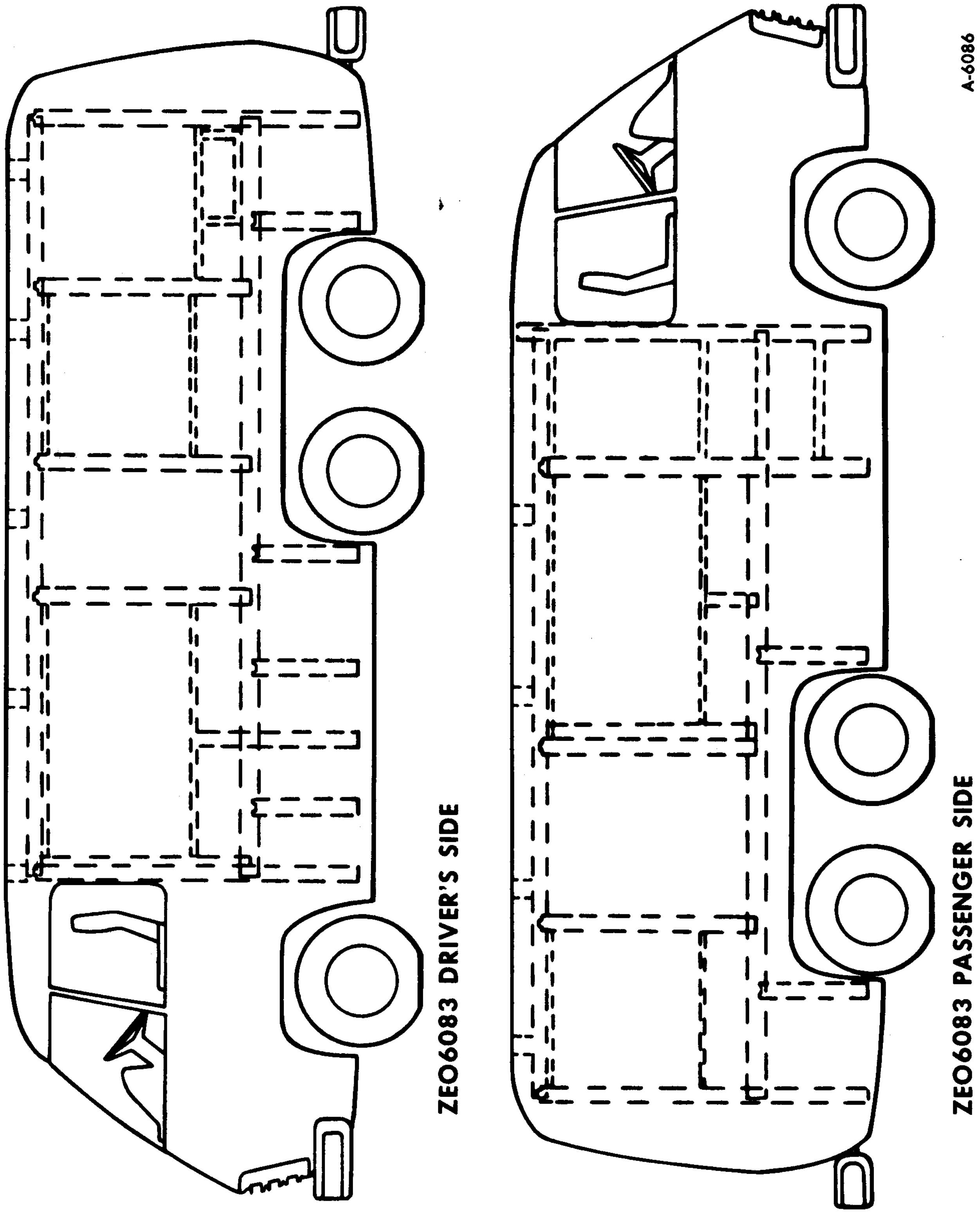


Figure 3—TransMode Body Side Structure (ZEO6083)

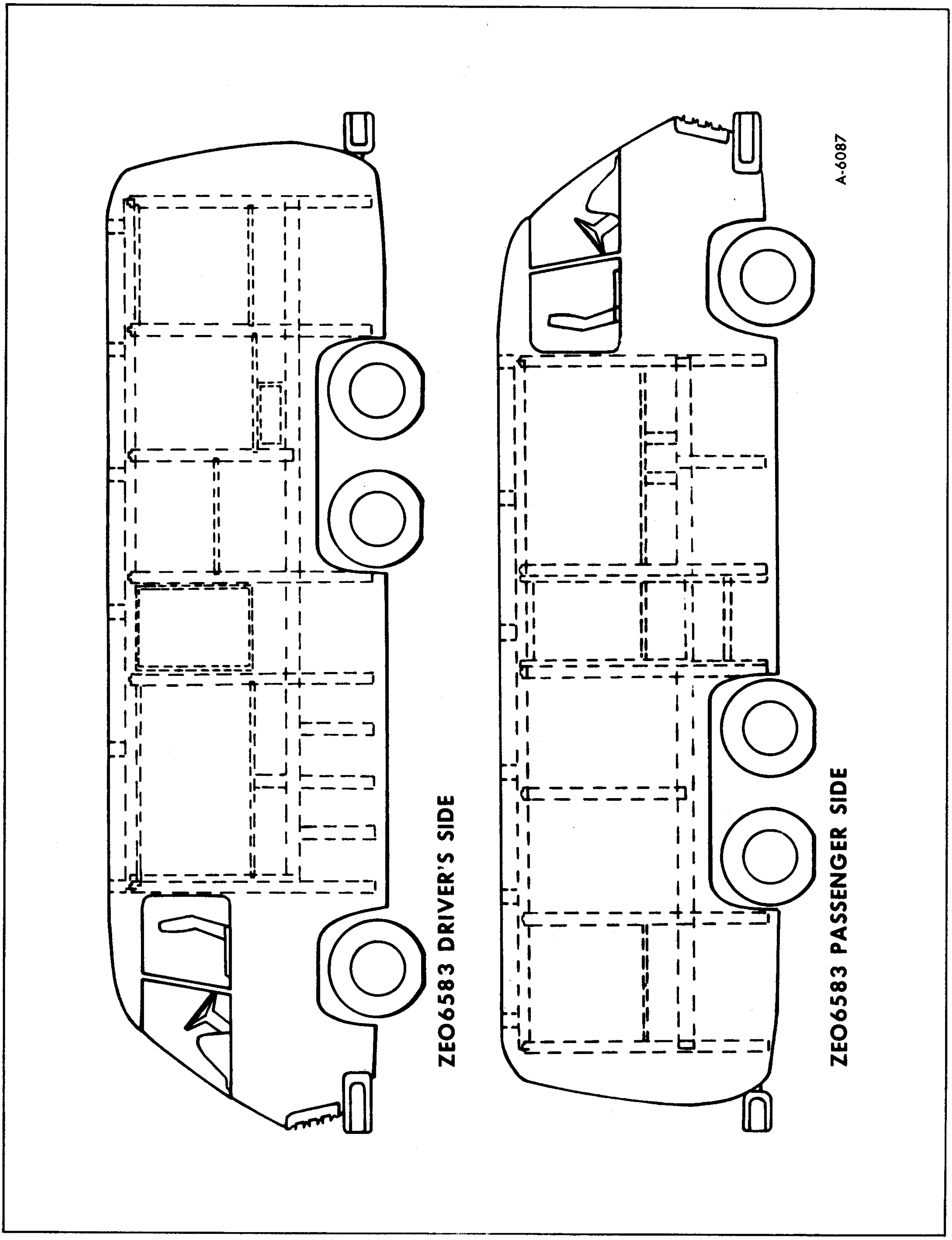


Figure 4—TransMode Body Side Structure (ZE06583)

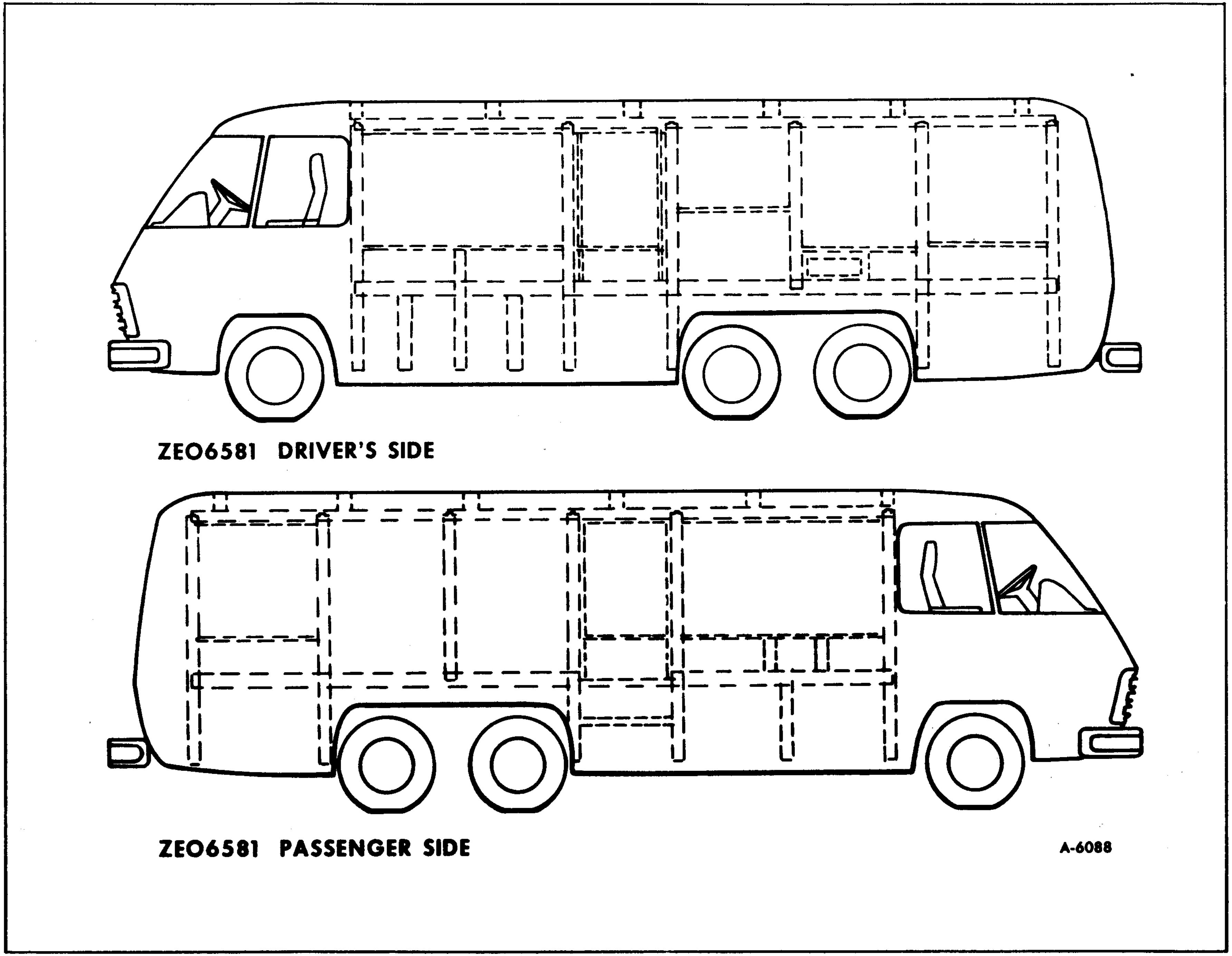


Figure 5—Motorhome Body Side Structure (ZE06581)

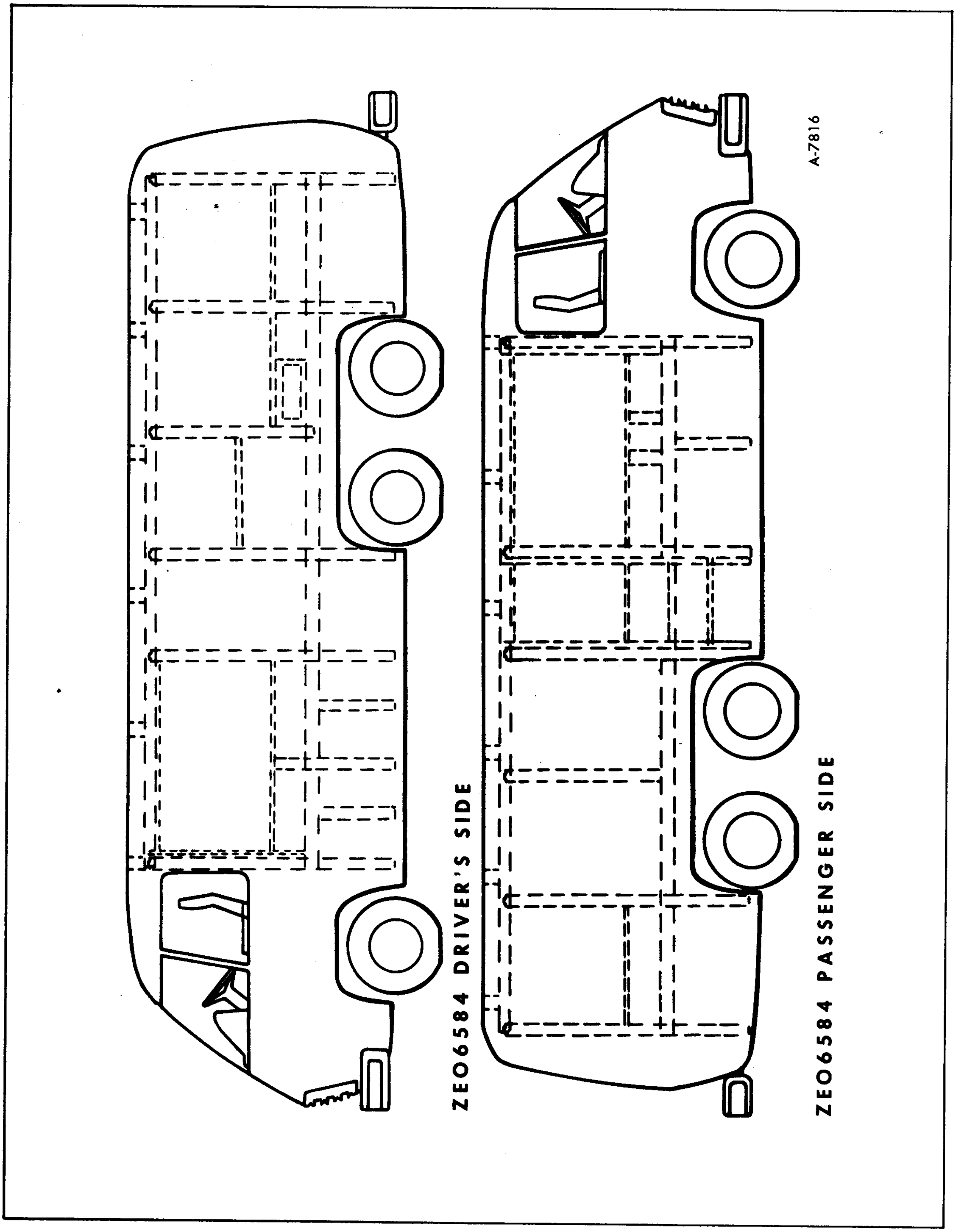


Figure 6—"Twin Bed" Motorhome Body Side Structure (ZE06584)

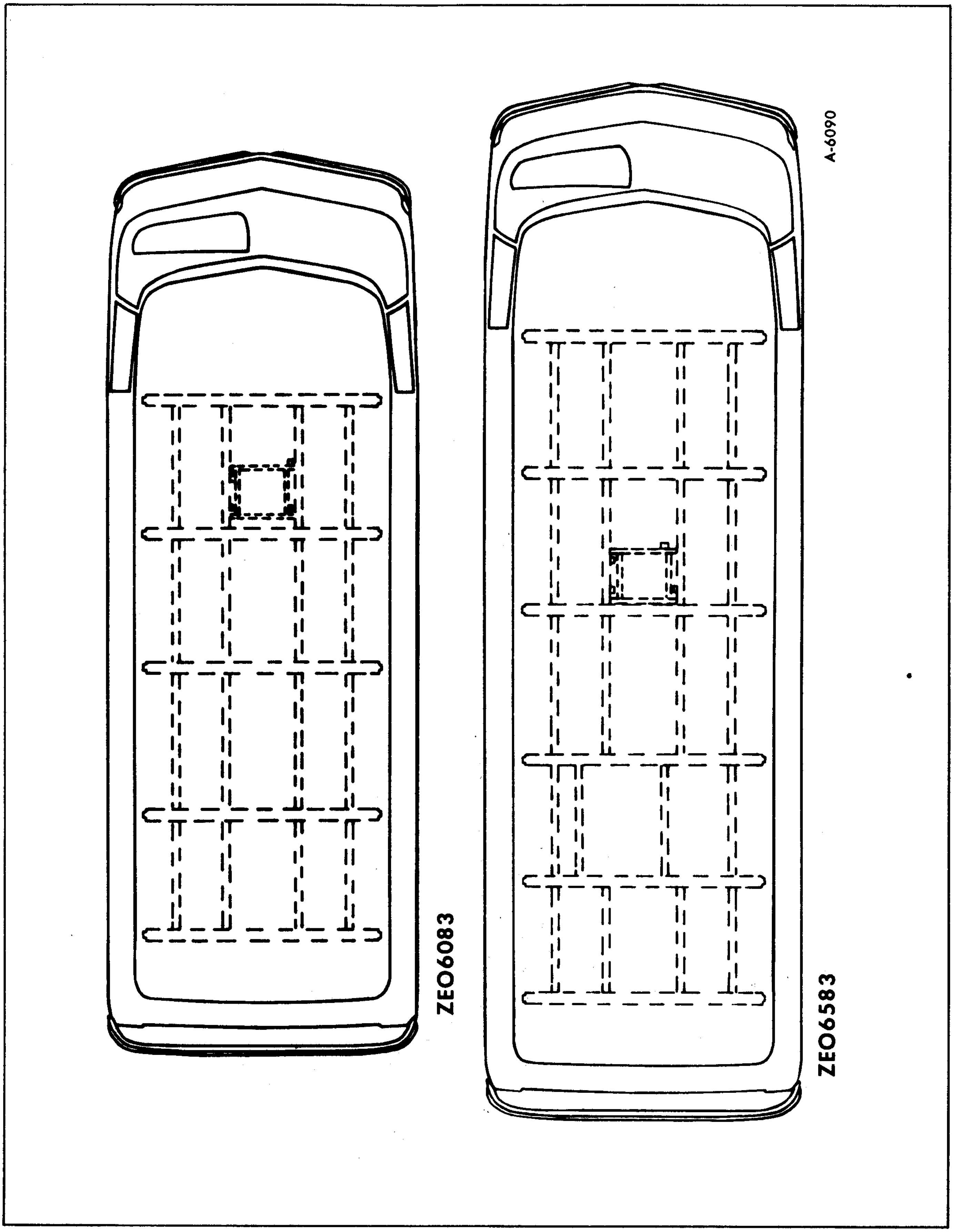


Figure 7—TransMode Roof Structure (ZEO6083, ZEO6583)

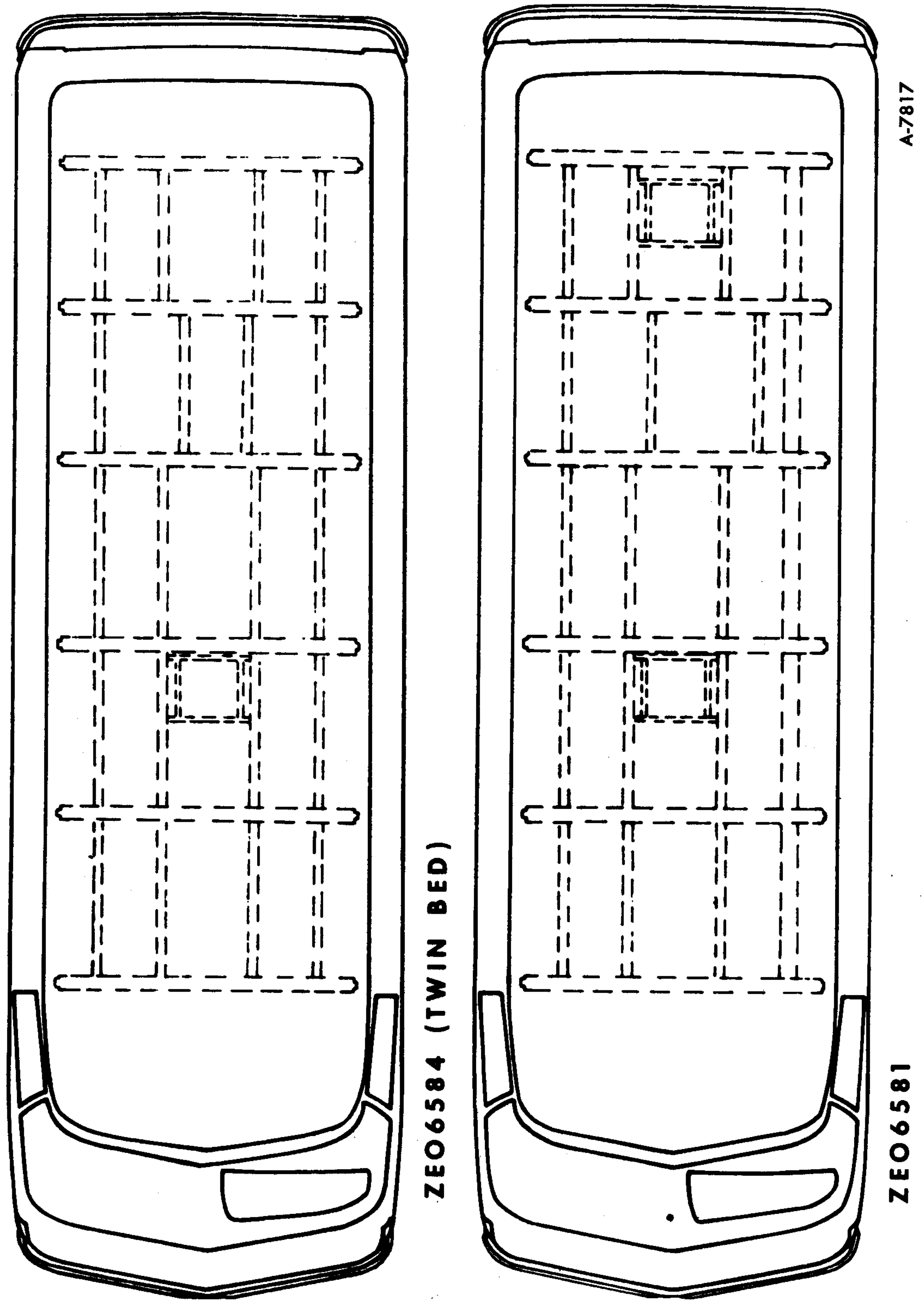


Figure 8—Motorhome Roof Structure (ZE06581, ZE06584)

this can be done all windows, access doors, vents, belt and roof line trim moldings in the damaged area should be removed. The panels, which are secured to the rib with a polyurethane adhesive, are difficult to separate and remove from the body. The suggested method which follows should make the repair job easier.

NOTE: There are numerous overlapping joints on the vehicle where the front and rear fiberglass panels are joined to the body structure and to each other. These joints are glued together. Some panels are also bolted together or held by fasteners behind the exterior skin. These panels include: (a) the lower front panel which is bolted to the lower front side panels at the front corners of the vehicle (five bolts each side of vehicle), (b) the lower side panels, which are held to the main body side panels with two screws and a pop rivet, and (c) the rear corner pillar assemblies, which are bolted to the main rear side panels (eight bolts each side of vehicle).

Should the corners of the vehicle become damaged, or should any part of the front or rear "cap" need replacement, the lap joint bolts must be loosened or removed. To do so may require that specific interior components, trim panels, cabinets, dash panel, etc., be removed to allow access to certain of the bolts. When all the attaching bolts are loosened or removed, the adhesive bond between the joints must be broken. Then the exterior skin must be "peeled back" before the affected panel(s) can be pulled off the vehicle for repair or replacement.

NOTE: Carefully read and follow all manufacturer's safety precautions for primer, solvent and body adhesive.

PANEL REMOVAL

Typical positioning of body structural members (right and left hand views) in the standard TransMode and Motorhome vehicles is depicted in figures 3 through 6. Figures 7 and 8 illustrate TransMode and Motorhome roof structures.

NOTE: Individual Motorhome and TransMode vehicles may have structural additions and changes not represented by these views. If possible, determine vehicle alterations from standard before beginning body repair.

Using these figures for reference, it is essential to determine position of the rib structure of the vehicle prior to repair. This is important to avoid damaging structural components, piping, wiring, insulation, etc. located immediately behind the panels. It is suggested that each damaged panel be removed in two parts, using Special Tool J-26805 (figure 9). This tool is a Pneumatic Chisel Bit Set, to be used with a standard air chisel (parker shank) for body repair.

1. Remove all mechanical attachments. When removing rivets, drill only deep enough to remove the rivet, or piping, wiring, insulation, etc. directly behind the panels will be damaged. After rivet head is drilled off, use a punch to carefully drive out the rivet shaft.

2. Determine position of vehicle structural supports in area to be repaired. Trace frame or rib area with washable marker on outside of vehicle.

3. Working from the vehicle exterior and using a standard air chisel with a Rip Bit (J-26805-1), begin to cut the damaged panel out, cutting parallel to the "ribs" and approximately two inches "inside" of the rib structure. (See figure 10.) Then remove the cut-out section of the panel.

With the largest part of the panel out of the way it will now be easier to remove the remainder of the panel (which is secured to the crossmember with adhesive) without damaging the crossmember.

4. Using a Flat End Scraper Bit (J-26804-2), operate the air chisel along the rib line and underneath the panel piece to break the adhesive bond between the panel and the rib. Note that figure 11 shows panel "remains" from <u>two</u> body side panels (panel A & panel B) being removed from the structural support. This would be necessary only if both panels were damaged. If only one panel needs replacement, only one panel is removed from the rib, using the visible seam between panels as a guide. (Refer to figure 11).

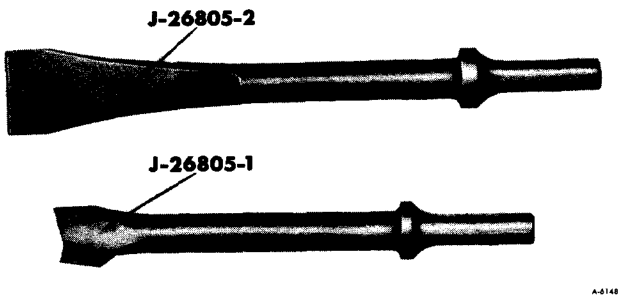


Figure 9—Pneumatic Chisel Set

Follow the same 2-part cutting method along the roof seams and any other structural supports that border damaged panels. Use care not to damage structural components behind adjacent panels. All small pieces which have broken free must be removed.

ADHESIVE REMOVAL

Before prefitting or any further structural work on the vehicle, the old cured adhesive must be removed from ribs and body structural supports. A suggested method would be to grind off the adhesive with an extra coarse disc on an air driven grinding wheel. An air chisel with Flat End Scraper Bit (J-26805-2) may also be used.

INSPECTION

Inspect crossmembers for damage. Any damaged rib will have to be straightened, replaced, or have shim material fastened to the rib so proper support will be provided for the panel.

PANEL INSULATION

New body panels must be insulated to insure temperature control and good performance of heating and air conditioning systems. Insulate with rigid urethane foam (available in aerosol cans) or 1-inch, 1 1/2 lb. density fiberglass insulation sheets, cut to fit. Both types of insulation are available locally. Do not cover areas which must remain accessible for servicing, such as structural flanges and interior component mounting surfaces. If urethane

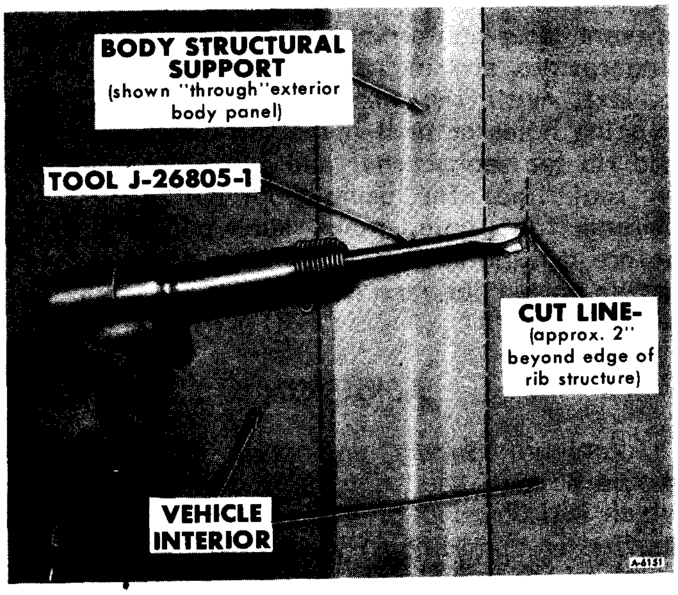


Figure 10—Panel Removal with Air Chisel —Step 3

foam is used, take care not to spray adhesive bonding surfaces.

PREFITTING

A replacement panel should be prefitted for proper fixturing after panel has been insulated and ribs have been thoroughly cleaned of adhesive. This should be done before the ribs have been solvent wiped or primed, in order to

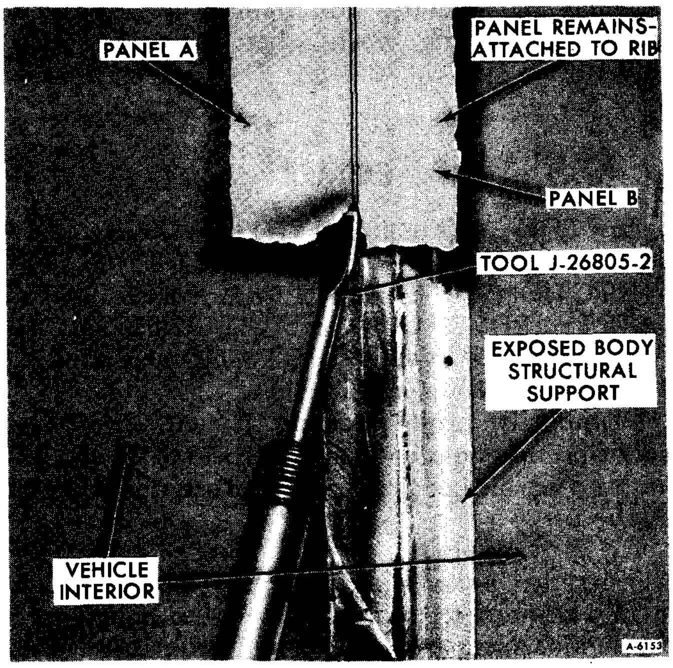


Figure 11—Panel Removal with Air Chisel - Step 4

prevent later contamination from dirt, grease, fingerprints, etc. in the glue line areas.

Next, with the panel held in place, use existing holes or drill holes through the panel and rib (at each corner and along the beltline or roof line) for using pop-rivets. After drilling first hole, make sure panel is flat before drilling second hole. The panel should not be bowed between holes.

ABRASION

Aluminum panels and body frame parts should be disc sanded to bare metal in areas which will be bonded. Fiberglass* may also be scuffed on bond line. Finished surface will be rough to the touch.

*Glass fiber reinforced panels, commonly called fiberglass. Not the same as fiberglass insulation referred to earlier.

SOLVENT

BEFORE WORKING WITH SOLVENT, BE SURE TO READ MANUFACTURER'S INSTRUCTIONS AND TAKE ALL NECESSARY SAFETY PRECAUTIONS.

Wipe bond surfaces on fiberglass and aluminum panels and on body structural supports with Methylene Chloride solvent. It is important that all surfaces be clean and free of surface contaminants such as shop dirt, grease, drawing compounds, and overspray. Safety gloves should be worn when cleaning with solvent.

PRIMER

BEFORE WORKING WITH PRIMER, BE SURE TO READ MANUFACTURER'S INSTRUCTIONS AND TAKE ALL NECESSARY SAFETY PRECAUTIONS. SPECIFICALLY, AVOID ALL SKIN CONTACT AND USE ONLY IN WELL VENTILATED AREA.

Primer is used because it will promote adhesion and help prevent corrosion. It should be used on all bond surfaces before adhesive is applied.

It is important that primer base be thoroughly agitated. No settled pigment should remain on the bottom of the container. Mix equal parts by volume of primer base and accelerator, such as 3M EC-1945 B/A or equivalent. Follow manufacturer's mixing and use instructions.

Primer may be sprayed, or brushed on with a clean brush. Apply a "mist" coat or a thin brush coat of primer to all sanded structural surfaces. Do not spray heavy coat or let primer run on surface.

Drying time is dependent upon ambient temperature, air movement and relative humidity. Cure primer by air drying or heating to a minimum temperature of 150°F (65°C) for 15 to 30 minutes. Temperature must not exceed 250°F (121°C) at any time. Heat lamps normally used for paint curing may be used when heat drying. If air drying, cure for a minimum of one hour at room temperature.

NOTE: Adhesive must be applied within 16 hours of primer application to achieve maximum adhesion. If primer is exposed beyond 16 hours, surface must be reprepped and reprimed.

ADHESIVE

BEFORE WORKING WITH BODY ADHESIVES, BE SURE TO READ MANUFACTURER'S INSTRUCTIONS AND TAKE ALL NECESSARY SAFETY PRECAUTIONS. SPECIFICALLY, AVOID ALL SKIN CONTACT AND USE ONLY IN WELL VENTILATED AREA.

Use adhesive such as manufactured by Minnesota Mining and Manufacturing, EC-3549 B/A, or equivalent. This is a two-part (base and accelerator) urethane adhesive designed for bonding aluminum, polyester and steel. Adhesive should be used only at room temperature of about 75°F (24°C) as viscosity increases at lower temperatures. Also, if heat dry has been used for primed areas, be sure that panels and frame sections to be bonded are cooled to room temperature before proceeding. Hot surfaces will greatly shorten adhesive work life and lower ultimate bond strength.

It is essential that bonding surfaces be thoroughly clean, dry and grease-free to maintain good adhesion. Also, be sure that all fixtures, clamps, metering devices and safety equipment are at hand before mixing adhesive.

Mix adhesive just prior to application, keeping in mind that adhesive work life is from 15 to 30 minutes (normally closer to 15 minutes). Follow manufacturer's mixing and curing instructions. It is very important that mix be "on ratio" to obtain maximum bond strength.

Using disposable adhesive cartridge and applicator, apply about a 3/8-inch diameter bead to bonding surface (either stationary part or new panel, but not both). Use two beads for wide area. Application with putty knife not recommended. Adhesive must wet total surface area being bonded to assure maximum adhesion.

NOTE: After the new panel has been positioned on the body, it will be necessary to see a "witness bead" of excess adhesive along the edge of the panel. This will assure that adhesive has been properly applied. One 6-oz. cartridge will normally bond about 6-8 lineal feet unless large mismatch of parts requires greater quantity.

FIXTURING

Put replacement panel into position before adhesive cures and press firmly into place by hand. Clean cotton or plastic gloves are recommended to prevent contamination of primed panels and to keep adhesive off the hands.

NOTE: If adhesive gets on gloves, they should be discarded before further handling of panels. Adhesive will definitely leave blemish marks which are difficult to remove from exterior panel surface.

Next, insert pop-rivets where indicated to prevent movement of panel while adhesive is curing. Use closed-end (ie., waterproof) rivets for roof seams. Clamp as practical and necessary.

Look for "witness bead" of excess adhesive around panel edges as assurance that adhesive has completely "wetted" the glue line area. Then, remove excessive squeeze-out on exterior within one hour after application. Use a plastic tool or a wooden tongue depressor for removal. Any excess remaining after this can be wiped off with a clean cloth dampened with white gasoline. (Be sure to use cautions as appropriate for flammable liquids.) It is important that excess adhesive be removed before curing takes place and before pop-rivets or clamps are removed. Discard all partially used containers of mixed primer and adhesive.

CURING

This adhesive must cure for 24 hours at room temperature (65-85°F) (-18-29°C) before any structural work or movement of the vehicle is permitted. This will assure maximum bonding of the adhesive. After 24 hours the rivet heads may be ground off and the holes filled with a body putty. Proceed with final finishing work.

RUB RAIL

1977 and 1978 model vehicles are equipped with a new body rub rail which is installed the length of the vehicle at the belt line.

The rub rail is bonded to the belt rail with double-backed pressure-sensitive adhesive tape. In addition, retaining screws are used at the end of each individual strip of rub rail and at the front and rear side marker lamps to hold the lamps and the rub rail strips securely in place.

Rub rails may be replaced or repaired if necessary. On-vehicle repair may include: (1) application of adhesive to a small area directly behind rub rail where pressure-sensitive tape is not secure, or (2) addition of fasteners to secure a larger piece or pieces of the rub rail which are not adhering to the body. A combination of adhesive and fasteners may be necessary in certain repair situations. If adhesive is required, use GM#1051910 or equivalent. Be sure to follow all manufacturer's safety precautions (included with adhesive package). If additional fasteners are required, use a sheet metal screw to fasten rub rail to belt rail. Use GM#2006755 screw and washer assembly (or equivalent), or a phosphate coated (black) flat or oval-headed self tapping screw. Fasteners should be approximately .75" long.

RUB RAIL REPLACEMENT

If rub rail has been badly damaged and needs replacement, perform the following:

REMOVAL

1. Remove screws from ends of damaged rub rail pieces. If side marker lamp is damaged, remove two screws holding marker lamp to rub rail. Pull lamp forward and disconnect bulb socket from lamp. Take lamp out.
2. With all retaining screws removed, pull rub rail off of vehicle.

INSTALLATION

NOTE: Do not clean surface to be bonded or peel off adhesive tape backing from rub rail until just prior to installation of rub rail. If marker lamp was damaged, install new marker lamp assembly. Connect bulb socket and fasten two retaining screws.

When the bonding operation is to be performed, the rub rail and the bonding surface should be at a temperature of 70 to 90°F (21.1° to 32.2°C). If practical, it is desirable to lay the new rub rail out flat in the same environment as the vehicle for 24 hours prior to installation. This will assure temperature equilibrium between the replacement part and the application area. It will also help to eliminate problems of shrinkage and curling.

Clean the bonding surface on the vehicle thoroughly with isopropyl alcohol or equivalent. Dry the surface with a clean (lint-free) cloth. It is important that bonding surface remain clean and oil-free. Bond will not hold if surface contamination exists.

After cleaning, when ready to install rub rail, peel off backing paper. Line the strip up evenly with one edge of the aluminum belt rail. Do not touch the surface with hands and do not allow the tape backing to come into contact with dirt or foreign matter. Apply rub rail with a uniform pressure of 20 lbs. minimum to seal the adhesive tape to the bonding surface. Secure rub rail pieces with screws where called for.

ENTRANCE DOOR

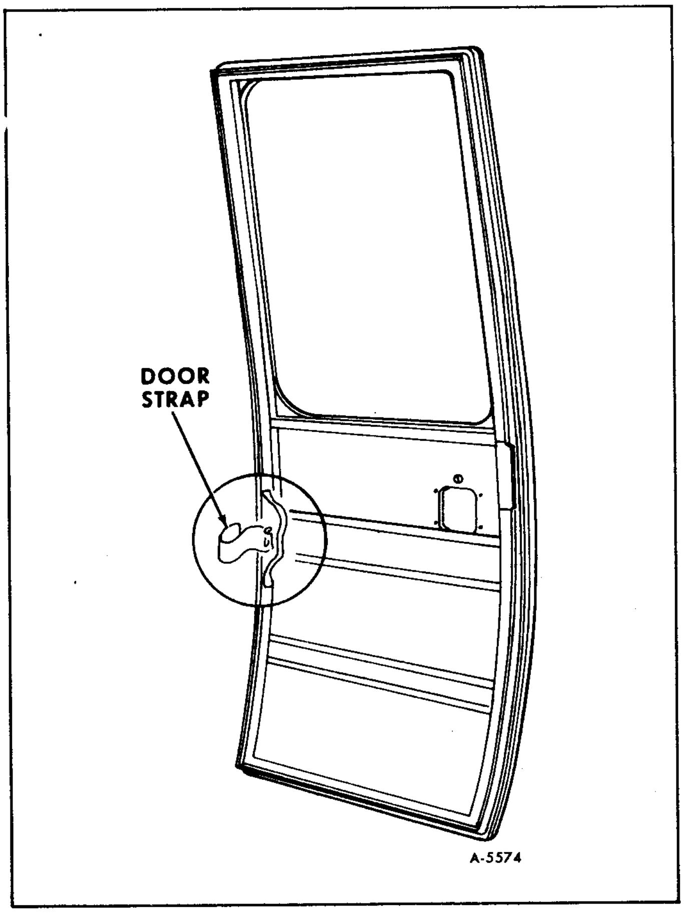


Figure 12—Door Strap

DOOR STRAP

The vehicle entrance door has a check strap (figure 12) to prevent the door from opening out too far and making contact with the body panel. The strap assembly and bracket hardware may be replaced if necessary.

END CAP

NOTE: When installing new or repaired rear access panel, 32 retaining screws are needed. The seven lower screws are self tapping. The remaining 25 screws on the sides and top of the rear access panel are double helix thread ("hi-low") screws. To prevent damage to the threads in the vehicle fiberglass body when hi-low screws are installed, position screw and then turn counterclockwise to engage screw in hole; then rotate screw clockwise to attach rear panel. IMPORTANT: Before screws are installed, sealing is required to prevent water leaks in the vehicle. Using caulking gun or any suitable applicator, apply a small amount of clear, air-dry rubber-based sealer into the screw holes in the fiberglass body. Sealer can be a butyl-type sealer, an RTV silicone, a windshield repair sealer, or equivalent.

FLOOR

GENERAL INFORMATION

The floor and floor sub-structure in 1977-78 model vehicles have changed. Refer to figure 13 for typical layout. Note that substructure may vary with specific optional equipment.

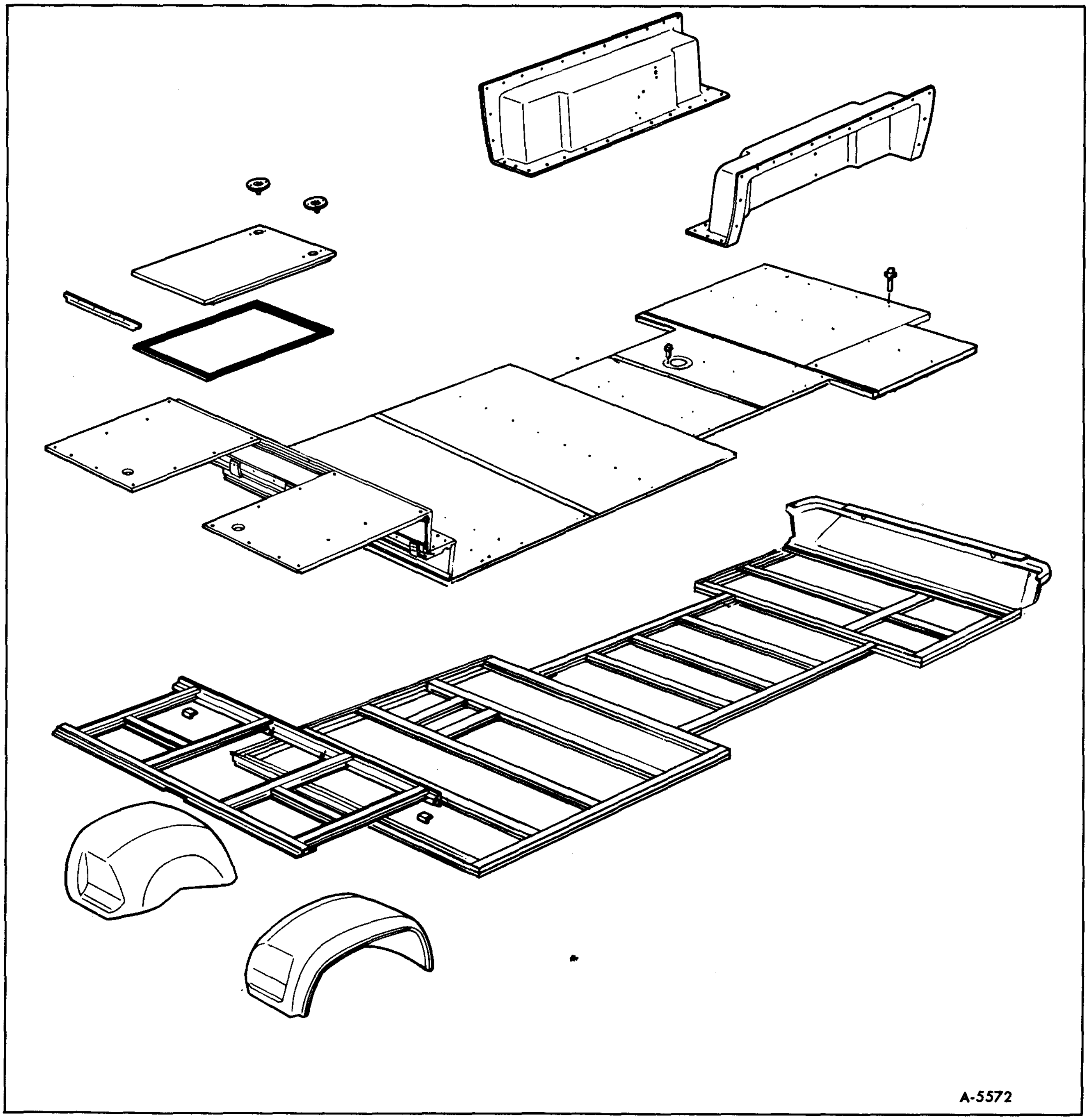


Figure 13—Wheel Housing, Floor and Floor Sub-Structure (Typical)

SECTION 1B
HEATING AND AIR CONDITIONING SYSTEM

CONTENTS

The following "Caution" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page two of this section".

CAUTION: 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 OF 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. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

SUMMARY OF AIR CONDITIONING/HEATING CHANGES

Changes in the air conditioning/heating system include the following:

1. Increased refrigerant charge capacity—now 3-3/4 lb.
2. New A/C heater control head and new control panel components.
3. New A/C plenum and revised duct system.
4. New vacuum system.
5. Revised heater and evaporator assembly.
6. Baffles added at condenser and heater/evaporator housing.
7. Addition of time delay relay in blower circuit wiring.
8. Externally equalized thermal expansion valve.
9. Smaller diameter high pressure service fitting on late 1977 model vehicles and on all 1978 model vehicles — fitting size is 3/8" - 24.
10. Revised compressor mounting.
11. Inverted vacuum tank mounting.
12. Revised Discharging, Evacuating and Charging Procedures.

These changes have different effective

points during the 1977 model year. All changes are current for 1978 model vehicles. Explanation of these changes will be discussed under the appropriate major category.

DESCRIPTION AND OPERATION

Both the heating and cooling functions are performed by an integrated air conditioning/heating system. Air entering the vehicle interior through the duct system must first pass through the cooling unit (evaporator) and then through or by-passing the heating unit (heater core), depending upon Temperature Lever selection. This system provides complete comfort control during any season of the year.

HEATING AND AIR CONDITIONING CONTROLS

Full control of the heating/air conditioning system is obtained through the use of a single control panel (figure 1). The panel is located in the instrument panel bezel in the upper right hand corner (above the optional radio controls). There are three separate levers on the control panal face: the System Selector Lever, the Temperature Lever, and the Fan Switch (figure 2).

These control levers make use of electrical and vacuum connections and a bowden cable to activate the various doors and switches necessary for system operation.

A brief explanation of the system operation at various lever settings follows.

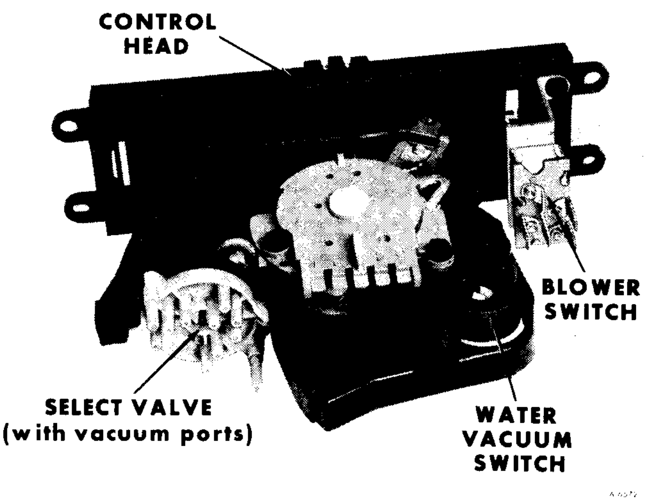


Figure 1—Control Panel Components

SELECTOR LEVER

The system Selector Lever determines the mode of system operation and the direction of outlet air flow inside the vehicle. When the system Selector Lever is placed in MAX, NORM, or DEFROST, electrical circuit connection is made to the compressor clutch through the control panel switch. If the low pressure switch is closed (ambient temperature above 40° to $45^{\circ}F$ (4° to $7^{\circ}C$), the compressor will run. When system Selector Lever is in OFF, VENT or HEATER positions, the compressor clutch is not energized.

Moving the lever from mode to mode varies the position of the rotary vacuum valve ("Select" valve) at the back of the control head. This nine-port vacuum valve will supply vacuum to, or vent, vacuum diaphragms which in turn position air doors in the heater/evaporator housing assembly and in the distribution box.

The position of these air doors determines if output air flow is directed from the heater outlet only (OFF), the heater outlet with slight air flow from the defroster nozzles (HEATER), the air conditioning registers only (MAX or NORM), the air conditioning registers with slight air flow from the heat outlet (VENT), or defrost nozzles with slight air flow from the heat outlet (DEFROST). Typical air flow patterns for specific control panel settings will be discussed later in this section.

The Selector Lever also provides a fixed HI fan speed and air recirculation operation for maximum cooling whenever MAX position is selected. There are no bowden cables connected to this lever.

TEMPERATURE LEVER

The Temperature Lever ("COLD" to "HOT")

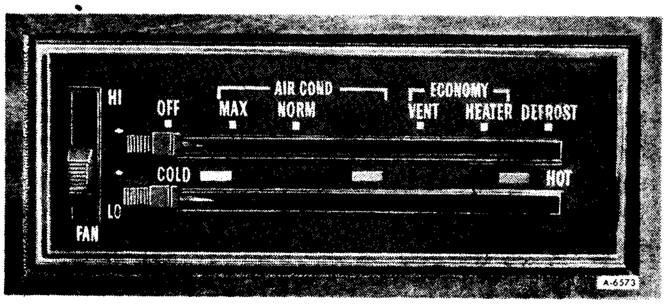


Figure 2—Control Panel Face

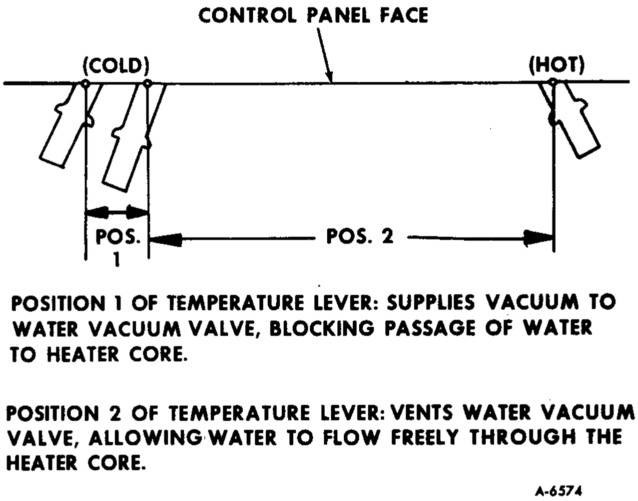


Figure 3—Temperature Lever Positions

(see figure 2) determines the temperature of outlet air flow from the system by positioning the temperature door in the heater/evaporator assembly. This movement is accomplished mechanically by means of a bowden cable. When the Temperature Lever is positioned fully to the left ("COLD"), the temperature door is fully closed and prevents air flow through the heater core. When the Temperature Lever is positioned midway in its range of travel, the temperature door is moved in proportion to allow more outside air to flow through the heater core and be warmed. When the Temperature Lever is positioned fully to the right ("HOT"), the temperature door is fully open and directs all outside air through the heater core.

The Temperature Lever also operates the water vacuum valve located in the heater water inlet line, at the heater/evaporator face panel. When the Temperature Lever is in Position 1, or"COLD" (figure 3), vacuum is supplied to the water vacuum valve, cutting off the flow of hot water through the heater core. Position 2 of the Temperature lever vents the water valve, allowing water to circulate freely through the core.

FAN SWITCH

The four-speed Fan Switch provides a means of selecting the amount of air flow from the system by regulating the speed of the blower motor. The blower operates at LO, two intermediate speeds, or HI, depending upon the setting of the Fan Switch lever. To provide constant ventilation in the vehicle, the blower motor electrical circuit is designed for continuous blower operation whenever the ignition switch is in the "RUN" position. It is not recommended that this system be rewired to provide an OFF position for the Fan Switch.

An electrical "override" to the Fan Switch is provided through the A/C control panel whenever the Selector Lever is in MAX position. This position automatically provides a "HI" blower speed, regardless of Fan Switch setting.

AIR CONDITIONING CYCLE OF OPERATION

Motorhome and TransMode vehicles operate with a cycling clutch thermostatic expansion valve (CCTXV) air conditioning refrigerant control system. The CCTXV system cycles "on and off" to maintain the evaporator core at approximately 32°F (0°C). Cooling is accomplished by circulating a refrigerant through closed lines and components of the system. Five major components, interconnected by rubber hose and metal tubing, are involved — (1) the compressor; (2) condenser; (3) receiver-dehydrator; (4) thermostatic expansion valve; and (5) evaporator core. Refer to figure 4 for a general schematic of the refrigeration system showing relationship of components on Motorhome and TransMode air conditioning/heating systems. Figure 5 shows location of air conditioning refrigerant system components on the vehicle itself.

Explanation of the basic refrigeration cycle is as follows: Refrigerant enters a finned coil core, over which the air to be cooled passes. This is known as the "evaporator". When warm air is blown over the evaporator surface, heat from the air is absorbed by the refrigerant inside, cooling the air and causing the refrigerant to boil and vaporize.

By the time the refrigerant leaves the evaporator, much of it has vaporized (through the process of boiling) and its temperature has warmed slightly.

Once the vapor is out of the evaporator, all that is needed is to remove the heat it contains. Since heat is the only thing that expanded the refrigerant from a liquid to a vapor in the first place, removal of that same heat will let the vapor condense into a liquid again. Then the liquid refrigerant can be returned to the evaporator to be used over again.

Actually, the vapor coming out of the evaporator is very cold. Liquid refrigerant boils at temperatures considerably below freezing, and the vapors arising from it are only a shade warmer even though they do contain quantities of heat. Consequently, heat cannot be re-

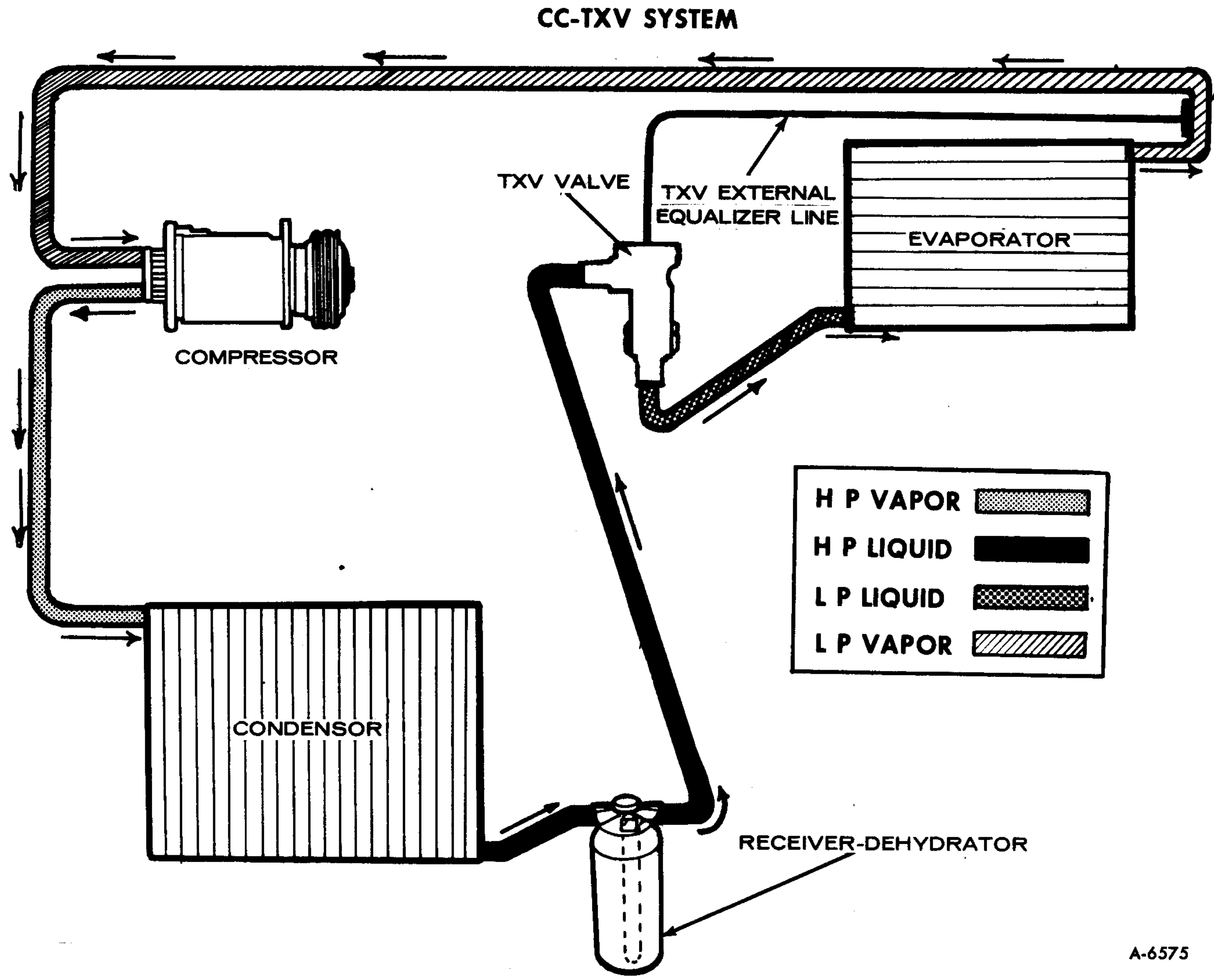


Figure 4—Refrigeration System Schematic

moved from sub-freezing vapors by "cooling" them in air temperatures that usually range from 60-100°F (15-38°C). . . heat only flows from a warm object to a cold object.

But with a pump, the heat-laden, low-pressure vapor can be squeezed into a smaller space. And when the vapor is compressed, it becomes hotter. This is the job of the compressor. The heat-laden refrigerant is drawn from the evaporator outlet through the "suction" line into the compressor, where it is subjected to compression. Now this vapor is hot enough to be cooled off in warm air. At the same time, the refrigerant's pressure is raised above the condensing point at the temperature of the surrounding air so that it will condense.

Then, refrigerant vapor that has been compressed is pumped at high pressure through the compressor discharge line to the condenser. The condenser is a radiator-like component with no moving parts. The purpose of the condenser, as the name implies, is to condense

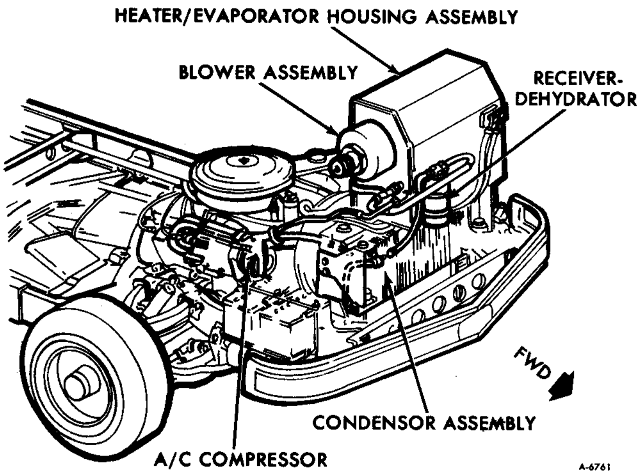


Figure 5—Location of Air Conditioning Refrigeration System Components, Typical

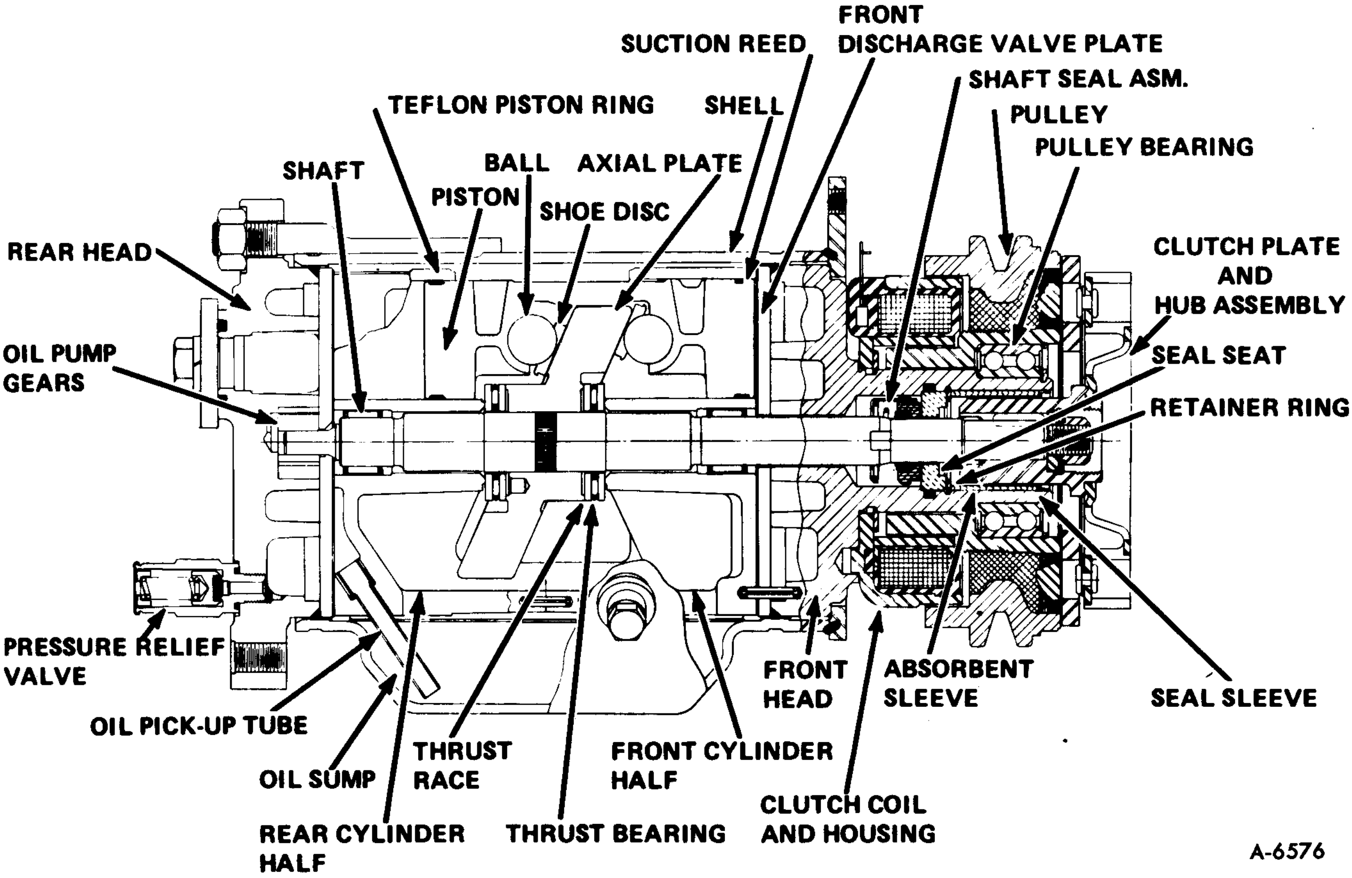


Figure 6—Compressor Cross-Sectional View

the high-presure, high-temperature refrigerant vapor into a high-pressure liquid refrigerant. This happens as the refrigerant passes through the condenser, giving up much of its heat to the air going across the metal surfaces of the condenser.

The liquid refrigerant, which is still under high pressure, travels from the condenser outlet to the receiver-dehydrator. The receiver-dehydrator acts as a reservoir, assuring a constant column of liquid refrigerant to the thermostatic expansion valve, which is installed in the refrigerant line at the evaporator inlet.

The expansion valve meters the liquid refrigerant into the evaporator as required by the evaporator outlet temperature and pressure. During normal operation the refrigerant enters the expansion valve as a medium-temperature, high-pressure liquid. As it passes through the valve orifice it becomes a low-pressure, low-temperature liquid. The liquid refrigerant in the evaporator boils (vaporizes) and the cycle is repeated.

CYCLING CLUTCH

The refrigerant cycle, however, is not constant. When the evaporator temperature drops below a specified value, a temperature sensing switch cycles the compressor on and off to prevent condensate from freezing on the evaporator core. This cycling helps to control the temperature of air flowing from the evaporator as well as insuring maximum air flow through the core. This basic principle is known as the cycling clutch. In the cycling clutch thermostatic expansion valve system (CCTXV), the compressor pumps refrigerant through the system only as long as necessary to maintain the comfort level as selected by the setting of the temperature lever on the A/C control panel.

During some air conditioning operating conditions, slight increases and decreases of engine speed/power may be noticed. This should be considered normal, as the system is designed to cycle on and off.

When the ignition switch is turned "OFF" with the air conditioning controls still "ON", refrigerant pressures in the air conditioning system will stabilize as the refrigerant flows from the high pressure side of the system to the low pressure side of the system. This may be detected audibly as a faint sound of liquid flowing for 30 to 60 seconds, and is a normal condition.

REFRIGERATION AND HEATING COMPONENT OPERATION

COMPRESSOR

The prime purpose of the compressor (figure 6) is to take the low pressure refrigerant vapor produced by the evaporator and compress it into a high-pressure, high-temperature vapor which will be sent on to the condenser.

It utilizes the principle that "when a vapor is compressed, both its pressure and temperature are raised". The compressor is mounted above the engine in a special mounted bracket and is belt driven from the engine through an electromagnetic clutch pulley on the compressor.

The compressor has three double-acting pistons, making it a six cylinder compressor. The compressor has a 1.5 inch bore and 1.1875 inch stroke, giving it a total displacement of 12.6 cu. in. Identification of the compressor is by model and code number stamped on a plate on top of the compressor.

Clutch and Pulley Assembly

The armature plate is the movable member of the clutch. The plate is attached to a driven ring by driver springs, which are riveted to the armature plate and the driven ring. The driven ring is attached to the clutch hub by a rubber disc, which is bonded to both the driven ring and the clutch hub. The clutch hub is pressed onto the compressor shaft and is aligned with a square drive key located in the keyway of the compressor shaft. This hub and drive plate assembly is retained by a spacer and retainer ring (assembled to the shaft) and is held in place with a hexagonal lock nut.

The rubber disc isolates the compressor shaft from the drive pulley to prevent vibrations from being transmitted either into or out of the compressor shaft.

The pulley hub and ring assembly consists of three parts:

1. Pulley rim, which contains the belt groove.
2. Power element ring.
3. Pulley hub.

These parts are formed into an assembly by molding a frictional material between the hub and the rim. The power element ring is embedded in the forward face of the assembly, between the outer rim and the inner hub.

A two-row ball bearing is pressed into the hub of the pulley and held in place by a retainer ring. This pulley and bearing assembly is pressed over the front head of the compressor and held in place by a retainer ring.

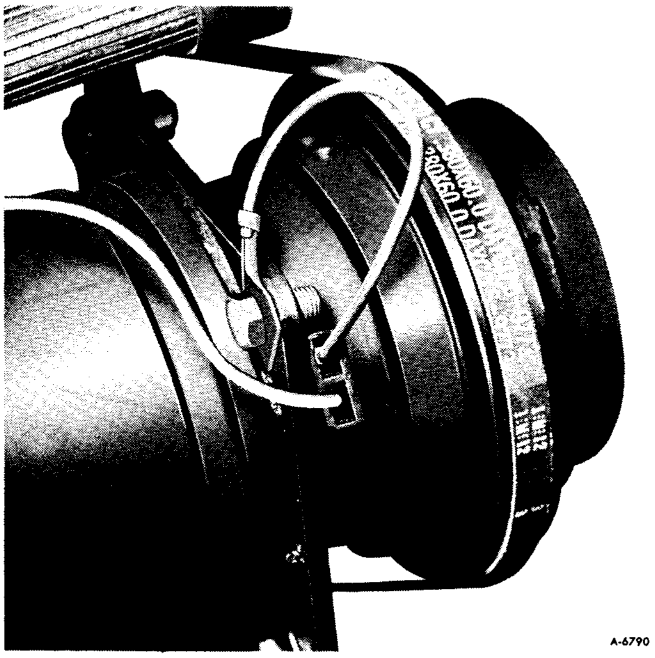


Figure 7—Compressor Clutch Electrical Connections

Clutch Coil

The coil is molded into the coil housing and must be replaced as a complete assembly. Three protrusions on the rear of the housing fit into alignment holes in the compressor front head. A retainer ring secures the coil and housing in place. The coil has 3.85 ohms resistance at 80°F (27°C) ambient temperature and will require no more than 3.2 amperes at 12 volts DC. Since the clutch coil is not grounded internally, a ground lead is required as well as a "hot" lead (figure 7). This will be discussed in greater detail under "Electrical Component Operation" later in this section.

Shaft Seal

The main shaft seal, located in the neck of the compressor front head, consists of the seal assembly with its carbon seal face in a spring loaded cage. An O-ring seal, located within the carbon seal, provides a seal to the shaft surface. The contact surface of the shaft seal and ceramic seal seat are finished to a high polish and must be protected against nicks, scratches and even fingerprints. Any surface damage will cause a poor seal. An O-ring, located in an internal groove in the neck of the front head provides a seal with the outer diameter of the seal seat. A retainer ring, tapered side away from the seat, secures the seat in place. The hub and armature plate felt sleeve and sleeve retainer must be removed to gain access to the seal. A shaft seal kit contains all necessary replacement parts for

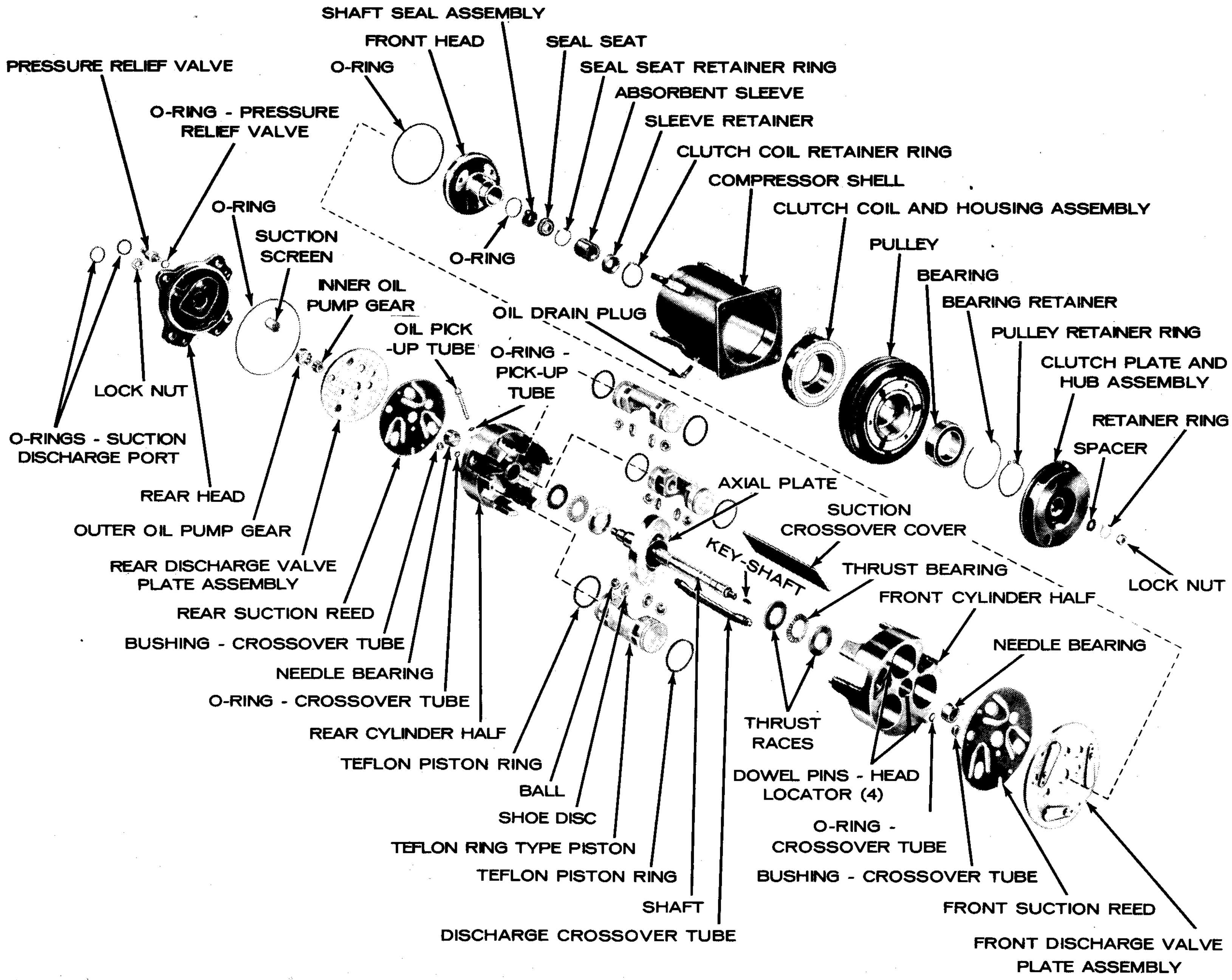


Figure 8—Compressor Components

field service.

After removing the clutch drive, pulley and bearing and coil housing assemblies, the rear head and internal mechanism (figure 6) may be removed from the compressor shell. Four threaded studs, welded to the compressor shell, locate the rear head and four lock nuts secure it in place.

Rear Head

The rear head (figure 8) has a machined cavity in the center for the oil pump gears. This cavity, in all clockwise rotation compressors, is machined so that the eccentricity of the bore is approximately .042 inch to the LEFT of the centerline of the cavity. The counterclockwise rotation compressor used in some other systems has the eccentricity machined approximately .042 inch to the RIGHT of the cavity centerline.

A small .187" diameter hole is drilled in the rear head near the lower left mounting hole.

Mainshaft

The central mainshaft, driven by the clutch-pulley when the coil is energized, extends through the front head to the rear head and oil pump cavity of the compressor. The shaft revolves in needle roller bearings located in the front and rear halves of the cylinder assembly. A 3/16" internally drilled passage extends through the shaft from the rear oil pump cavity to the shaft seal cavity in the front compressor head. Four .078 inch holes, drilled at 90° to the main passage, direct oil under pump pressure to the shaft seal surfaces, thrust bearings and shaft-cylinder bearings.

Axial Plate

The axial plate is an angular shaped member pressed onto the mainshaft forming the mainshaft and axial plate assembly (figure 8). Knurling on the shaft and press fit of the axial plate to the shaft prevent movement of the plate around the shaft. Location of the plate on the shaft is factory set and must not be changed. The very smooth angular faces of the plate are ground to be parallel within .0003 inches of each other. The plate changes the rotating action of the shaft into the reciprocating driving force for three pistons. The driving force is applied, through the drive balls and ball seats (shoe discs) to the midpoint of each of the double end pistons.

Cylinder Block

The cylinder block consists of a front and a rear half. Three piston bores are line bored in each half during production to assure proper alignment and parallelism. The two halves must be serviced as an assembly to assure correct relationship of parts. The shaft bearings are included and in place in the service assembly.

Pistons

The cast aluminum double end pistons (figure 8) have special grooves to receive teflon piston rings. A notch in the casting web of each piston identifies the end of the piston which should be positioned toward the front end of the compressor. A spherical cavity is located on both inner faces of each piston to receive the piston drive balls.

Drive Balls

The hardened steel drive balls have a micro-finish. They are manufactured to a .0001 inch spherical tolerance and a .6248 - .6250 inch diameter tolerance.

Shoe Discs

The bronze shoe discs have one flat side, which contacts the axial plate, and one concave surface into which the drive ball fits. Ten discs are provided in .0005 inch thickness variations including a basic ZERO disc for simple field gauging operations. Discs are marked with their size which corresponds to the last three digits of the piece part number.

Thrust Bearings

The thrust bearings, sandwiched between two thrust races, are located between the shoulders of the axial plate and the shoulders of both the front and rear cylinder hubs.

Thrust Races

The steel thrust races are ground to fixed thicknesses. A total of 16 races in increments of .0005 inch thickness are available for field service. As in the case of the ball seats the thrust races will be identified on the part by their thickness, the number on the race corresponding to the last three digits of the piece part number. The FRONT combination of a "ZERO" race, bearing and "ZERO" race is selected to provide the proper head clearance between the top of the piston and the underside of the suction and discharge valve plates. The REAR end combination of "ZERO" thrust race, bearing and selected race is selected to obtain proper operating preload of the bearings and races for quiet operation of the compressor assembly (figure 9).

Oil Pump Gears

The oil pump gears are made of sintered

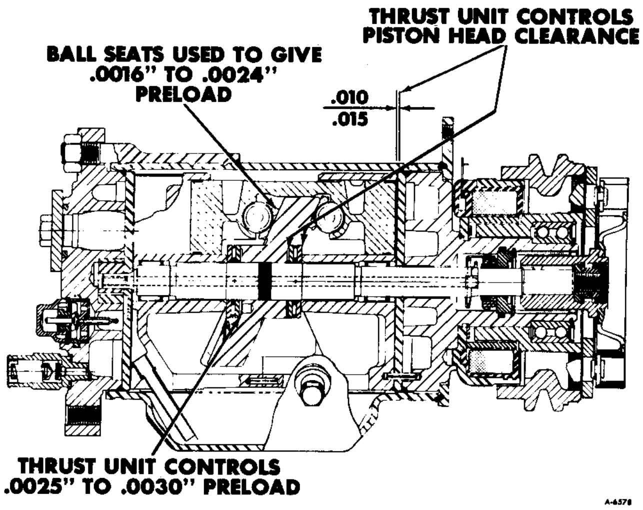


Figure 9—General Running Tolerances

iron. The inner, or driver gear has a "D" shaped hole in the center which fits over a similar area on the rear of the mainshaft. Both gears have a mark on one side for proper gear match identity.

Shell

The compressor shell has a mounting flange on the front end and four threaded studs welded to the outside of the rear end. The oil sump is formed into the shell and a baffle plate is welded over the sump on the inside of the shell.

Heads

Both front and rear heads have an irregular shaped casting web. These webs provide the

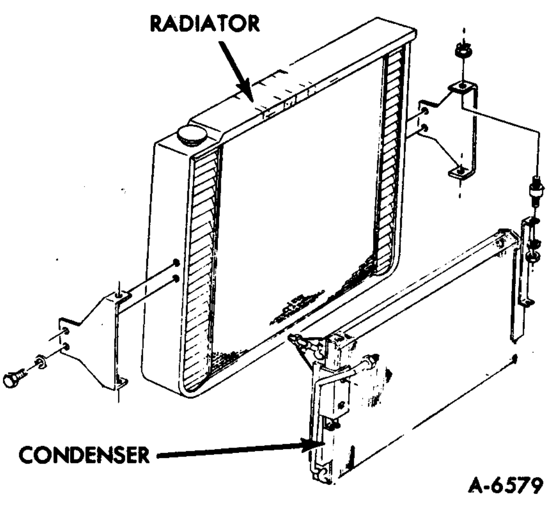


Figure 10—Condenser Location

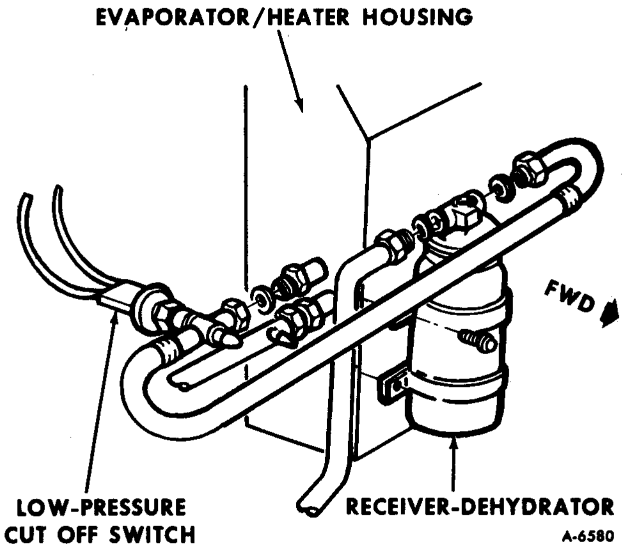


Figure 11—Receiver-Dehydrator Location

necessary seals to the surfaces of the discharge plates and prevent high pressure vapor from flowing into the low pressure cavity.

Suction Screen

A fine mesh inlet (or suction) screen is located in the low pressure cavity of the rear head. Its purpose is to stop any material which could damage the compressor mechanism.

Suction Crossover Cover

The suction crossover cover is assembled into the dove-tail cavity in the cylinder casting to form a passage for the low pressure vapor to flow from the rear head of the compressor to the front head.

Discharge Crossover Tube

Since the double acting pistons pump high pressure vapor at both ends of the compressor, the discharge tube is needed to supply a path for the high pressure vapor to pass from the front to the rear head. Should the cylinder halves be separated during service operations a service type discharge tube, bushings and O-rings must be substituted.

Suction Reed Valves

A separate three-reed suction valve disc is assembled to both front and rear heads. These reeds open when the piston is on the intake portion of the stroke to allow the low pressure vapor to flow into the cylinder. When the piston reverses and begins the compression portion of its stroke the reed valves close against their seats, thus preventing the high pressure vapor from being forced back into the low side of the system.

Discharge Valves

The two discharge valve plate assemblies act to direct high pressure vapor into the head castings. When the piston reverses into its suction stroke the high pressure on the opposite side of the plate causes the reeds to close, thus maintaining the differential of pressure between high and low pressure areas. The discharge plates include the valves and the retainers which prevent the high pressure from distorting the valves during the pressure stroke of the piston.

Head to Shell Seals

Two large diameter O-rings internally seal the front and rear heads to the shell. A chamfered edge on the head castings creates a squeezing action between the discharge valve plates, and the inside surface of the compressor shell.

Compressor Connector

Compressor connectors are attached to the compressor rear head by means of a single bolt and lock washer. All have inlet and outlet connections connected by a strap to form an integral unit.

Pressure Relief Valve

The pressure relief valve, located on the compressor rear head, is simply a safety valve designed to open automatically if the system pressure should reach a predetermined level high enough to cause system damage. After the pressure drops to a safe level the valve will close. After such an occurrence, the system should be thoroughly checked to diagnose and correct the cause of the abnormal pressure increase.

CONDENSER

The condenser (figure 10) is an assembly similar in appearance to the ordinary radiator but able to withstand much higher pressures.

Made completely of aluminum, this unit consists of serpentine tubes assembled into cooling fins which provide rapid transfer of heat from the refrigerant to the air flowing through the condenser.

In this refrigerant system the condenser connects between the discharge side of the compressor and the inlet side of the receiver-dehydrator.

The condenser functions as follows: High-pressure high-temperature vapor is pumped from the compressor to the condenser. The heated vapor which enters near the top of the condenser is cooled by giving off heat to the metal finned surfaces of the condenser. The heat is then extracted from these metal surfaces by the ram air or fan air passing over the condenser. Meanwhile, as the refrigerant vapor gives up its heat to the condenser surfaces, it condenses into a liquid.

Refrigerant temperatures found in the condenser normally range from 120-200°F (49 to 93°C), while pressures are normally between 150 and 300 psi.

The condenser is located in front of the engine cooling system radiator so that it receives a high volume of air from the movement of the vehicle and from the engine fan.

RECEIVER-DEHYDRATOR

The receiver-dehydrator (figure 11) receives liquid refrigerant (and some refrigerant vapor) from the condenser, and removes any moisture present in the refrigerant. This moisture removal is accomplished by means of a chemical compound called a desiccant. The desiccant is held in place in a felt bag in the receiver-dehydrator. Average receiver-dehydrator desiccants collect and hold about 50 drops of water.

The receiver-dehydrator also filter-traps any foreign matter which may have entered the system during assembly or during any service work. This is accomplished by means of a fine wire screen mounted on the end of the liquid pick-up tube.

In addition to moisture removal, the receiver-dehydrator acts as a reservoir to furnish a constant column of liquid refrigerant to the expansion valve. Since the liquid refrigerant entering the receiver may have some vapor in it, the tank itself acts as a separator. Vapor will tend to rise and the liquid will drop to the bottom. This is why the pick-up tube extends to the bottom of the tank, insuring vapor free liquid R-12 to the expansion valve. Storage of the refrigerant is temporary, and is dependent upon the demand placed upon it by the expansion valve.

Located between the condenser outlet and the evaporator inlet, the receiver-dehydrator is not servicable. It should be replaced when there has been a leak in the suction side of the system (permitting air and moisture to be drawn into the system) or when at any time, evidence of "free moisture" is noted in the system. This would be evident from corrosion or corroded particles noted during service.

Sight Glass

There is a sight glass built into the receiver-dehydrator (figure 12). This glass can be a valuable aid in diagnosis by permitting the refrigerant to be observed. The appearance of

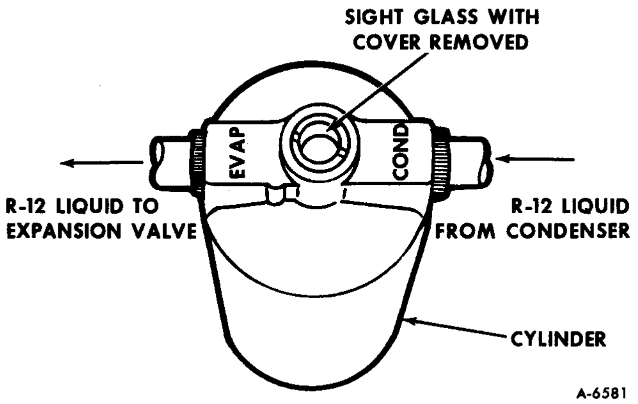


Figure 12—Sight Glass

a steady flow of bubbles, or a broken column of refrigerant under the glass indicates (under certain conditions) a shortage of refrigerant in the system.

The receiver-dehydrator sight glass has a dust cap that should be kept in place when the sight glass is not in use.

For further information regarding diagnosis with use of sight glass, refer to "Air Conditioning Diagnosis" later in this section.

EVAPORATOR (FIGURE 13)

The function of the evaporator is to cool and dehumidify the air before it enters the passenger compartment. The evaporator assembly consists of an aluminum core enclosed in sheet metal housing and is located at the front of the vehicle chassis. There are two water drain holes located in the bottom of the housing, and two refrigerant lines are connected to the evaporator core: the small inlet line and the larger outlet, or suction line. A thermostatic expansion valve is attached in

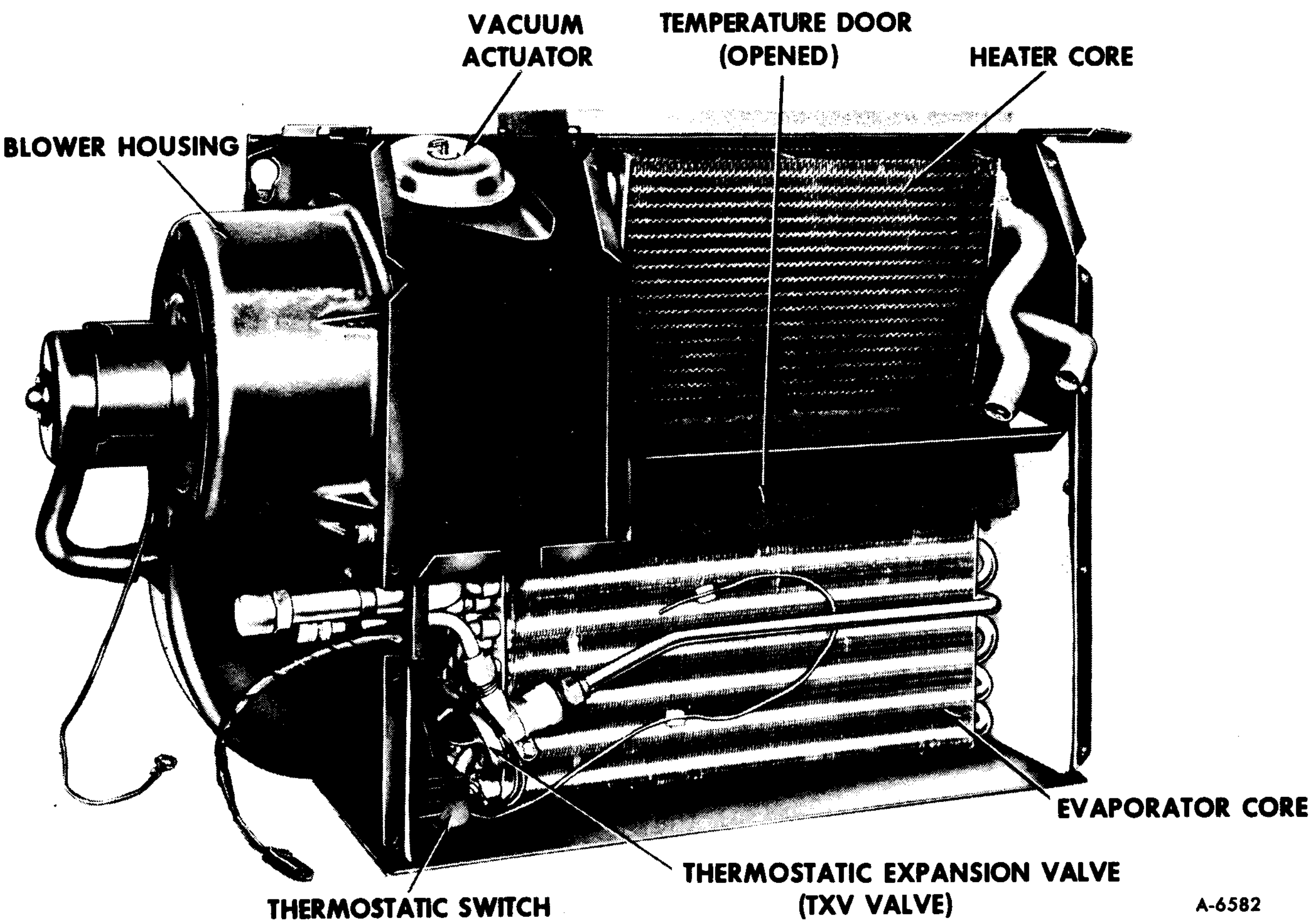


Figure 13—Evaporator Housing Components

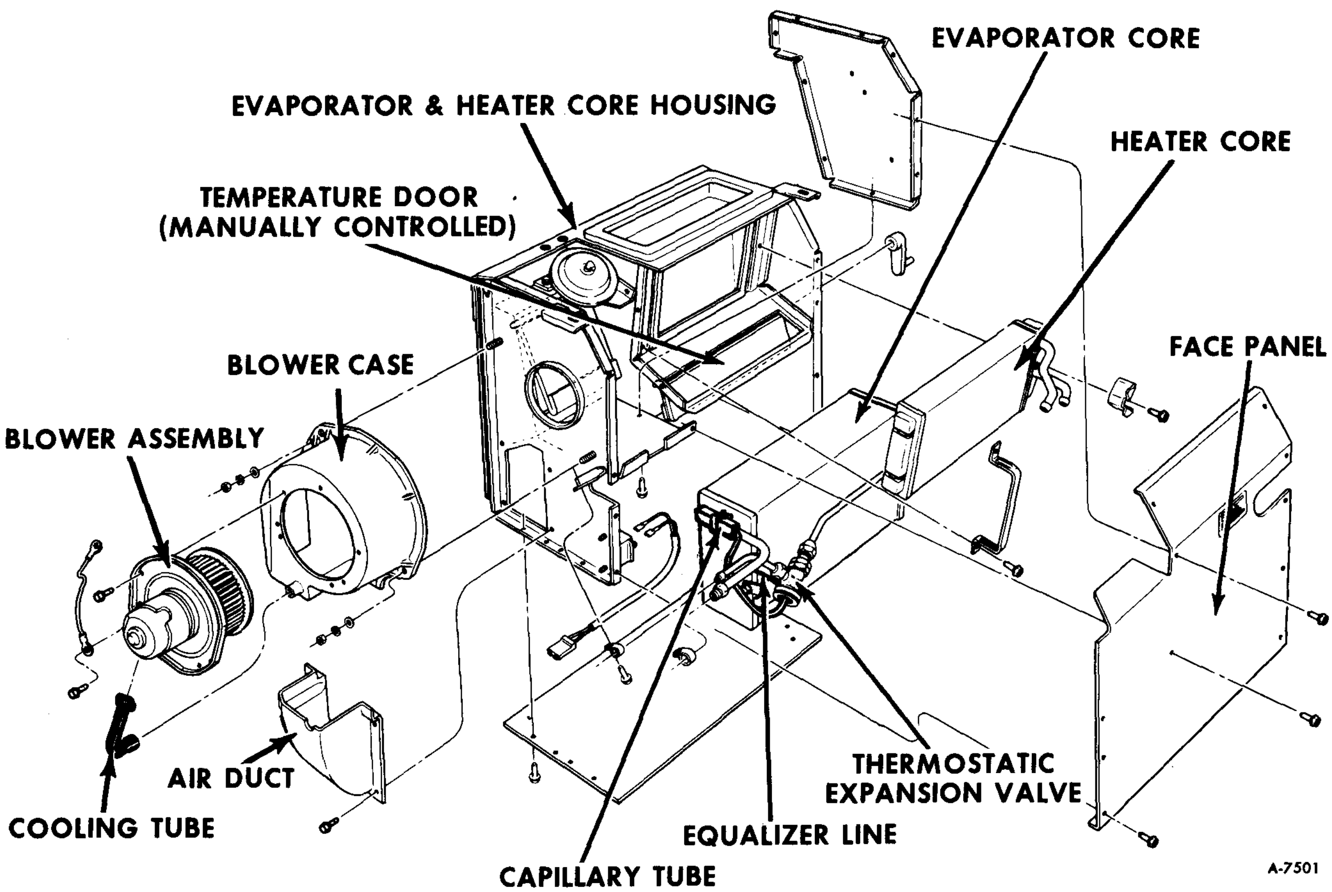


Figure 14—Evaporator and Heater Housing Components, Typical

the smaller diameter inlet line, and the temperature-sensing bulb of this valve is clamped to the outlet pipe of the evaporator core (refer to figure 14).

The refrigerant cycle in the evaporator is as follows: High pressure liquid refrigerant is metered through the expansion valve, where it expands to a low-pressure liquid and flows into the evaporator core. As the refrigerant absorbs heat from the air that passes over the evaporator fins, the liquid boils (vaporizes) at this low pressure into low-pressure low-temperature refrigerant. Air passing over the evaporator fins is then cooled, providing cool air for the passenger compartment. If heat is called for by the A/C control head, this air will be "reheated" by passing through the heater core.

As the air passes over the evaporator fins moisture in the air condenses on the evaporator surface and is drained off, carrying dust and pollen with it.

Evaporator temperature must be controlled so that the water collecting on the core surface will not freeze and form ice, blocking off air passage through the core. Freeze protection control on Motorhome and TransMode evaporators is provided by a cycling thermostatic switch. (See "Thermostatic Switch" for description of function.)

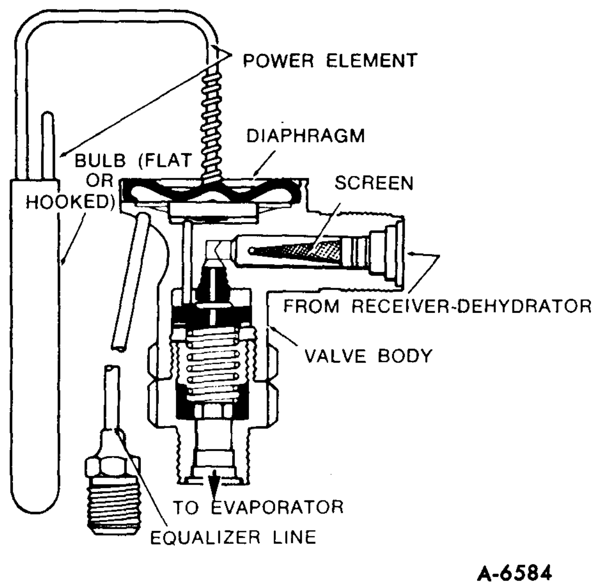


Figure 15—Expansion Valve Cross Section

Evaporator air temperature will vary from approximately 40°F (4°C) to approximately 55°F (13°C).

THERMOSTATIC EXPANSION VALVE (REFER TO FIGURE 15)

The thermostatic expansion valve is located just inside the heater/evaporator housing (passenger side) and is connected to the refrigerant inlet line (see figure 13). The purpose of this valve is to meter the liquid refrigerant into the evaporator core. The expansion valve is the dividing point in the system between high and low pressure liquid refrigerant. The valve consists primarily of a valve body (including orifice, valve, operating pins, spring and screen) and a power element (diaphragm, capillary tube and bulb).

All vehicles now have an externally equalized expansion valve — that is, the valve has an additional equalizer line connected to the evaporator discharge line. The equalizer line is used primarily to prevent prolonged or constant operation of the compressor under conditions where it is not receiving enough refrigerant. Such operation would be undesirable due to the resultant noise factor and also due to the possiblity of subjecting the compressor to reduced oil return. The equalizer line functions to permit the outlet pressure of the evaporator to be imposed on the diaphragm of the expansion valve. When the outlet pressure of the evaporator drops below a predetermined pressure, this decrease in pressure is also transmitted to the diaphragm of the expansion valve via the equalizer line. The expansion valve is caused to open and flood refrigerant through the evaporator, thereby resulting in an increase in the evaporator pressure. This action only occurs during times when the compressor capacity becomes greater than the evaporator output with the resultant drop in evaporator outlet pressure.

During normal operation, refrigerant enters the expansion valve as a medium-temperature, high-pressure liquid from the receiver-dehydrator. As it passes through the valve orifice, it becomes a low-temperature, low-pressure liquid. As the liquid absorbs heat, vapor is formed. By the time the vapor leaves the evaporator, its temperature has increased several degrees higher than that of the liquid from which it was produced.

The quantity of liquid leaving the expansion valve (i.e., into the evaporator core) is controlled by both the temperature of the power element bulb and the pressure of the liquid in the evaporator.

NOTE: It is very important that the power element capillary bulb be tightly clamped (full length of bulb) to the suction line at the evaporator. Both the suction line and the capillary bulb should be clean at the points of contact. Do not kink capillary tube when removing or installing.

The expansion valve is factory adjusted to control the refrigerant liquid level going into the evaporator. The only component of the valve that may be replaced is the screen, which can become plugged if any dirt or corrosion particles are circulating in the system.

FAN SLIP CLUTCH

A special engine fan is used. It is a seven-bladed fan, limited by means of a viscous clutch to a maximum speed of 3200 rpm, regardless of the speed of the engine. The silicone fluid in the clutch transmits only enough torque to drive the fan at this limited speed, thus avoiding excessive noise and power consumption by the fan at higher engine speeds. A temperature modulating device further limits fan speed to 1000 rpm until ambient temperature at the modulating device reaches 140°F (60°C) at which time fan speed will be allowed to increase to 3200 rpm.

REFRIGERANT LINES

Special refrigerant hose lines are required to carry the refrigerant liquid and vapor between the various system components. The hose line with the smallest diameter is called the high pressure liquid line. It is routed from the condenser or receiver-dehydrator to the evaporator or thermostatic expansion valve. The large diameter hose line connecting the compressor and evaporator is the low pressure vapor line. The large diameter hose between the compressor and condenser is the high pressure vapor discharge line.

These hoses are constructed with a synthetic material core covered with a woven metal mesh which is, in turn, covered by a woven fabric and coated for extra protection. This

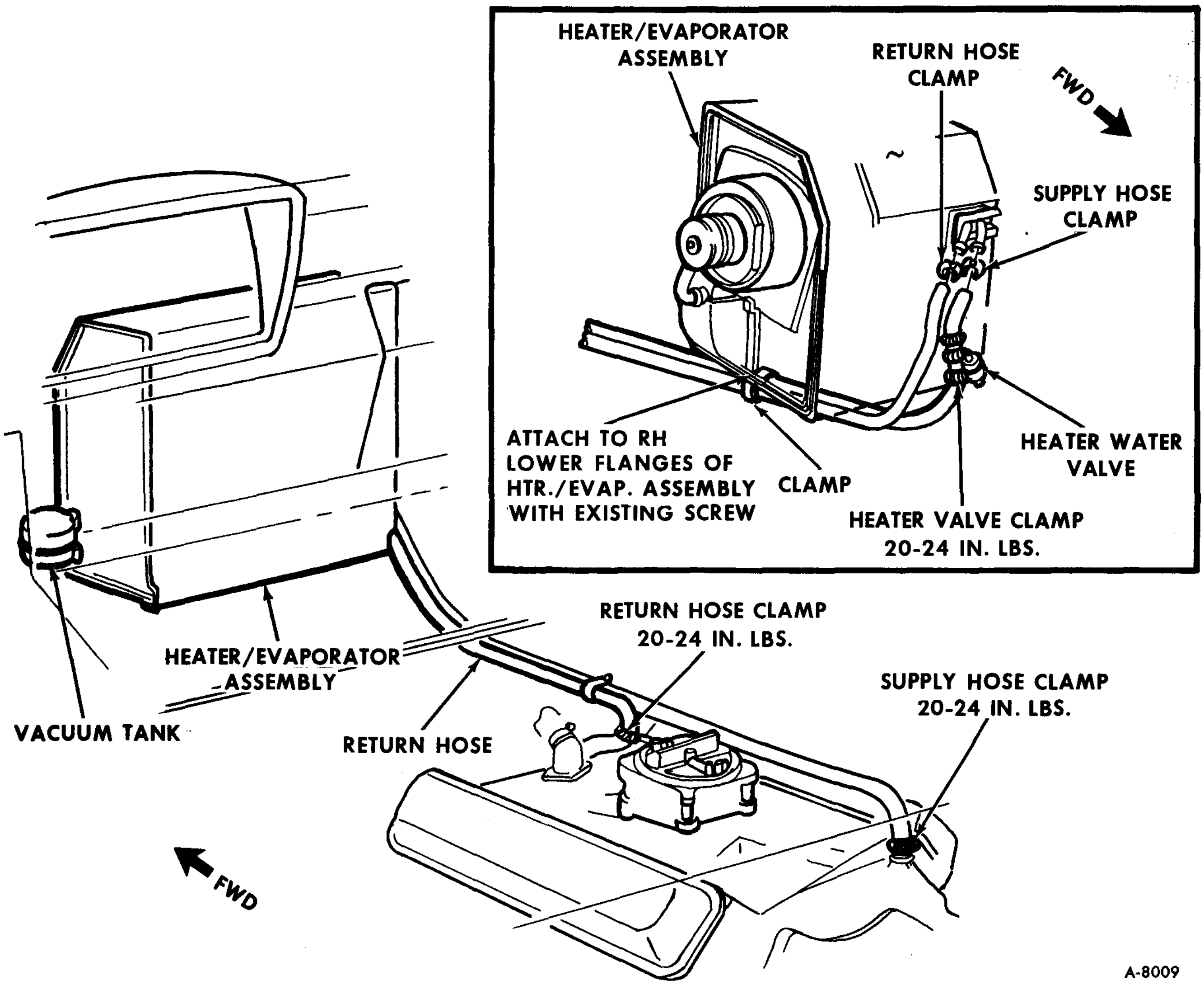


Figure 16—Heater Hoses

hose is constructed to withstand the extreme pressures and temperatures found in the modern refrigeration system. None but special refrigerant-type hoses should be used.

All systems make use of swaged-type connections (hose to metal fittings) with metal to metal fittings being made O-rings. Care must be taken when making these connections that they not be turned down too tightly or damage to the O-rings may result. Consult the torque chart for refrigerant line connection torques.

Flexible refrigerant hoses should not be permitted to contact the hot engine manifold nor should they be bent into a radius of less than 10 times their diameter.

HEATER HOSES

Heater hoses are routed from the water pump and thermostat housing to the heater core inlet and outlet pipes (figure 16) and return to the engine block. Hoses are attached at each end with screw-type clamps.

ELECTRICAL COMPONENT OPERATION

COMPRESSOR CLUTCH ASSEMBLY

The clutch assembly (refer to figure 6) consists of the coil, pulley and armature. The

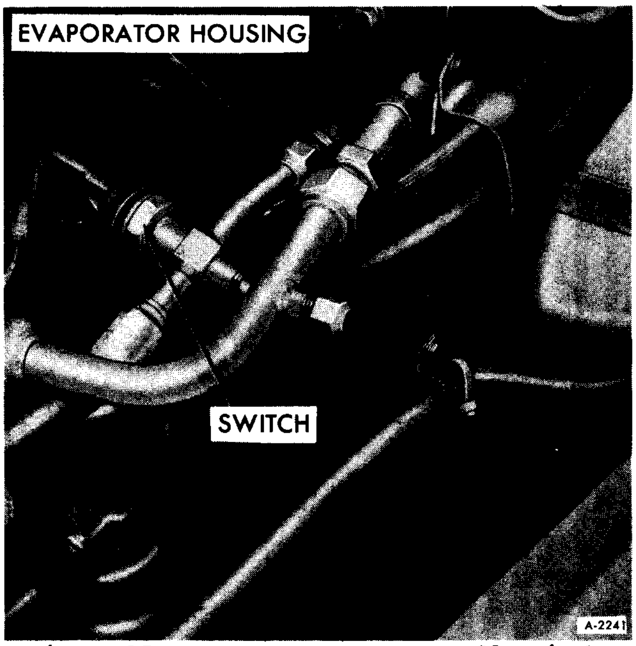


Figure 17—Low-Pressure Cut-Off Switch

coil is basically an electro-magnetic device energized by the battery. When energized, it sends a magnetic force through the soft iron in the pulley, which is constantly turning as a result of being belt driven by the engine, to the armature. The armature is keyed to the compressor shaft. When magnetically energized the armature is pulled into the pulley, causing the compressor to be activated.

LOW-PRESSURE CUT-OFF SWITCH

The compressor discharge pressure switch, or low-pressure cut-off switch (figure 17) performs the function of shutting off the

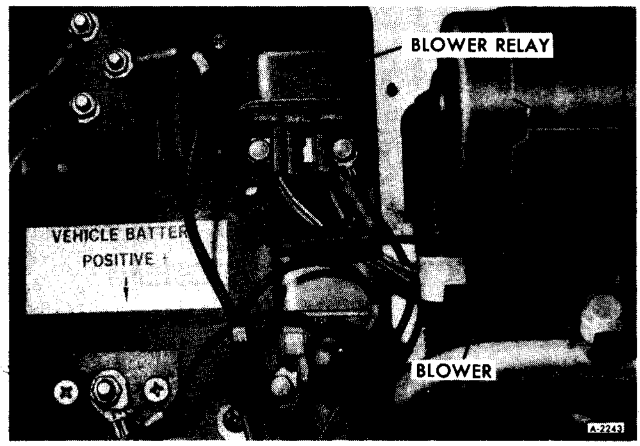


Figure 18—Blower Relay

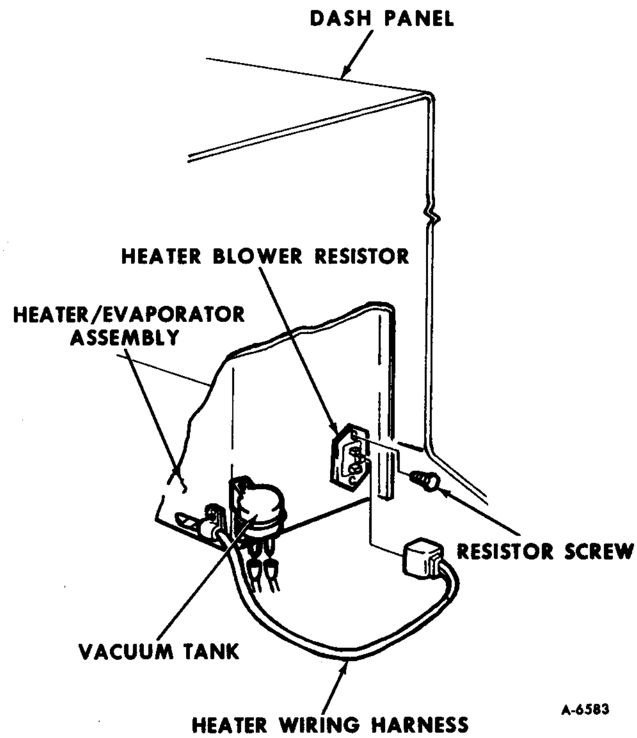


Figure 19—Blower Resistor

compressor when it senses low refrigerant pressure. Located in the evaporator inlet line (high pressure line), the switch electrically is wired in series between the compressor clutch, the thermostatic switch, and the master switch on the air conditioning control panel. When the pressure drops below 37 psi, the switch breaks contact and opens the electrical circuit to the compressor clutch, thus shutting off the A/C system and preventing compressor failure or seizure. The switch should normally be closed at all pressures above 37 psi (+5, -0).

The switch also performs the function of the ambient switch or outside air temperature sensor, as the pressure of the refrigerant at the switch varies directly with ambient temperatures. When the outside air temperature drops below 25°F (-4°C), the reduced system pressure keeps the compressor turned off.

In A/C modes, the air conditioning compressor should run above 45°F (7°C) ambient or approximately 42 psi at the switch.

The switch interacts with other electrical switches in the refrigeration system electrical system; in an A/C system where the compressor will not operate above 45°F (7°C) ambient, the following components should be checked for continuity:

1. Compressor discharge pressure switch.
2. Master switch (on control head).
3. Thermostatic switch.

If switches show proper continuity, check the wiring harness for loose, open or improper ground conditions.

THERMOSTATIC SWITCH

The thermostatic switch (refer to figure 13), mounted inside the evaporator/heater housing (blower side), is basically a bimetal switch whose function in the system is to cycle the compressor on and off. Need for cycling is determined by evaporator core temperature.

The thermostatic switch is controlled by a temperature sensing capillary tube (see figure 14) mounted across the face of the evaporator core. As the discharge air cools the sensing tube, the bimetal switch breaks the compressor clutch electrical circuit and cycles the compressor off until the sensing tube becomes warm enough to cycle the compressor back on.

If the thermostatic switch does not cycle

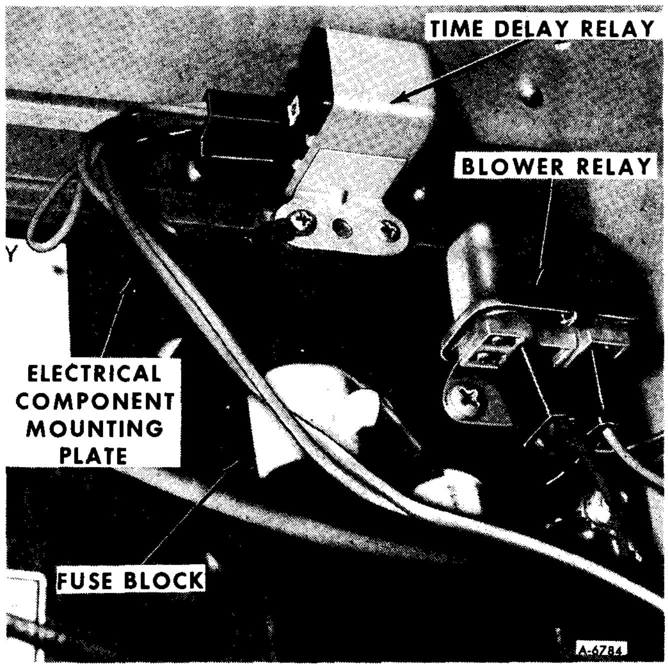


Figure 20—Time Delay Relay

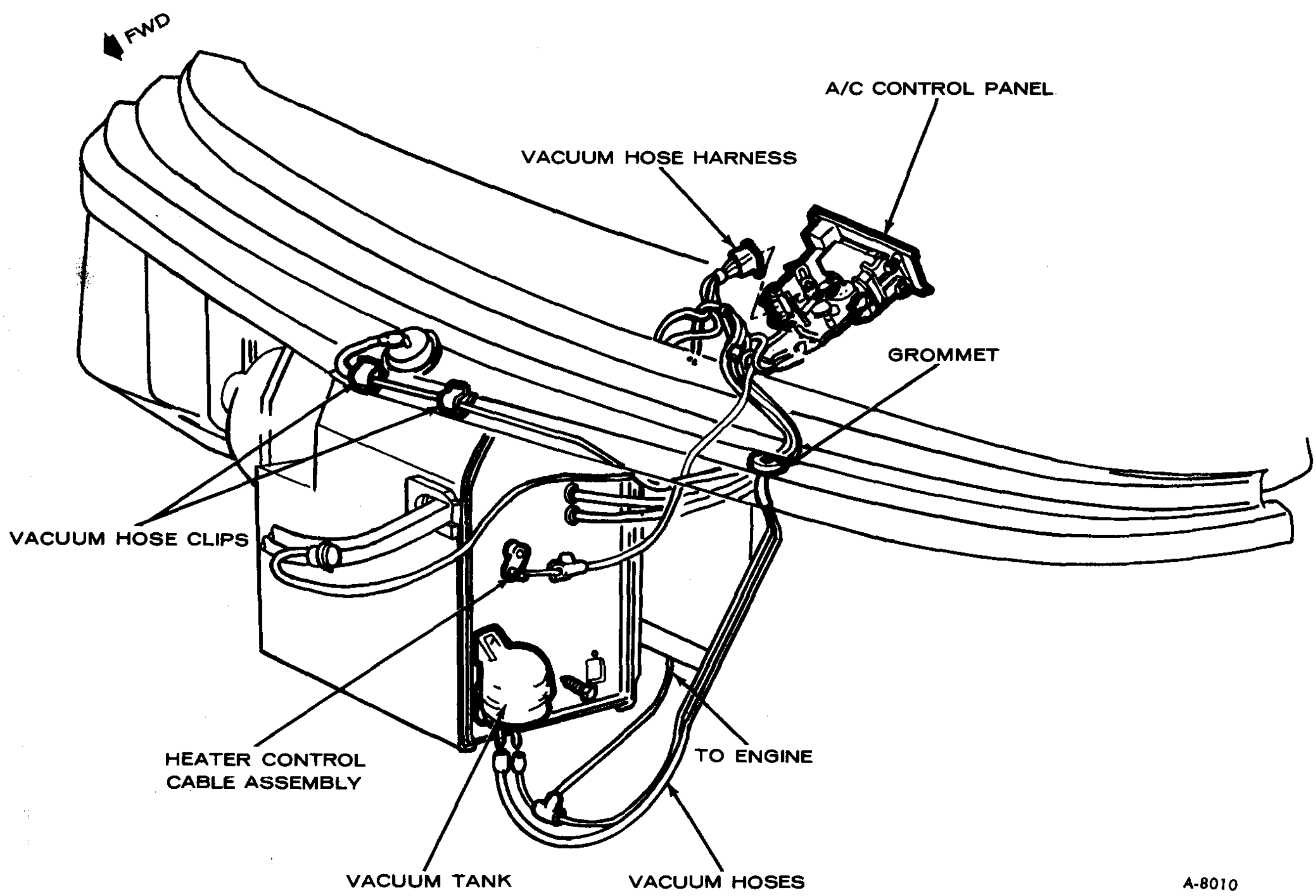


Figure 21—Vacuum Tank and Vacuum Harness

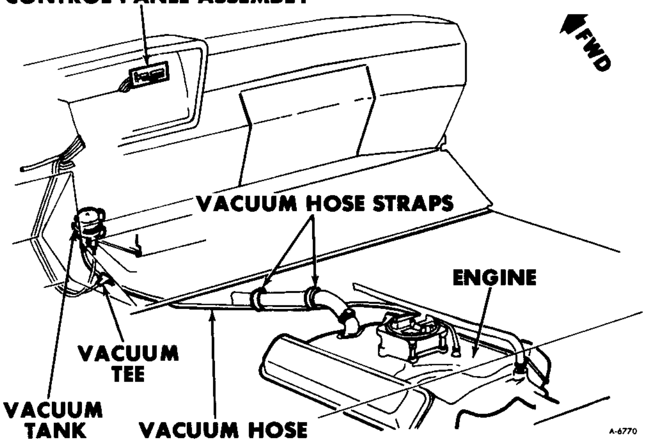


Figure 22—A/C Vacuum Hose to Engine

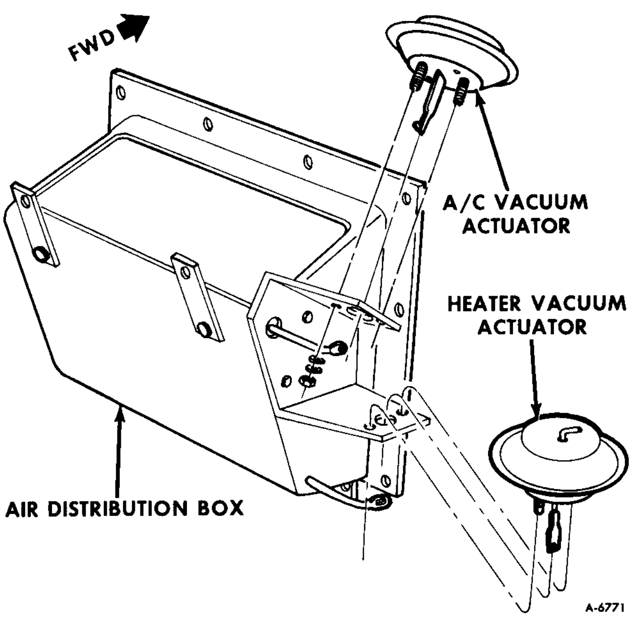


Figure 23—Vacuum Actuator Assembly, Typical

the compressor off when the low limit of evaporator outlet temperature is reached, the switch points are fused. This will lead to evaporator freeze-up unless the switch is replaced.

BLOWER RELAY

A single-pole, double-throw relay is used to supply power to the blower. The relay provides the proper connections for the low and two medium speeds through the resistor assembly, and direct battery current to the blower for "HI" speed.

The blower relay (figure 18) is located in the engine compartment on the vehicle firewall (under the passenger side access door).

BLOWER SWITCH

The four-speed blower switch, located on the air conditioning control head in the instrument panel (refer to figure 1) regulates LO, two medium, and a HI blower speed through a resistor system.

BLOWER RESISTOR

The blower resistor (refer to figure 19) on the driver side of the evaporator housing regulates the amount of electrical current fed to the blower, thereby regulating blower speed. This resistor assembly is by-passed during "HI" speed blower operation, thus allowing full battery current to reach the blower for maximum air speed delivery.

TIME DELAY RELAY

The time delay relay is wired in series between the blower relay and the blower switch. This relay provides a 3-5 second delay of blower motor operation whenever the blower is switched into "HI', assuring maximal operation of the heater door in the air conditioning distribution box.

The time delay relay (figure 20) is located in the engine compartment on the vehicle firewall (under the passenger side access door).

VACUUM COMPONENT OPERATION

The heating/air conditioning vacuum system consists of three basic components:

1. Vacuum control valves located on the A/C control head.

2. Vacuum tank and vacuum feed circuit.

3. Vacuum actuators (also called modes, or diaphragms).

VACUUM CONTROL VALVES

The vacuum control valves on the air conditioning control panel include the select valve and the water vacuum switch (refer to figure 1).

The select valve, located at the forward edge of the control head, is a nine-port rotary valve which either interconnects or vents the vacuum hoses attached to it, positioning air doors in the heater/evaporator assembly and the air distribution box. Refer to figures 24 through 41 later in this section for select valve connections and specific vacuum circuit operation.

The water vacuum switch, also located at the forward edge of the control panel, is controlled by the Temperature Lever on the A/C control panel. This switch supplies vacuum to, or vents, the water vacuum valve located in the heater core inlet line. Vacuum at the heater water vacuum valve causes this valve to block the flow of water to the core. When the switch at the control panel vents the vacuum valve, water flows freely through the core, allowing air that passes through the core to be heated.

VACUUM TANK AND VACUUM FEED CIRCUIT

The vacuum tank (figure 21) is simply a reservoir of vacuum to be used when engine vacuum drops too low to effectively actuate the vacuum components. Vacuum is supplied to the vacuum system through a 1/8-inch hose connected to the air intake manifold at the engine. The hose is routed from the engine to a tee located at the vacuum tank (figure 22). One leg of the tee supplies vacuum to the vacuum tank mounted on the driver side of the evaporator/heater housing, which in turn connects to the vacuum control switch at the A/C control panel. The control panel is the control center for directing vacuum through vacuum lines to the different actuators, to achieve correct air door positions in the distribution box.

VACUUM ACTUATORS (FIGURE 23)

Vacuum actuators are diaphragm switches which open and close the various doors in the air distribution box and the heater/evaporator assembly, allowing for "Heat", "Air Conditioning", "Defrost" and "Vent" conditions as shown on the control panel face.

There are four vacuum actuators, plus a water vacuum valve in the heater core inlet line. The "Recirc" actuator (to allow for recirculated air) and the "A/C" actuator are single-ported vacuum diaphragms which position the Recirc door in the evaporator/heater housing and the A/C door in the air distribution box, respectively. Both the Recir door and the A/C door have two positions — open, and closed. The "Defrost" actuator is a two-ported vacuum switch with an external locator spring. This actuator positions the Defrost door in the distribution box, locating it in one of three positions — closed, 1/4-inch open, or fully open. The "Heater" actuator is a two-ported, "push-pull" vacuum diaphragm with a restrictor in the upper port vacuum line. This actuator positions the heat door in the distribution box, locating it in a closed, 1/4-inch open or fully open position. The porous delay plug in the upper port line (green stripped vacuum line) slows the opening of the heat door by approximately 10-15 seconds when the control panel is set for "HEAT". This assures proper A/C door closing before heat door begins to open.

For further discussion of normal door positions and vacuum system operation, refer to "Operation of Air Flow and Vacuum Systems" following.

OPERATION OF AIR FLOW AND VACUUM SYSTEMS

When the ignition key is "OFF", no vacuum is supplied to any vacuum actuators. Figure 24 shows normal position of the air doors in the distribution box and the heater/evaporator assembly when the ignition key is "OFF"

When the ignition key is "ON" (engine running) vacuum is supplied to the A/C actuator, closing the A/C door in the air distribution box. All other door positions in the distribution box and the heater/evaporator assembly remain the same (figure 25).

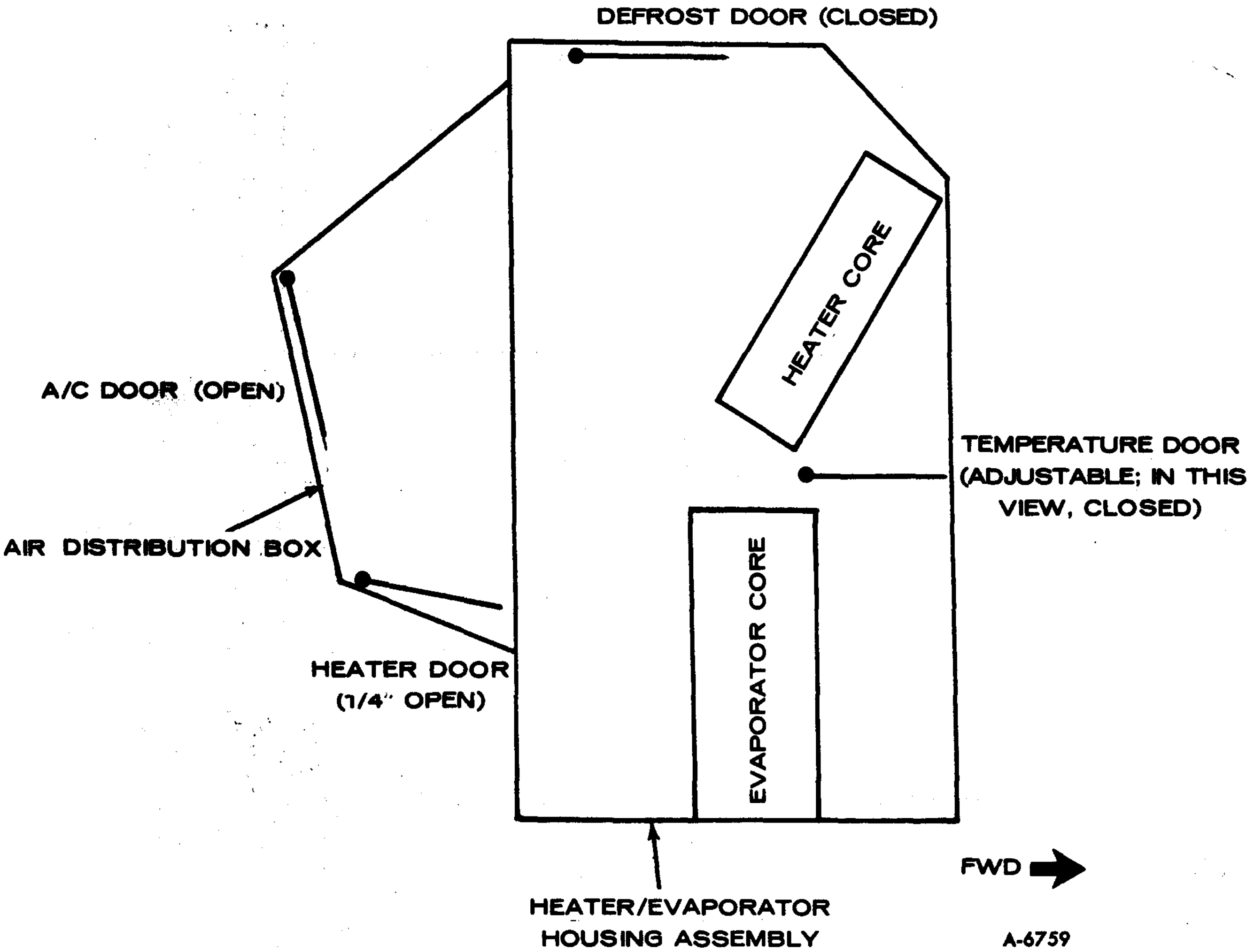


Figure 24—Air Door Positions — Ignition Key "OFF"

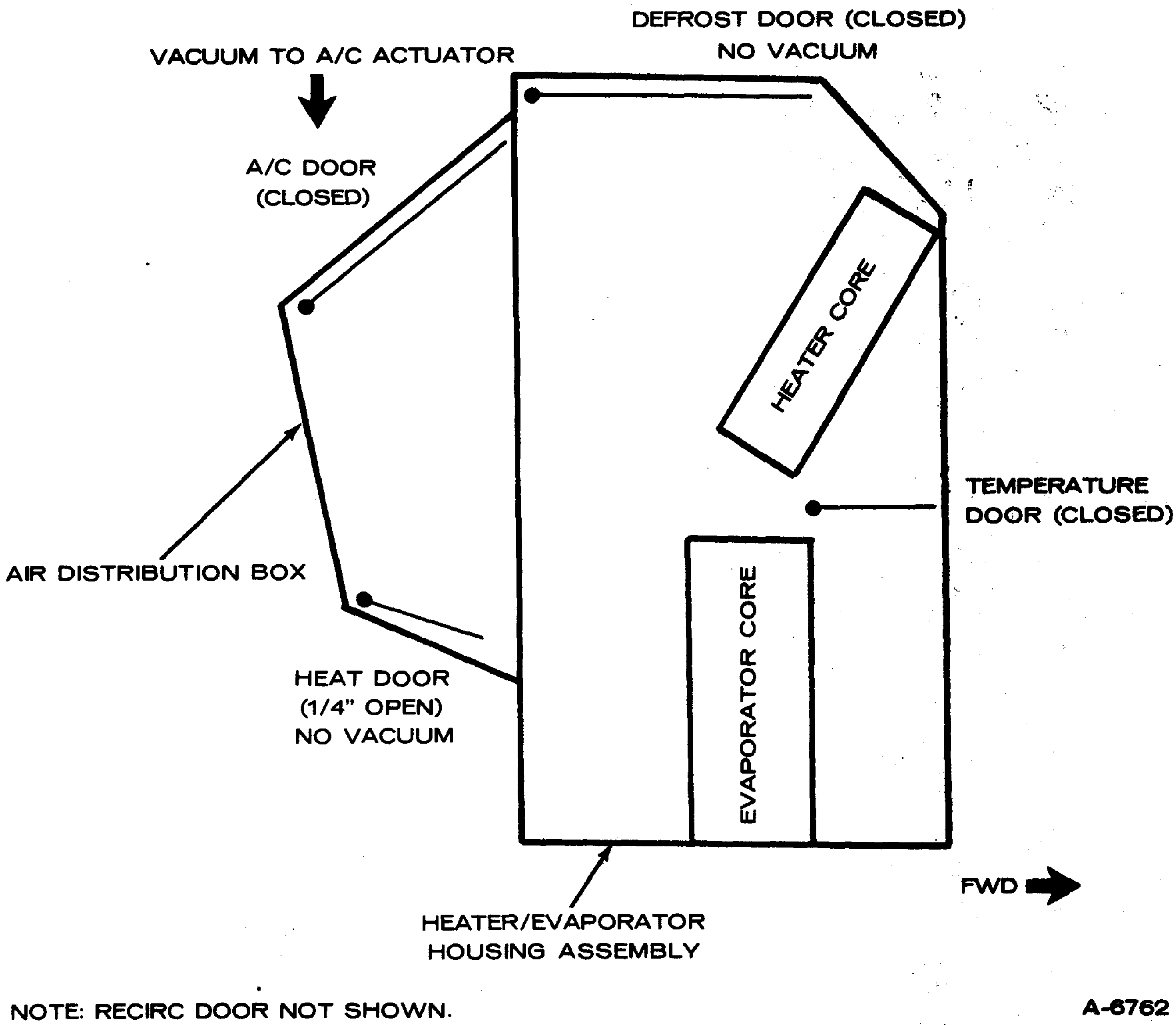


Figure 25—Air Door Positions — Engine Running, Air Conditioning System "OFF"

AIR DELIVERY SYSTEM

AIR SOURCE

Air drawn into the blower and utilized by the system is either outside air or recirculated air (figure 26). Outside air is the air inlet source for four selected positions on the air conditioning control panel: "NORM", "VENT", "HEATER" and "DEFROST". Recirculated air from the passenger compartment is the air inlet source for "MAX" A/C position only.

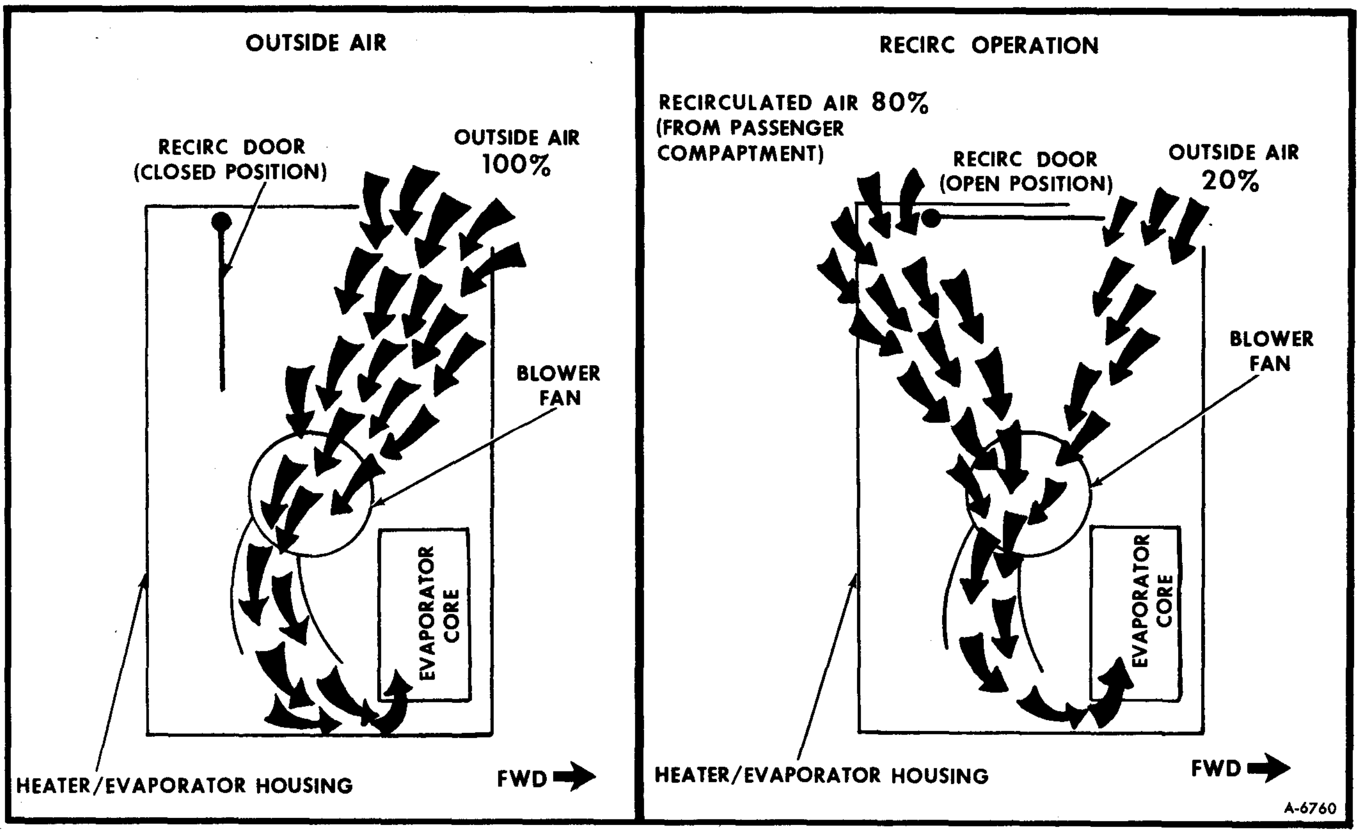


Figure 26—Air Inlet Source

AIR DELIVERY

In normal operation air utilized by the system enters the blower and is directed across the evaporator fins, where it is filtered, dehumidified and cooled to approximately $35^{o}F$ ($2^{o}C$). The air is then "reheated" (if called for at control panel) by being passed through and around the heater core. The temperature door in the heater/evaporator housing controls the amount of reheat that takes place. Then, directed by air doors in the distribution box, the air travels out through the plenum assembly to the various outlets in the vehicle instrument panel (figure 27).

AIR OUTLET

Air outlets located in the instrument panel can be seen in figure 28. Depending upon setting of Selector Lever at the A/C control panel, air may flow out the four A/C outlets (two above the glove box, one on either side of the driver seat), out the heater distributor at the lower center of the instrument panel or out the Defroster outlets at the base of the windshield.

Blower operaton is continuous, providing positive air flow even when windows are closed and A/C system is in "OFF" (provided ignition key is "ON"). See information immediately following for discussion of air flow and vacuum system operation in selected air conditioning and heating modes.

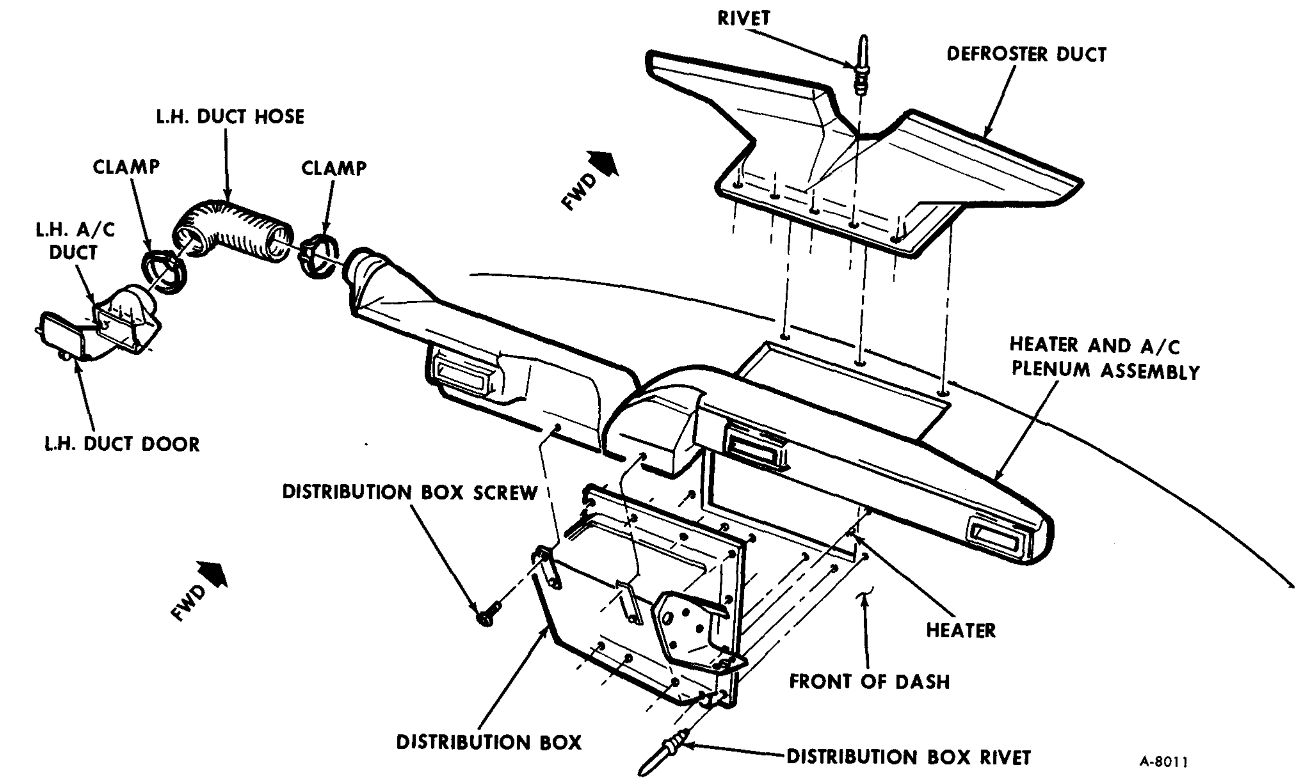


Figure 27—A/C and Heater Plenum and Defroster Duct Assembly

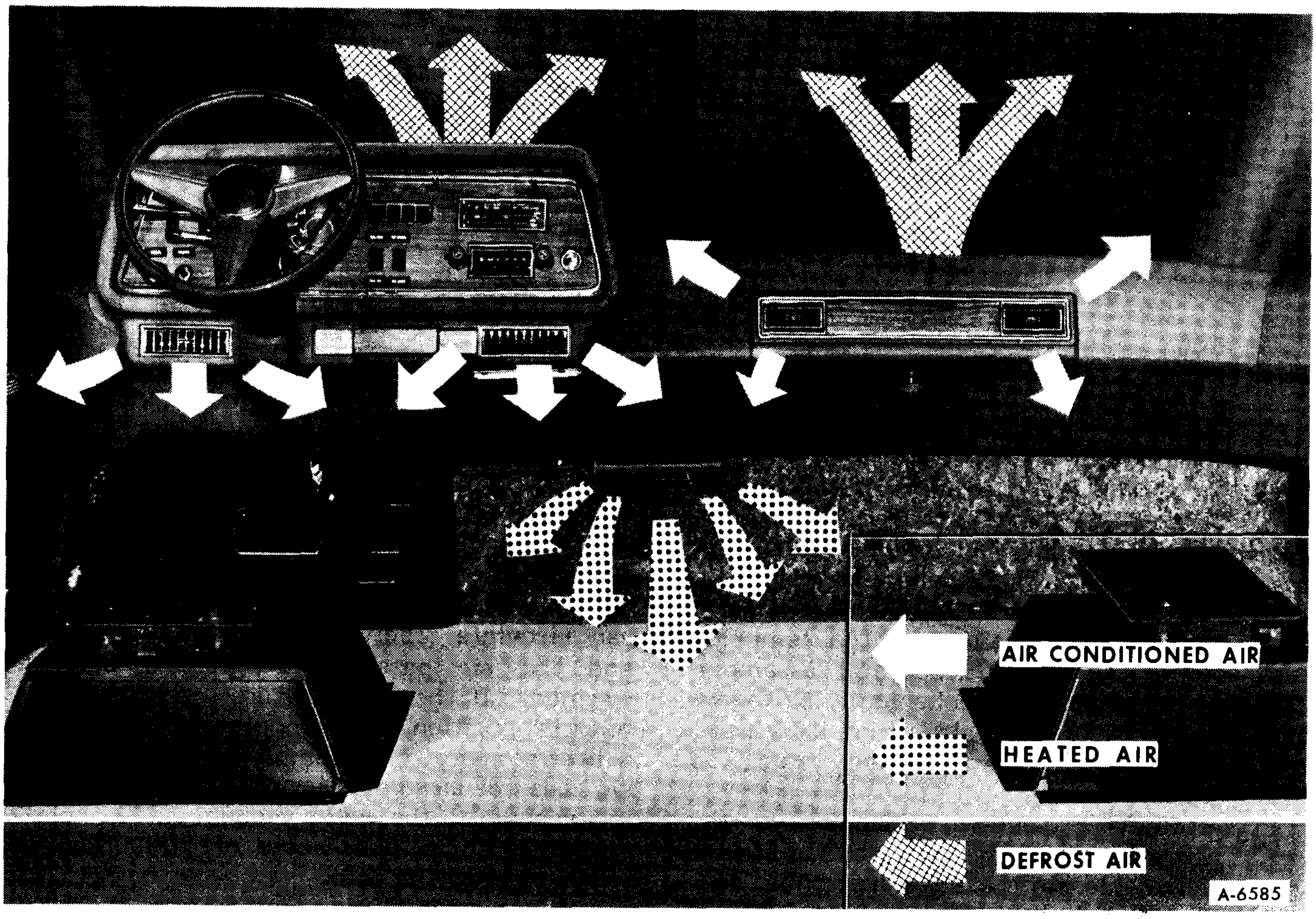


Figure 28—Air Flow — Vehicle Interior

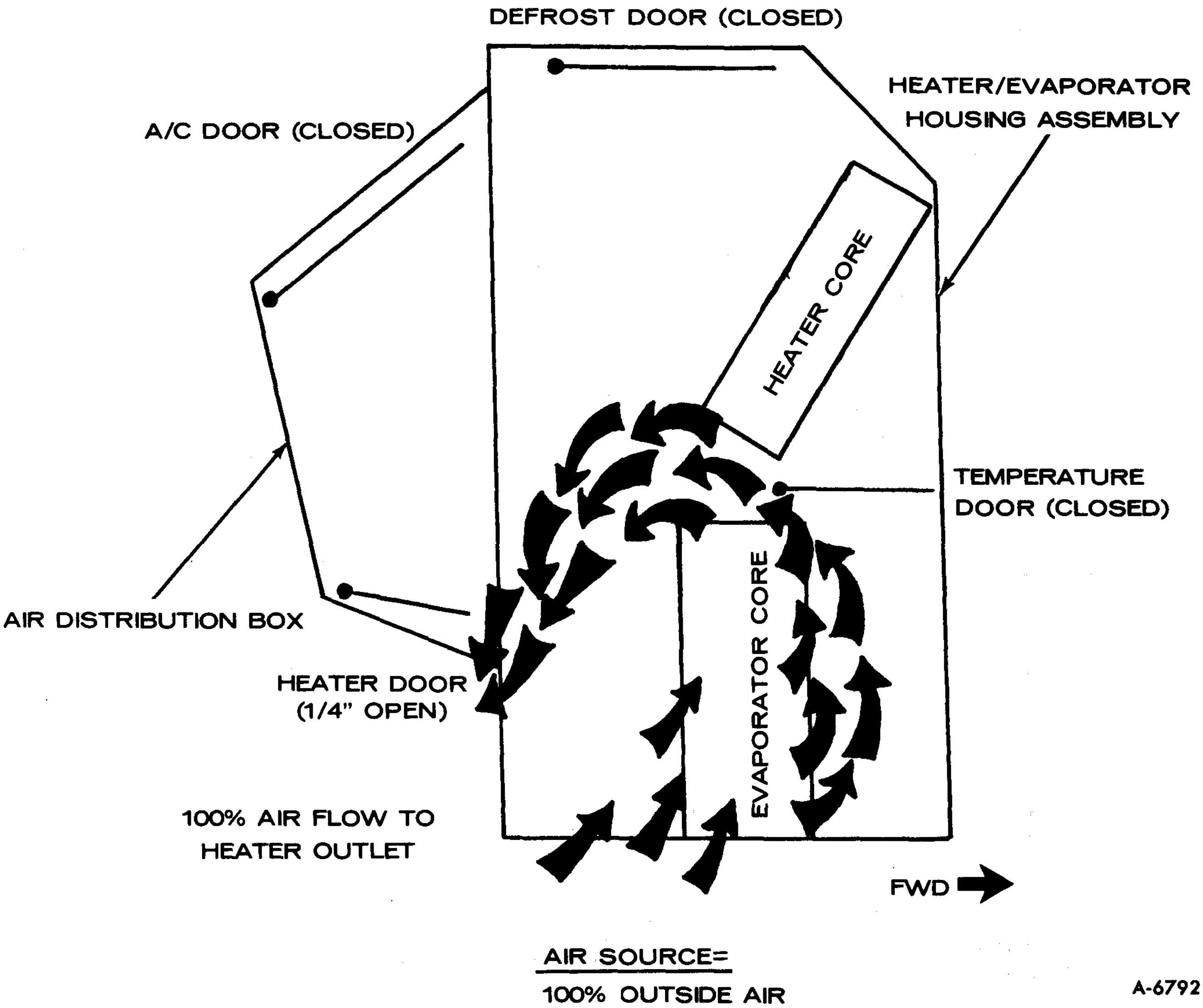


Figure 29—A/C "OFF" Position Air Flow (Engine Running)

AIR FLOW AND VACUUM OPERATION

"OFF" POSITION (FIGURES 29 AND 30)

With the air conditioning system in OFF position (ignition switch "ON", engine running), outside air is circulated at a fixed low blower speed through the heater/evaporator assembly. It may be circulated through the heater core, depending upon the position of the temperature door in the heater/evaporator assembly. This door is controlled mechanically by means of a bowden cable. The air is then discharged into the passenger compartment from the heater outlet.

In system OFF vacuum is supplied to the A/C actuator through the brown-striped vacuum line, closing the air conditioning door in the distribution box. This routes 100% of system air through the heater door (1/4 inch open — normal position) in the distribution box and out the heater outlet in the instrument panel.

When the Temperature Lever on the control panel is adjusted to add heat to the incoming air (position 2 — see figure 3), the temperature door is opened and the water vacuum valve in the heater core inlet line is vented. With no vacuum supplied to this valve, water can circulate freely through the heater core and the air passing through the core is warmed. If the Temperature Lever is in the "COLD" position, the temperature door in the heater/evaporator assembly remains closed, air does not circulate through the heater core, and vacuum to the water vacuum valve (violet-striped vacuum line) seals off the flow of water through the core.

The air conditioning compressor is disengaged at this setting.

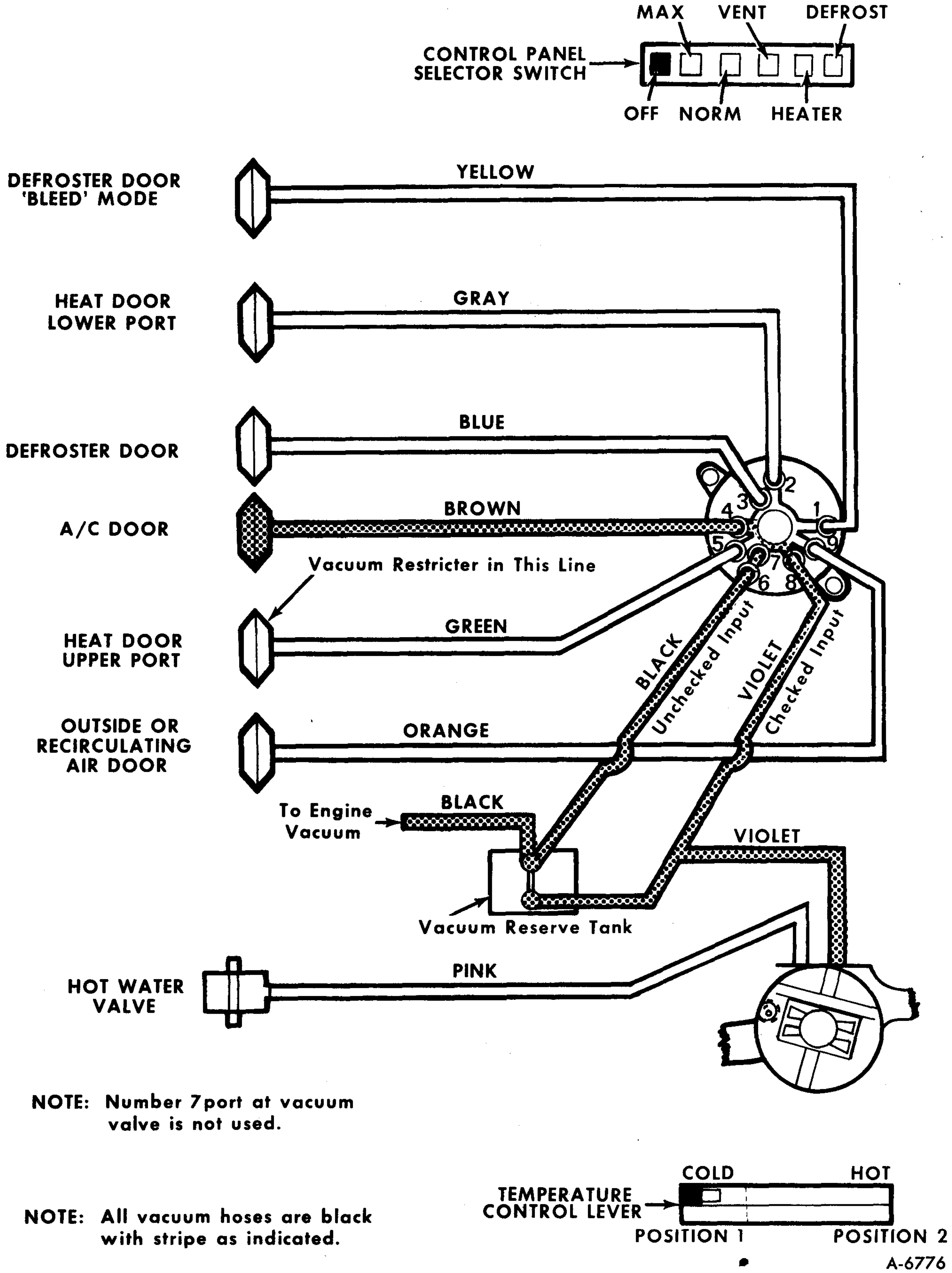


Figure 30—Vacuum Circuit Selector Switch in "OFF" Position (Engine Running)

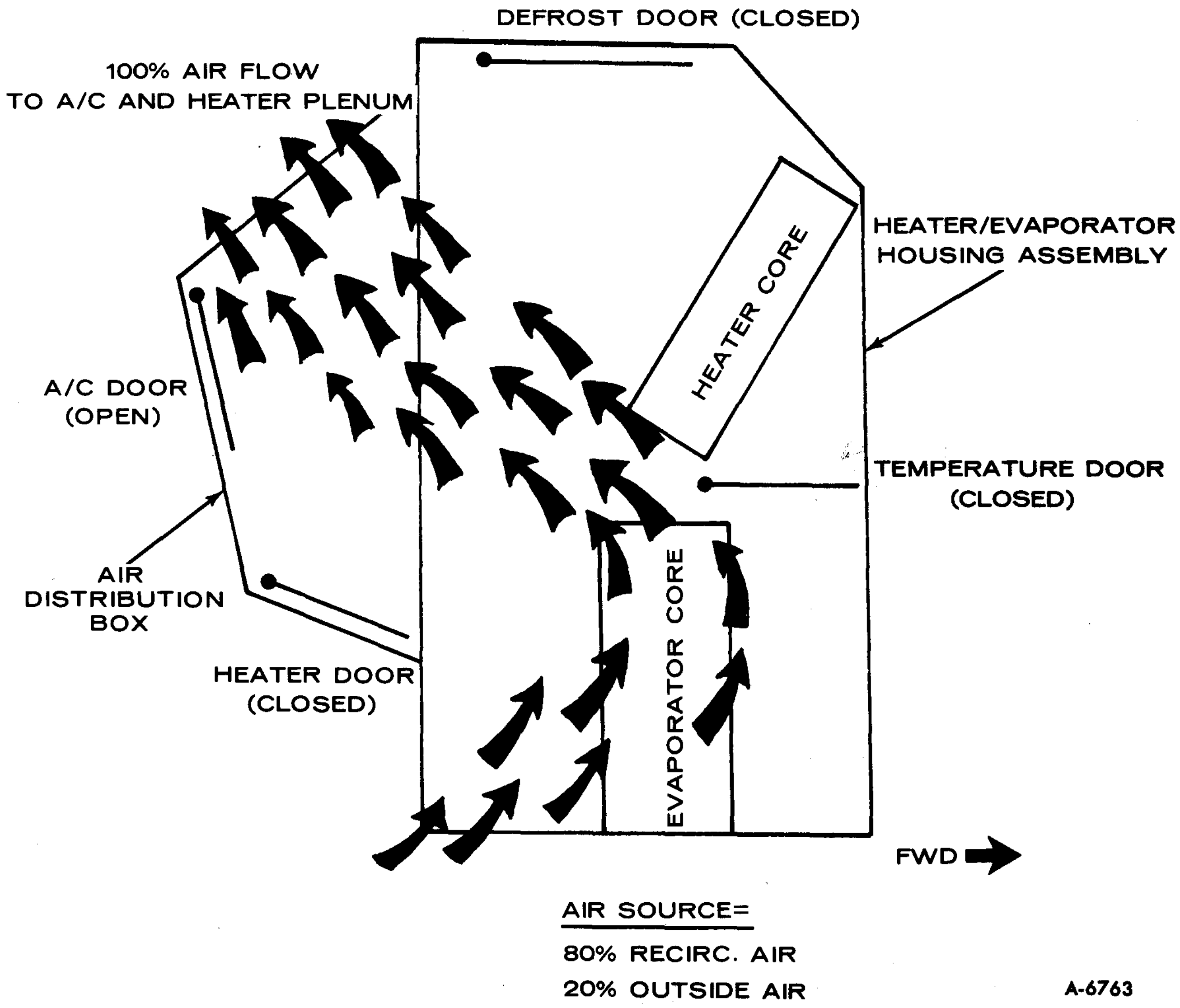


Figure 31—"Max" A/C Position Air Flow

"MAX" A/C POSITION

(FIGURES 31 AND 32)

Operation at this setting provides maximum cooling at a fixed "HI" blower speed, independent of fan switch setting. With the system selector lever in MAX, air inlet source is almost completely from the vehicle interior, as shown in figure 31. Vacuum supplied to the Recirc actuator (orange-striped vacuum line) opens the Recirc door, allowing about 80% of system air to be drawn into the blower channel from the passenger compartment. The remaining 20% system air enters through a small open area at the outside air inlet. Air is then routed through the evaporator core and out the normally open air conditioning door in the distribution box (figure 31). Directed through the A/C plenum behind the instrument panel, air then flows out the air conditioning registers in the instrument panel.

In addition to vacuum at the Recirc actuator, MAX A/C position supplies vacuum to the heater actuator lower port (gray-striped vacuum line), closing the heater door and blocking passage of air to the heater outlet. The A/C and Defrost actuators are vented, leaving these doors in their normal positions.

Maximum cooling is maintained by positioning the Temperature Lever all the way in the "COLD" position. This position of the Temperature Lever (refer to figure 3) causes vacuum to be supplied to the water vacuum valve (violet-striped vacuum line), sealing off water flow through the heater core. This lever position also closes the temperature door in the heater/evaporator housing assembly by means of a bowden cable. This assures that no air is diverted through the heater core.

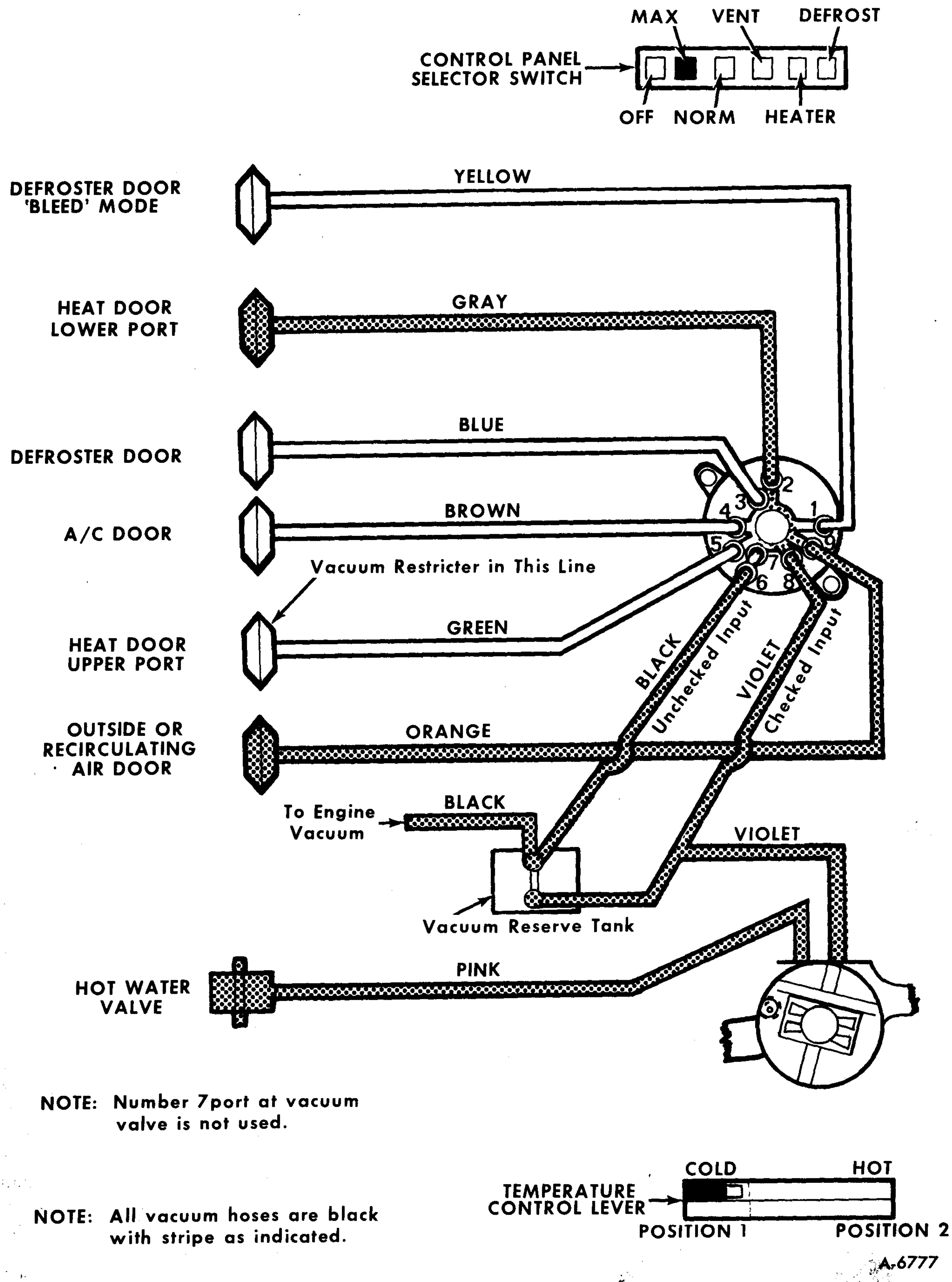


Figure 32—Vacuum Circuit Selector Switch in "MAX" A/C Position and Temperature Lever in Position 1

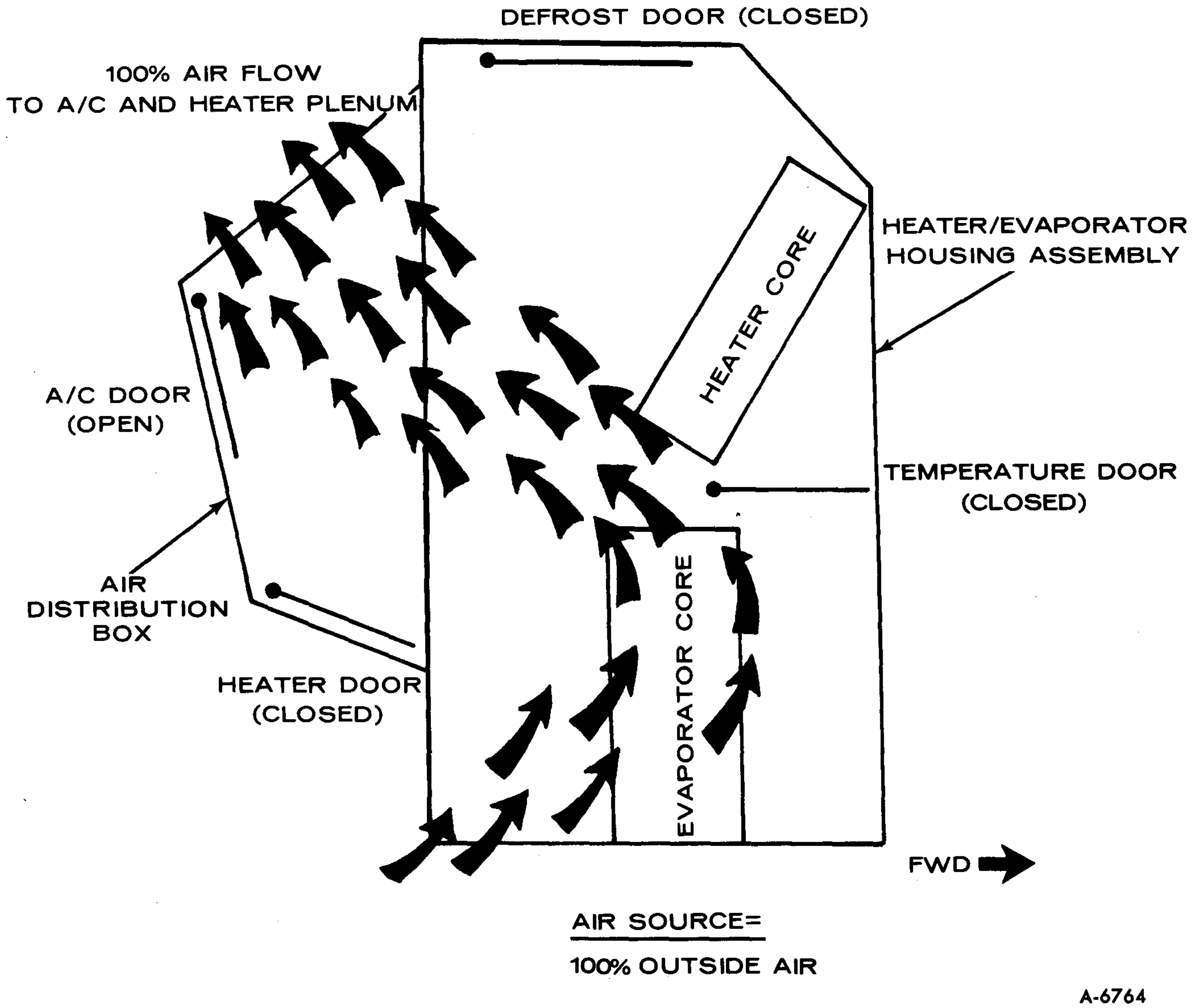


Figure 33—"NORM" A/C Position Air Flow

"NORM" POSITION (FIGURES 33 AND 34)

In NORM air conditioning position, 100% outside air enters the system for cooling. Once inside the blower channel, air flow and vacuum logic are the same as those in MAX A/C. However, blower speed in NORM is adjustable and is determined by fan switch setting.

As in all other modes, temperature of air being circulated is adjusted at the control panel temperature lever. "COLD" position of the lever closes the temperature door in the heater/evaporator housing assembly by means of a bowden cable. Thus all air is routed through the evaporator. "COLD" position also supplies vacuum to the water vacuum valve, sealing off the flow of water to the heater core.

The compressor will operate in NORM when outside temperature is above approximately $40^{o}F$ ($4^{o}C$).

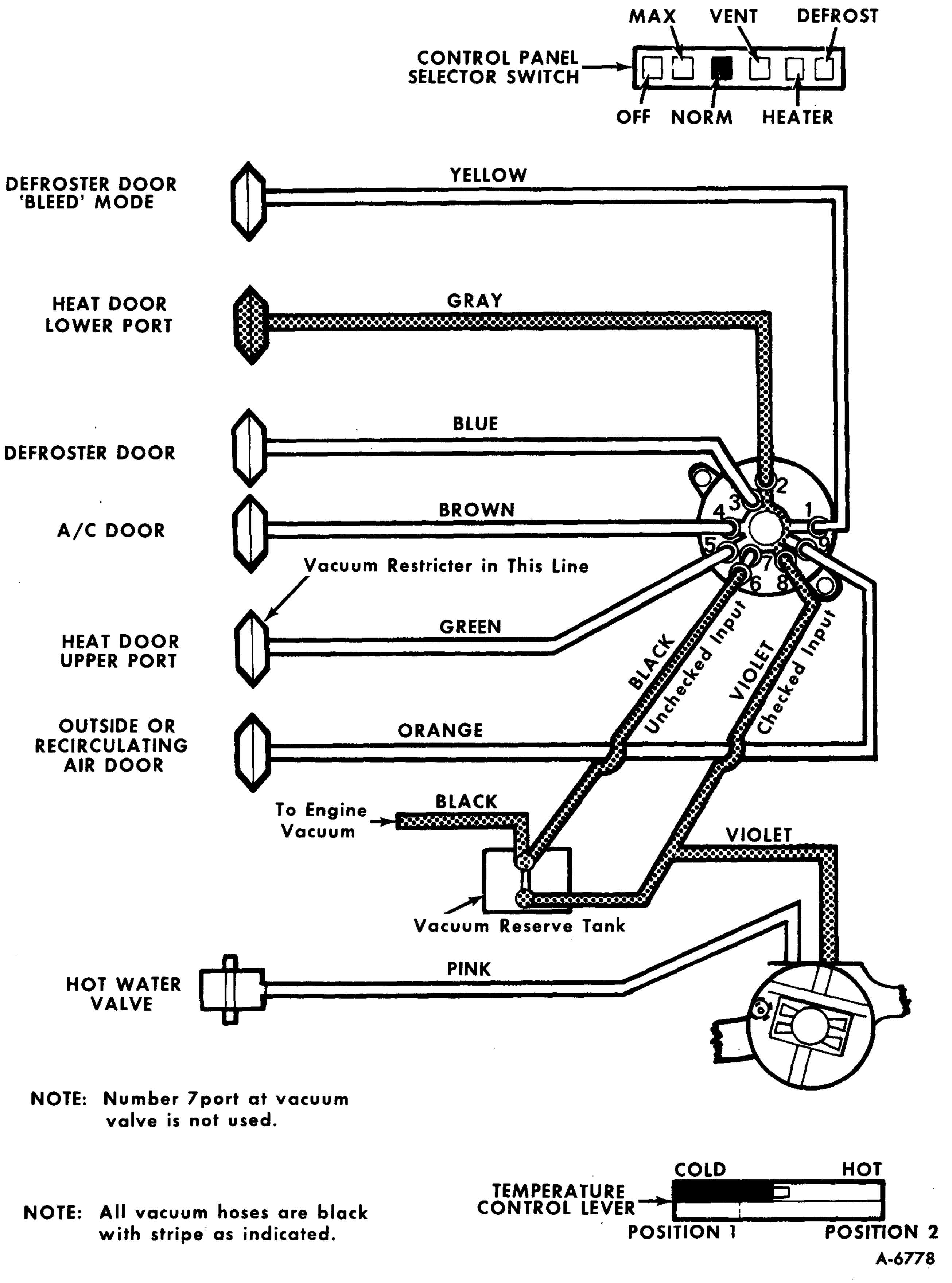


Figure 34—Vacuum Circuit Selector Switch in "NORM" A/C Position and Temperature Lever in Position 2

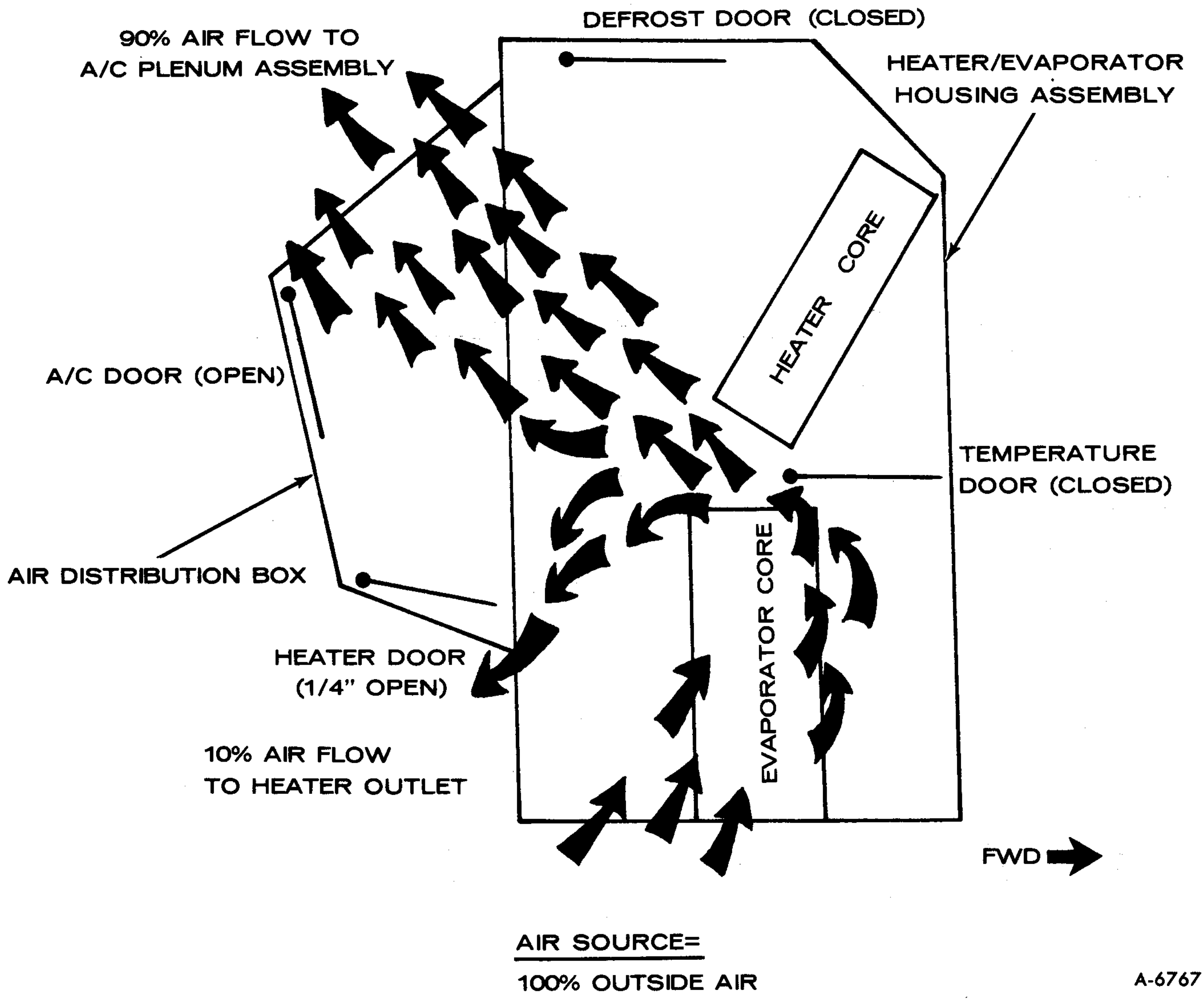


Figure 35—"VENT" Position Air Flow

"VENT" POSITION (FIGURES 35 AND 36)

Operation in VENT provides for circulation of 100% outside air at any selected blower speed. Air that has passed through the evaporator core may circulate through the heater core, depending upon the position of the temperature door in the heater/ evaporator housing assembly. With all vacuum actuators vented, 90% of air flows out the open air conditioning door in the distribution box through the A/C plenum to the air conditioning registers in the instrument panel. The remaining 10% of air flows out the heater door in the distribution box, which is 1/4 inch open. This air is then discharged from the heater outlet at the lower center of the instrument panel.

Heat is added to vent air as desired by adjustment of the temperature lever on the control panel.

VENT is one of two economy positions in which the air conditioning compressor does not operate.

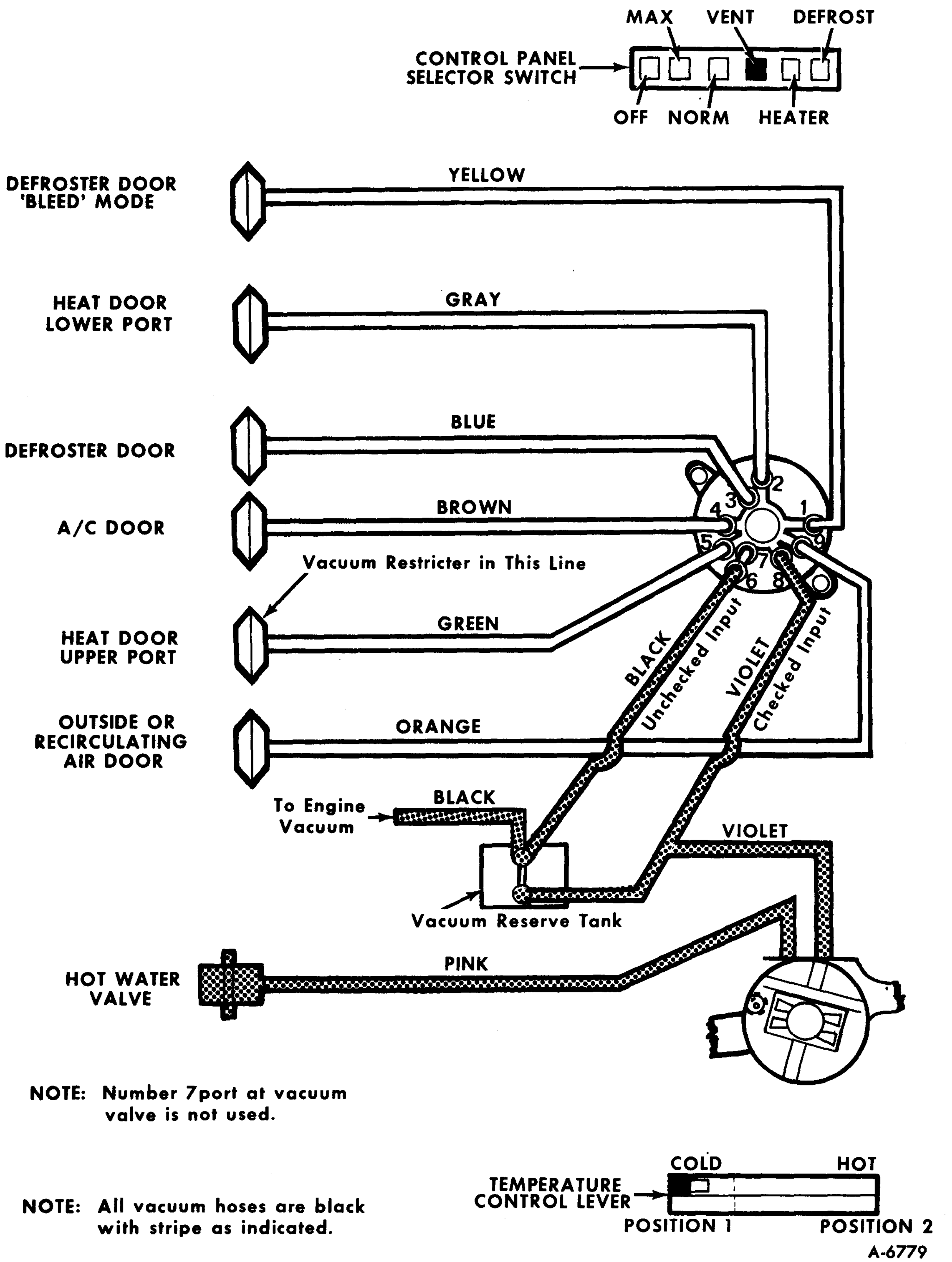


Figure 36—Vacuum Circuit Selector Switch in "VENT" Position and Temperature Lever in Position 2

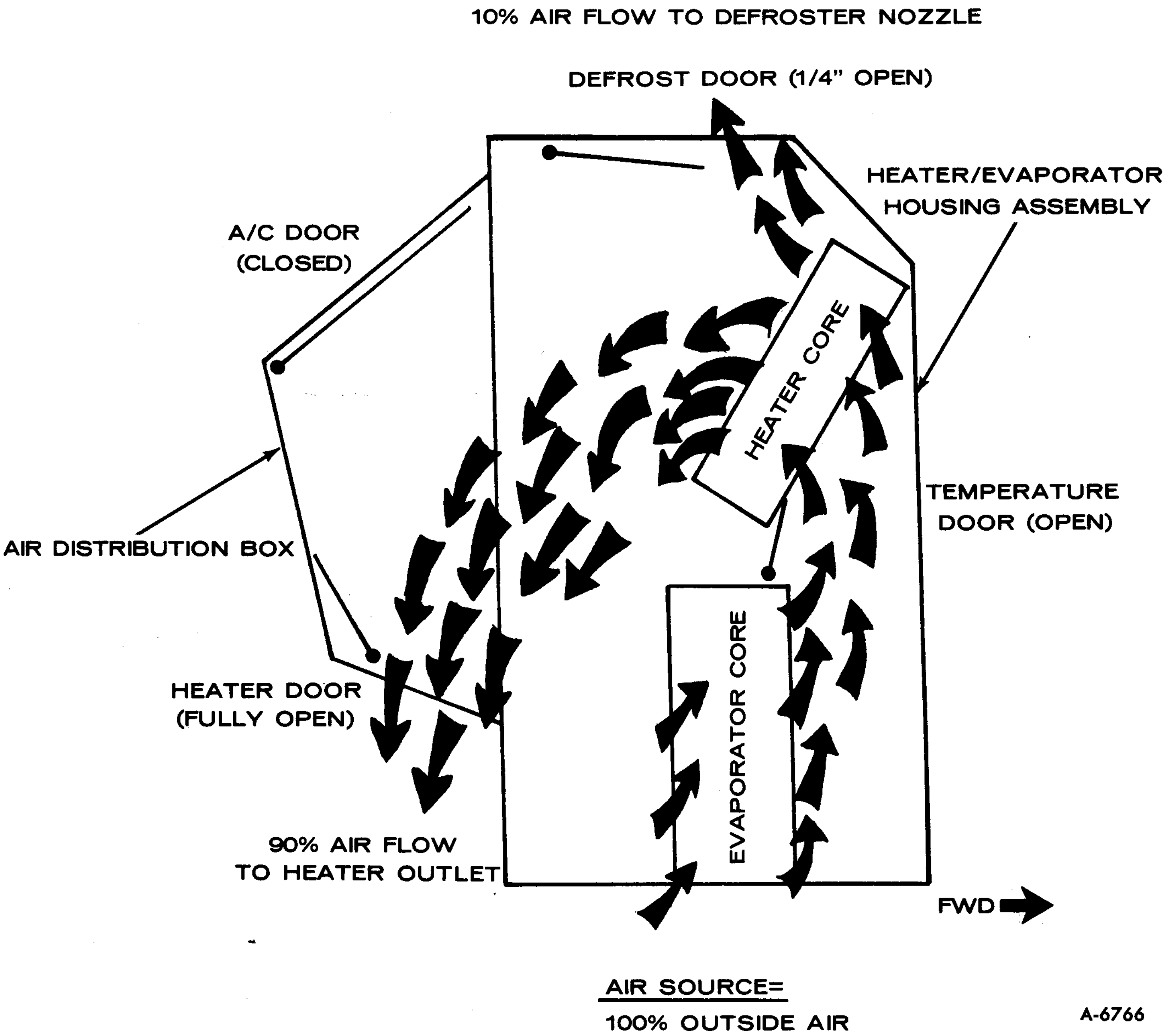


Figure 37—"HEATER" Position Air Flow

"HEATER" POSITION
(FIGURES 37 AND 38)

Operation in this setting circulates most or all air through the heater core. With the Temperature Lever all the way to "HOT", the temperature door in the heater/evaporator assembly is open and the water vacuum valve is vented, allowing water to circulate through the heater core. Air is then heated as it passes through the core.

HEATER mode supplies vacuum to the bleed port at the Defrost actuator (yellow-striped vacuum line), opening the Defrost door (1/4 inch). Vacuum is also supplied to the A/C actuator (brown-striped vacuum line) and the Heat actuator upper port (green-striped vacuum line), closing the A/C door and fully opening the heat door. This allows 90% of system air to flow through the open heater door in the distribution box and out the heater outlet in the lower center of the instrument panel. The remaining 10% of air is directed through the partially open defrost door in the top of the heater/evaporator housing to the defroster nozzles at the base of the windshield.

HEATER is one of two economy positions in which the air conditioning compressor does not operate.

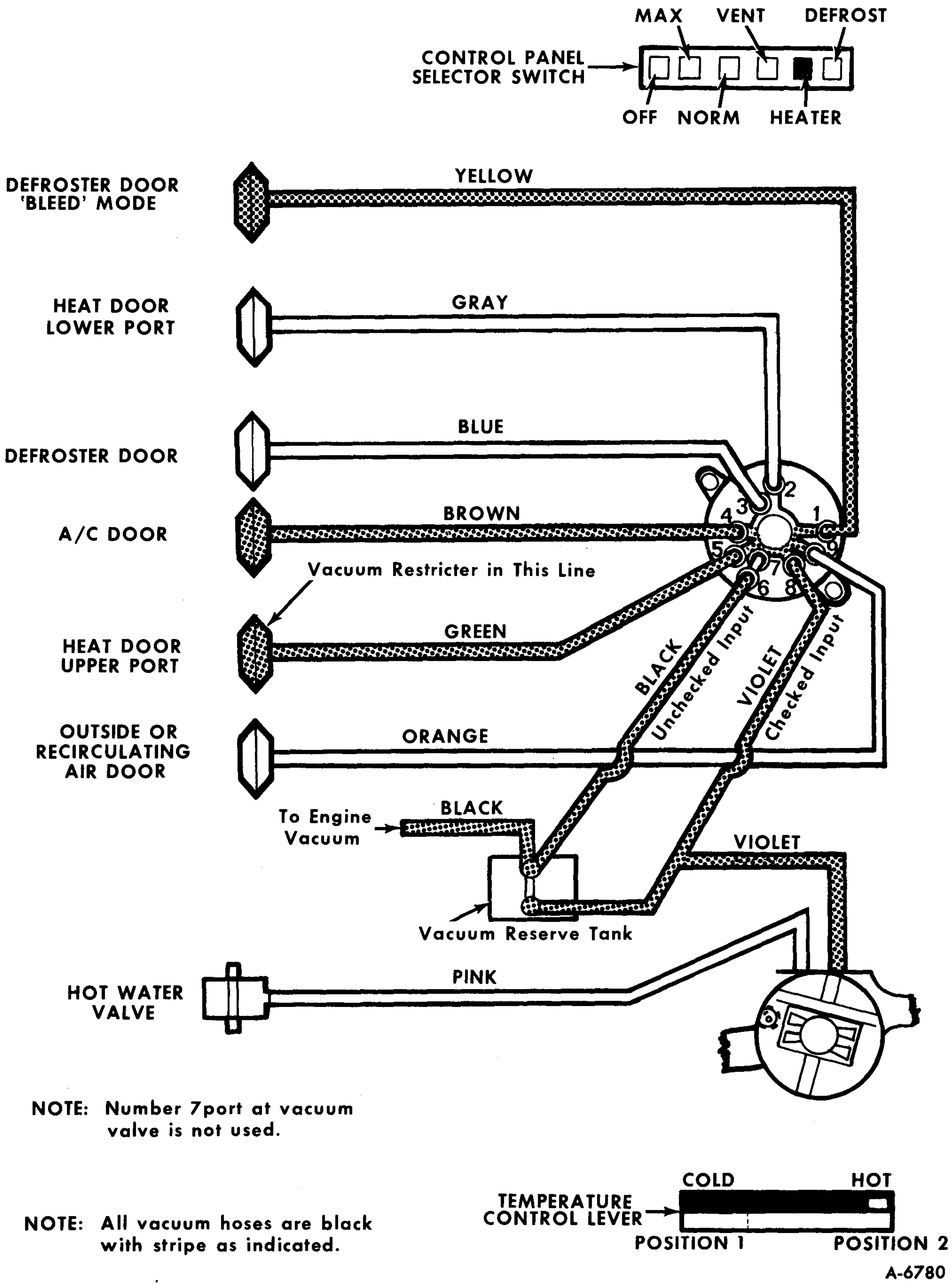


Figure 38—Vacuum Circuit Selector Switch in "HEATER" Position
and Temperature Lever in Position 2

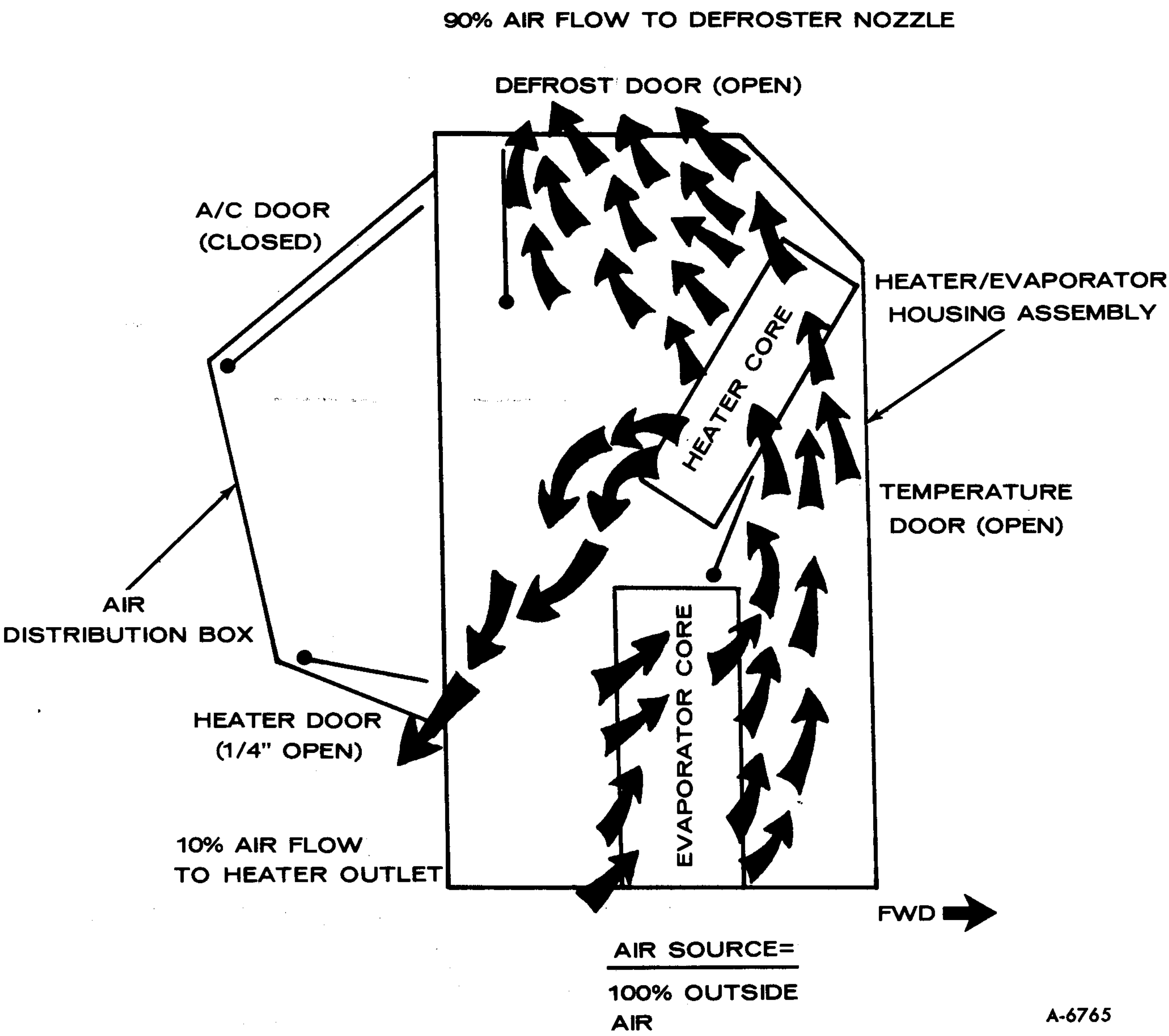


Figure 39—"DEFROST" Position Air Flow

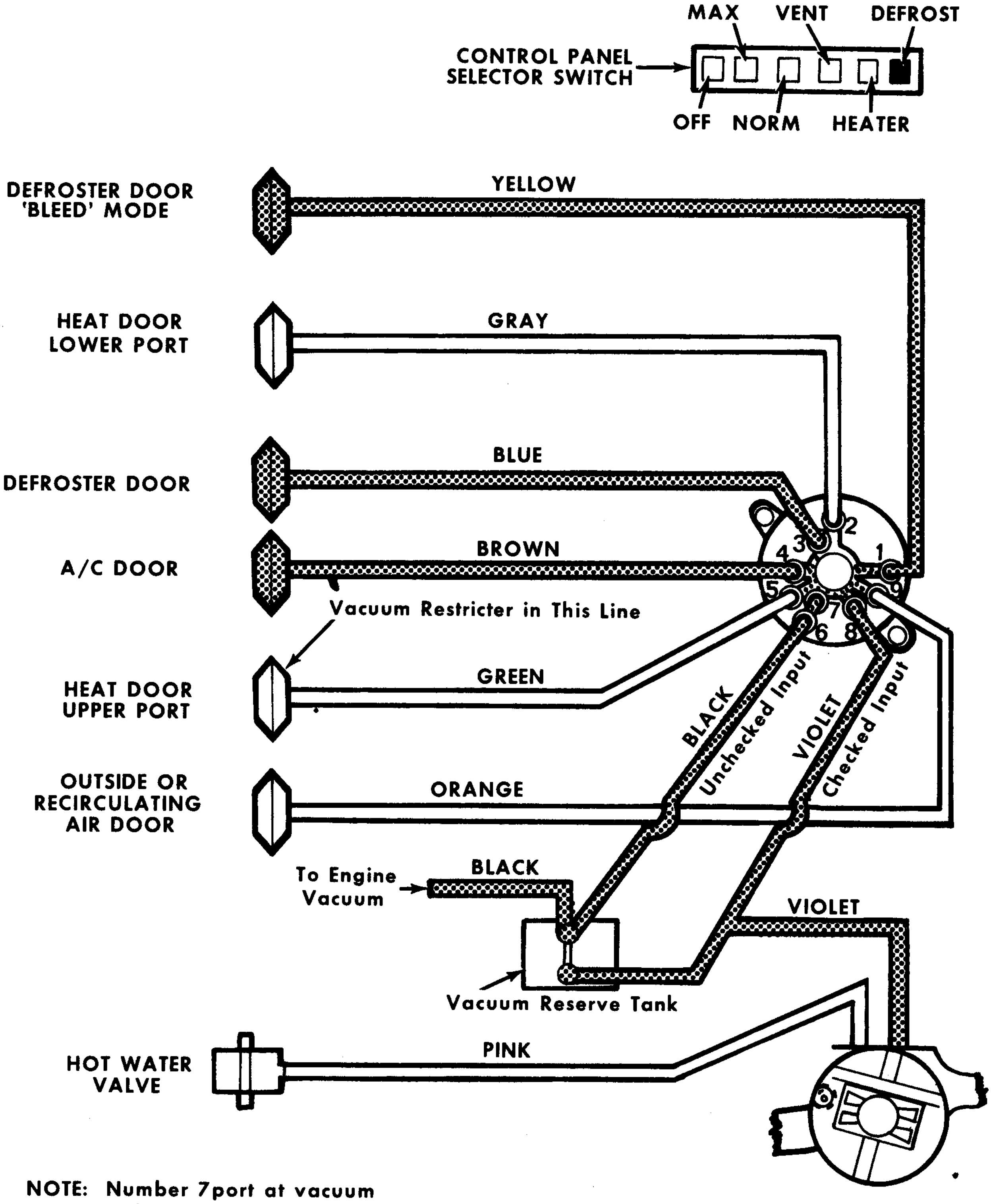
"DEFROST" POSITION
(FIGURES 39 AND 40)

In DEFROST position, air is routed through the heater/evaporator assembly at any selected blower speed. The air may be circulated through the heater core, depending upon the position of the temperature door.

Vacuum is supplied to both ports of the Defrost actuator (blue-striped vacuum line and yellow-striped vacuum line). This fully opens the Defrost air door at the top of the heater/evaporator housing assembly. Vacuum is also supplied to the A/C actuator (brown-striped vacuum line), closing the air conditioning door in the distribution box. In DEFROST mode, then, 90% of system air flows out the fully open Defrost door to the defroster nozzles at the top forward edge of the instrument panel. The remaining 10% of air is directed through the heater door (1/4 inch open — normal position) and is discharged through the heater outlet in the instrument panel.

Heat is added to Defrost air as desired by adjustment of the temperature lever on the control panel. If the Temperature Lever is moved to position 2 (figure 3), vacuum is supplied to the water vacuum valve at the control panel (violet-striped vacuum line).

The air conditioning compressor engages automatically in DEFROST if outside temperatures are above 40-45^{o}F (4-7^{o}C).



NOTE: Number 7port at vacuum valve is not used.

NOTE: All vacuum hoses are black with stripe as indicated.

COLD HOT

TEMPERATURE CONTROL LEVER

POSITION 1 POSITION 2

A-6781

Figure 40—Vacuum Circuit Selector Switch in "DEFROST" Position and Temperature Lever in Position 2

WATER VALVE OPERATING CHART

Port No.	Function	Position 1	Position 2	Stripe
1	Input	Conn 2	Seal	Violet
2	Water/ Valve Signal	Conn 1	Vent	Pink

SELECT VALVE OPERATING CHART

PORT NO.	CONN	OFF	MAX	NORM		VENT	HEAT	DEFROST	STRIPE
1	DEFROSTER BLEED	VENT	VENT	VENT	VENT	VENT	CONN. 6	CONN.6	YELLOW
2	HEAT DOOR (LOWER)	VENT	CONN. 8,9	CONN. 8	VENT	VENT	VENT	VENT	GRAY
3	DEFROST	VENT	VENT	VENT	VENT	VENT	VENT	CONN. 4,8	BLUE
4	A/C DOOR	CONN. 8	VENT	VENT	VENT	VENT	CONN. 5,8	CONN. 3,8	BROWN
5	HEAT DOOR (UPPER)	VENT	VENT	VENT	VENT	VENT	CONN. 4,8	VENT	GREEN
6	INPUT UNCHECKED	SEAL	SEAL	SEAL	SEAL	SEAL	CONN. 1	CONN. 1	
7	NOT USED—SEAL IN CONNECTOR								
8	INPUT CHECKED	CONN. 4	CONN. 2,9	CONN. 2	SEAL	SEAL	CONN. 4,5	CONN. 3,4	VIOLET
9	O/AIR R/AIR	VENT	CONN. 2,8	VENT	VENT	VENT	VENT	VENT	ORANGE

A-6768

Figure 41—Select Valve Operating Chart

INSPECTION AND PERIODIC SERVICE

PRE-DELIVERY INSPECTION

1. Check that engine exhaust is suitably ventilated.
2. Check the belt for proper tension.
3. With controls positioned for operation of the system, operate the unit for five minutes at approximately 2000 rpm. Observe the clutch pulley belt to see that the compressor is operating at the same speed as the clutch pulley. Any speed variation indicates clutch slippage.
4. Before turning off the engine, check refrigerant charge (see "Refrigerant Quick Check Procedure" under "DIAGNOSIS OF PROBLEMS" later in this section).
5. Check refrigerant hose connections:
O-ring Connections—Check torque of fittings as charted later in this section under "Refrigerant Line Connections;" retorque if required. Leak test the complete system.
6. If there is evidence of an oil leak, check the compressor to see that the oil charge is satisfactory.

NOTE: A slight amount of oil leakage at the compressor front seal is considered normal.

7. Check the system controls for proper operation.

6000 MILE INSPECTION

1. Check unit for any indication of a refrigerant leak.
2. If there is an indication of an excessive oil leak, check the compressor for proper oil charge.

NOTE: A slight amount of oil leakage at the compressor front seal is considered normal.

3. Check refrigerant charge (see "Refrigerant Quick Check Procedure" under "DIAGNOSIS OF PROBLEMS" later in this section).
4. Tighten ~~the compressor~~ brace and support bolts and check the belt tension.
5. Check refrigerant hose connections as in Step 5 of "Pre-Delivery Inspection."

PERIODIC SERVICE

1. Inspect condenser regularly to be sure that the fins are not plugged with leaves or other foreign material.
Also check to be sure fins are not folded over, blocking air flow. Fins may be straightened if bent.
2. Check evaporator drain tubes regularly for dirt or restrictions.
3. At least once a year, check the system for proper refrigerant charge and the flexible hoses for brittleness, wear or leaks.
4. Every 6000 miles check for low refrigerant level.
5. Check belt tension regularly

AIR CONDITIONING AND HEATING DIAGNOSIS

PRIMARY CAUSES OF SYSTEM FAILURE

LEAKS

A shortage of refrigerant causes oil to be trapped in the evaporator. Oil may be lost with the refrigerant at point of leakage. Both of these can cause compressor seizure.

Oil circulates as globules with the vapor. It leaves the compressor by the action of the pistons and mixes with the refrigerant liquid in the condenser. The oil then enters the evaporator with the liquid and, with the evaporator properly flooded, is returned to the compressor through the low pressure line. Some of the oil returns as globules in the vapor but more importantly, it is swept as a liquid along the walls of the tubing by the velocity of the vapor. If the evaporator is starved of refrigerant, the oil cannot return in sufficient quantities to keep the compressor properly lubricated.

HIGH TEMPERATURE AND PRESSURE

A fundamental law of nature accounts for the fact that when a substance is increased in temperature, its pressure is also increased. A definite pressure and temperature relationship exists in the case of liquid refrigerants and their saturated vapors. Increasing the temperature of a substance causes it to expand. When the substance is confined in a closed

REFRIGERANT-12 PRESSURE-TEMPERATURE RELATIONSHIP

TEMP. (°F.)	(°C.)	PRESSURE (PSI)	TEMP. (°F.)	(°C.)	PRESSURE (PSI)
−40	−40	*11″	45	7.2	41.7
−35	−37.2	* 8.3″	50	10	46.7
−30	−33.3	* 5.5″	55	12.8	52.0
−25	−37.7	* 2.3″	60	15.6	57.7
−21.7	−29.8	** 0	55	18.3	63.7
−20	−29	0.6	70	21.1	70.1
−15	−26.1	2.4	75	23.9	76.9
−10	−23.3	4.5	80	26.7	84.1
− 5	−20.6	6.8	85	29.4	91.7
0	−17.8	9.2	90	32.2	99.6
5	−15	11.8	95	35	108.1
10	−12.2	14.7	100	37.8	116.9
15	− 9.4	17.7	105	40.6	126.2
20	− 6.7	21.1	110	43.3	136.0
25	− 3.9	24.6	115	46.1	146.5
30	− 1.1	28.5	120	49	157.1
32	0	30.1	125	51.7	167.5
35	1.7	32.6	130	54.4	179.0
40	4.4	37.0	140	60	204.5
			150	65.6	232.0

*Inches Vacuum.
**Atmospheric Pressure.

A-6155

Figure 42—Refrigerant-12 Pressure-Temperature Relationship

container, the increase in temperature will be accompanied by an increase in pressure, even though no mechanical device was used. For every temperature, there will be a corresponding pressure within the container of refrigerant.

The table above (figure 42) indicates the pressure of Refrigerant-12 at various temperatures. Pressures are indicated in gauge pressure, either positive pressure (above atmospheric) in pounds, or negative pressure (below atmospheric) in inches of vacuum.

If a gauge is attached to a container of R-12 and the room temperature is 70°F (21°C), the gauge will register approximately 70 psi; in a 100°F (38°C) room, the pressure would be 117 psi. This relationship can also be used conversely to determine the temperature at which Refrigerant-12 boils under various pressures. For example, at a pressure of 30.1 psi, Refrigerant-12 boils at 32°F (0°C).

A temperature pressure increase accelerates chemical instability in clean systems. Other results of this increase are brittle hoses, O-ring gaskets and by-pass valve diaphragms with possible decomposition, broken compressor discharge reeds, and seized compressor bearings.

Any chemical reactions caused by contaminants already in the system are greatly accelerated as the temperature increases. A 15°F (9°C) rise in temperature doubles the rate of the chemical action.

While temperature alone can cause the synthetic rubber parts to become brittle and possibly to decompose, the increased pressure can cause them to rupture or blow.

As the temperature and pressure increases, the stress and strain on the discharge reeds also increases. This can result in broken reeds. Due to the effect of the contaminants caused by high temperature and pressure, compressor bearings can be caused to seize.

High temperature and pressure is also caused by air in the system.

AIR IN THE SYSTEM

Air results from a discharged system, open system or careless servicing procedures. This reduces system capacity and efficiency and causes oxidation of oil into gum and varnish.

When a leak causes the system to become discharged, the resulting vacuum within the system caused by temperature change will cause air and moisture to be drawn in. Air in a system is a noncondensable gas and will usually tend to move toward and collect at the condenser as it would in an air compressor tank.

The discharge pressure will rise to a point above the pressure corresponding to the temperature at which the vapor is condensing. In extreme cases, the pressure may rise to a point to cause the pressure relief valve at line end of compressor to "POP" open.

Many systems are contaminated and also reduced in capacity and efficiency by careless servicing procedures.

Too frequently, systems which have been open to the atmosphere during service operations have not been properly purged or evacuated. Air is also introduced into the sytem by unpurged gauge and charging lines. Any air in the system is too much air.

To determine whether or not there is air in the system, the compressor must be allowed to stand idle long enough for the entire system to cool down to the temperature of the surrounding air. After the system has attained the same temperature as the surrounding air, the reading of the discharge pressure test gauge should not be more than 5 lbs. above the saturation pressure corresponding to the surrounding air temperature.

POOR CONNECTIONS

Hose clamp-type fittings must be properly made. Hoses should be installed over the sealing flanges and with the end of the hose at the stop flange. The hose should never extend beyond the stop flange. Locate the clamp properly and torque as recommended. Be especially careful that the sealing flanges are not nicked or scored or a future leak will result.

When compression fittings are used, overtightening can cause physical damage to the O-ring gasket and will result in leaks. The use of torque and backing wrenches is highly recommended. When making a connection with compression fittings, the gaskets should be first placed over the tube before inserting it in the connections.

Another precaution—inspect the fitting for burrs which can cut the O-ring.

RESTRICTIONS

Restrictions may be due to corrosion byproducts or dirt and foreign matter. This may result in a starved evaporator and loss of cooling, high temperature at the bypass hose, or a seized compressor.

When the amount of moisture in a system sufficiently exceeds the capacity of the desiccant, it can cause corrosion which can be carried with the refrigerant liquid to the expansion valve screen. While some of it may pass through the valve screen into the evaporator, it may quickly build up at the screen to cause a restriction.

Due to the fact that sufficient oil then cannot be returned to the compressor, the compressor may seize.

DIRT

Dirt, which is any foreign material, may come from cleaner residues, cutting, machining, or preserving oils, metal dust or chips, lint or dust, loose rust, soldering or brazing fluxes, paint or loose oxide scale. These can also cause seized bearings by abrasion or wedging, discharge and expansion valve failure, decomposition of refrigerant and oil, or corrosion of metal parts.

CORROSION

Corrosion and its by-products can restrict valve and drier screens, roughen bearing surfaces or hasten fatiguing of discharge reeds. This can result in high temperature and pressure, decomposition or leaks. In any event, this means a damaged compressor.

From this, we can see the vicious circle that can be produced in a refrigeration system to cause its failure. Corrosion can be the indirect cause of leaks and leaks can be the direct cause of corrosion. We can also see the important role servicepersons play in maintaining chemical stability.

The major cause of corrosion is moisture.

MOISTURE

Moisture is the greatest enemy of refrigerating systems. Combined with metal, it produces oxide, Iron Hydroxide, and Aluminum Hydroxide. Combined with R-12, it produces Carbonic acid, Hydrochloric acid, and Hydrofluoric acid. Moisture can also cause freeze-up of an expansion valve.

Although high temperature and dirt are responsible for many difficulties in refrigerating systems, in most instances it is the presence of moisture in the system that accelerates these conditions. The acids that moisture produces, in combination with both the metals and the refrigerant, cause damaging corrosion. While the corrosion may not form as rapidly with R-12 as with some other refrigerants, the eventual formation is as damaging.

If the operating pressure and temperature in the evaporator is reduced to the freezing point, moisture in the refrigerant can collect at the orifice of the expansion valve and freeze. This temporarily restricts the flow of liquid, causing erratic cooling.

POINTS TO REMEMBER

- That the inside of the refrigerant system is completely sealed from the outside world. If that seal remains broken at any point—the system will soon be damaged.
- That complete and positive sealing of the entire system is vitally important and that this sealed condition is absolutely necessary to retain the chemicals and keep them is a pure and proper condition.
- That all parts of the refrigerant system are under pressure at all times, whether operating or idle, and that any leakage points are continuously losing refrigerant and oil.

HOW TO ISOLATE THE PROBLEM

To diagnose an air conditioning problem in the shortest time and with the least effort, it

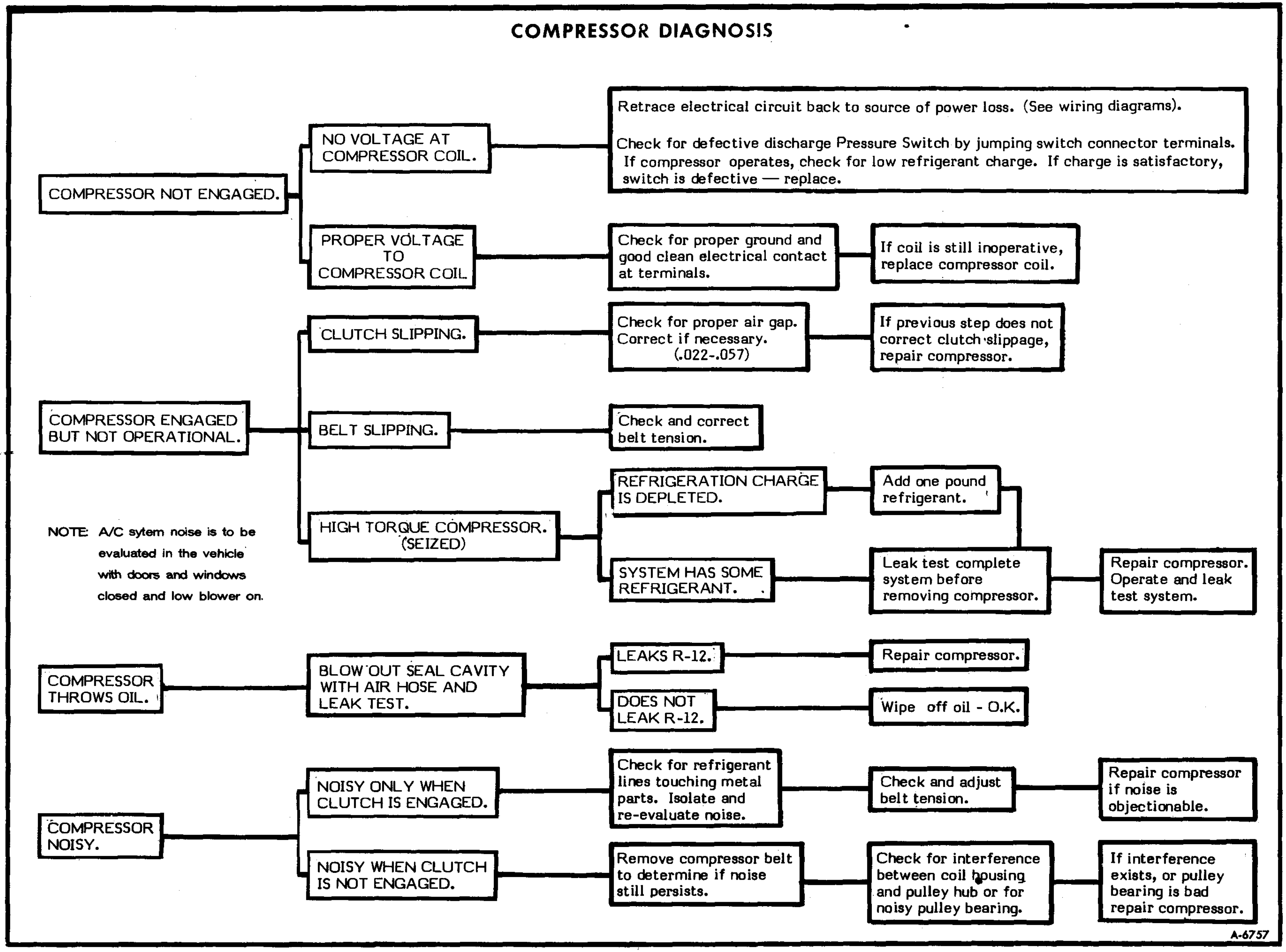


Figure 43—Compressor Diagnosis Chart

is essential to follow a logical service procedure.

STEP 1 - Visual Checks.
STEP 2 - Operational Checks.
STEP 3 - Performance Tests.

NOTE: Do the easiest checks first.

STEP 1 - VISUAL CHECKS

1. Check compressor drive belt tension.
2. Check wiring connection at compressor.
3. Check compressor clutch air gap (.022"-.057").
4. Check for broken, burst, or cut refrigerant lines and hoses. Also, check for refrigerant leaks.
5. Check for air flow restriction through condenser.
6. Check operation of temperature control door.
7. Check for air leakage anywhere around the evaporator.

STEP 2 - OPERATION CHECKS

NOTE: Warm up the engine and operate at approximately 2000 rpm.

Electrical System—If the compressor is engaged and blower is operating, this generally indicates that electrical circuits are OK.

NOTE: Refer to Compressor Diagnosis Chart (figure 43) for diagnostic procedures for manv compressor electrical problems.

Air conditioning system electrical wiring diagrams are included at back portion of this supplement.

Air Flow System—Insufficient cooling may be caused by:

1. Air flow restriction through evaporator core.
2. Warm air leaks in vehicle interior.
3. Improper heat door control adjustment, loose connections or improper installation, or cold air ducts (under instrument panel - loose connections).

Refrigeration System

1. Check sight glass for "clear" condition. Bubbles or foaming indicates low refrigerant or low ambient temperature.
2. Compressor high pressure line should be warm. The low pressure line should be cool.

NOTE: If lines are not of indicated temperatures, low refrigerant may be the cause.

Step 3 - Performance Tests

NOTE: Using the gauge readings on "Performance Data Chart," and following the procedures indicated on the "Insufficient Cooling Diagnosis Chart" (figure 44), determine the cause of malfunction.

This test consists of checking the following:

Air Temperature

1. Entering the condenser.
2. Leaving the air discharge nozzles within the vehicle.

Evaporator Pressures.

1. At suction side of evaporator (low pressure service fitting in evaporator outlet line).
2. At discharge side of system (high pressure service fitting in evaporator inlet line).

NOTE: Compare these figures with figures on the "Performance Data Chart" shown in this section. If related figures correspond under a particular ambient condition, this indicates that the system is normal.

Test Procedures - The following conditions must be adhered to in order to compare the performance of system being tested with the figures listed on the "Performance Data Chart."

1. The vehicle should be inside or in the shade.
2. The access doors should be raised.
3. Place "Air Conditioning" controls for "MAX" cooling and "HI" blower speed. Set temperature lever at "COLD".
4. Install the refrigerant pressure checking gauge set, attaching correct lines to high and low pressure service fittings on vehicle.
5. Support a thermometer just ahead of the radiator and condenser, in front of vehicle grille.
6. Support another thermometer inside the vehicle next to center air register in instrument panel.
7. Make sure transmission shift lever is in "NEUTRAL".
8. Operate engine at approximately 2000 rpm for 10 minutes to allow system to level out.
9. Read the gauge pressures and thermometers, then compare these figures with those on the "Performance Data Chart".

INSUFFICIENT COOLING DIAGNOSIS CHART

The following procedures should be applied before performance testing an A/C System.

1. Check for proper belt installation and tension with J-23600.
2. Check for proper clutch coil terminal connector installation.
3. Check for clutch air Gap (.022 - .057).
4. Check for broken, burst, or cut hoses. Also check for loose fittings on all components.
5. Check for condenser air blockage due to foreign material.
6. Check for proper air ducting hose connections.
7. Check heater temperature door adjustment, adjust if incorrect.
8. Check evaporator sealing for air leak, repair if leaking.
9. Install pressure gages and thermometer and make performance test.

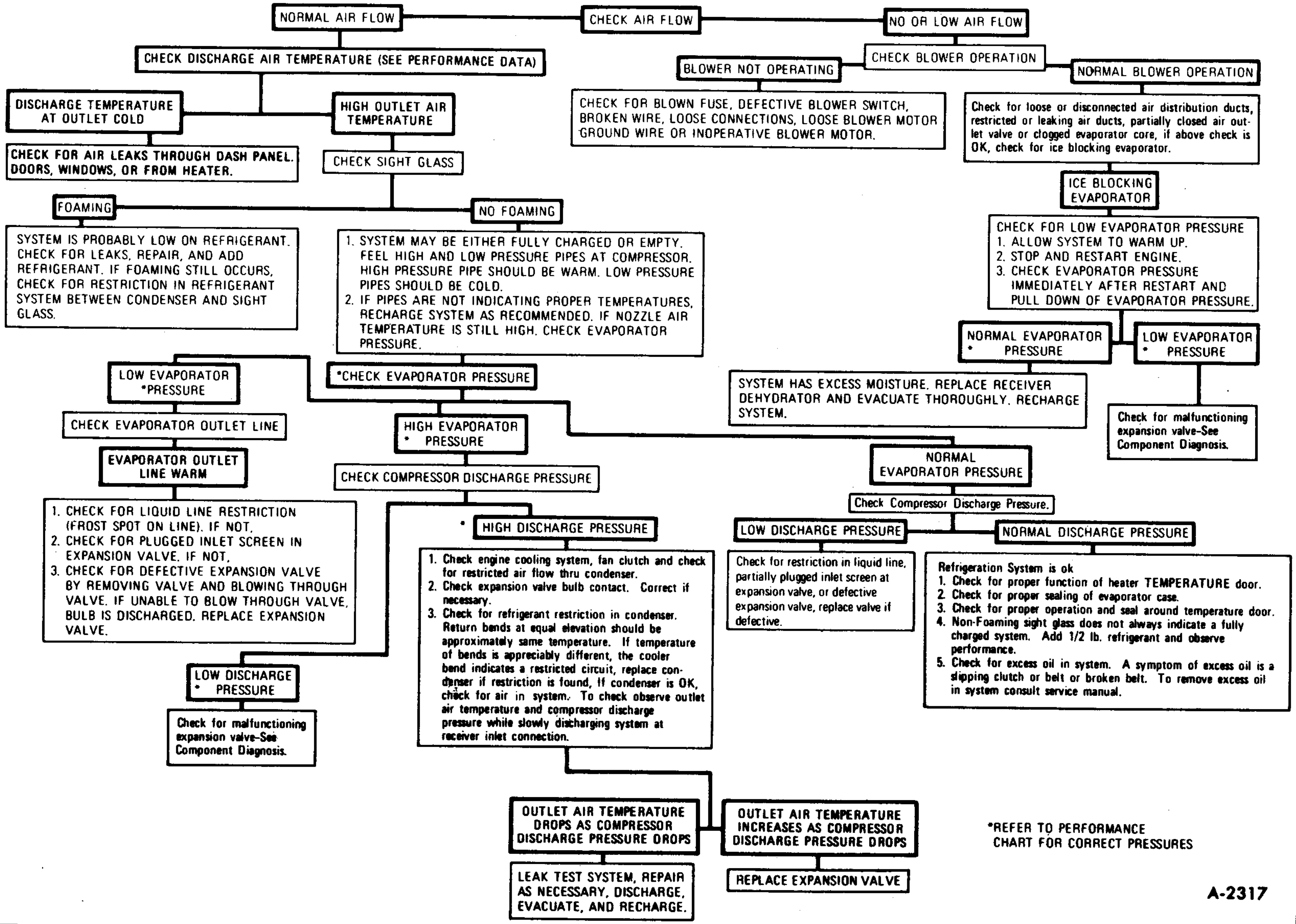


Figure 44—Insufficient Cooling Diagnosis Chart

NOTE: Should excessive discharge pressures be encountered at higher ambient temperatures, an 18-inch fan placed in front of the vehicle and blowing into the condenser will provide the extra circulation of air needed to bring the pressures to within the limits specified.

Higher temperatures and pressures will occur at higher ambient temperatures. In areas of high humidity it is possible to have thermometer and gauge readings approach, but not reach, the figures listed in the "Performance Data Chart" and still have a satisfactory operating unit. However, it is important to remember that low pressure has a direct relationship to nozzle outlet temperature. If pressure is too low, ice will gradually form on the evaporator fins, restricting airflow into the vehicle and resulting in insufficient or no cooling. Engine fan not operating properly will cause high head pressures and may cause pressure relief valve on compressor to blow and lose refrigerant oil.

REFRIGERANT SYSTEM DIAGNOSIS

The following is a description of the type of symptom each refrigerant component will evidence if a defect occurs:

COMPRESSOR

A compressor defect will appear in one of four ways: Noise, seizure, leakage, or low discharge pressure.

NOTE: Resonant compressor noises are not cause for alarm; however, irregular noise or rattles may indicate broken parts or excessive clearance due to wear. To check seizure, deenergize the magnetic clutch and check to see if drive plate can be rotated. If rotation is impossible, compressor is seized (See "False Compressor Seizure"). To check for a leak, refer to leak testing later in this section. Low discharge pressure may be due to a faulty internal seal of the compressor, or a restriction in the compressor.

Low discharge pressure may also be due to an insufficient refrigerant charge or a restriction elsewhere in the system. These possibilities should be checked prior to servicing the compressor. If the compressor is inoperative, but is not seized, check to see if current is being supplied to the magnetic clutch coil terminals.

Broken valves (reeds) in compressor are generally indicated by a rapid rise in suction pressure as soon as the compressor stops. Before the compressor is replaced, it should be determined that the pressure rise is not due to an open or leaky expansion valve which could cause a similar reaction.

CONDENSER

A condenser may be defective in two ways: it may leak, or it may be restricted. A condenser restriction will result in excessive compressor discharge pressure. If a partial restriction is present, sometimes ice or frost will form immediately after the restriction as the refrigerant expands after passing through the restriction. If air flow through the condenser or radiator is blocked, high discharge pressures will result. During normal condenser operation, the outlet pipe will be slightly cooler than the inlet pipe.

RECEIVER-DEHYDRATOR

A defective receiver-dehydrator may be due to a restriction inside the body of the unit. A restriction at the inlet to the receiver-dehydrator will cause high head pressures. Outlet tube restrictions will be indicated by low head pressures and little or no cooling. An excessively cold receiver-dehydrator outlet may be indicative of a restriction.

EXPANSION VALVE

A malfunction of the expansion valve will be caused by one of the following conditions: valve stuck open, valve stuck closed, broken power element, a restricted screen or an improperly located or installed power element bulb. The first three conditions require valve replacement. The last two may be corrected by replacing the valve inlet screen and by properly installing the power element bulb.

Attachment of the expansion valve bulb to the evaporator outlet line is very critical. The bulb must be attached tightly to the line and must make good contact with the line along the entire length of the bulb. A loose bulb will, result in high low-side pressures and poor cooling.

Indications of expansion valve trouble are provided by Performance Test; consult Diagnostic Charts.

VALVE STUCK OPEN

Noisy Compressor.
No Cooling—Freeze Up.

NOTE: When the expansion valve is stuck open, there will be an excessive amount of sweating on the suction line and compressor due to the large amount of liquid being passed into the suction line.

VALVE STUCK CLOSED, BROKEN POWER ELEMENT OR PLUGGED SCREEN

Very Low Suction Pressure.
No Cooling

POORLY LOCATED POWER ELEMENT BULB

Normal Pressure.
Poor Cooling.

Diagnosis for Defective Valve

The following procedure must be followed to determine if a malfuction is due to a defective expansion valve.

1. Check to determine if the system will meet the performance test as outlined previously. If the expansion valve is defective, the low pressure readings (evaporator pressure) will be above specifications.
2. The loss of system performance is not as evident when the compressor head pressure is below 200 psi. Therefore, it may be necessary to increase the system head pressure by partially blocking the condenser. Disconnect the blower lead wire and repeat the "Performance Check" to determine if the evaporator pressure can be obtained.
3. The system will also indicate a low refrigerant charge by bubbles occurring in the sight glass.

EVAPORATOR

When the evaporator is defective, the trouble will usually show up as uncooled air or as an inadequate supply of cool air. A partially plugged core due to dirt, a cracked case, or a leaking seal will generally be the cause.

If a malfunction in the refrigerant system is suspected due to abnormal evaporator core pressures, check for the following:

1. Restrictions in evaporator core, hoses, tubes, etc.
2. Refrigerant leaks.
3. Compressor clutch slippage.
4. Improper drive belt tension.
5. Excessive moisture in refrigerant system.
6. Inoperative expansion valve.

REFRIGERANT LINE RESTRICTIONS

Restrictions in the refrigerant lines will be indicated as follows:

1. Suction Line—A restricted suction line will cause low suction pressure at the compressor, low discharge pressure and little or no cooling.
2. Discharge Line—A restriction in the discharge line generally will cause the pressure relief valve to open.
3. Liquid Line—A liquid line restriction will be evidenced by low discharge and suction pressure, and insufficient cooling.

SIGHT GLASS DIAGNOSIS

At temperatures higher than 70°F (21°C) 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 sight 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 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 should be considered adequate.

In all instances where the indications of refrigerant shortage continues, additional refrigerant should be added in 1/4 lb. increments until the sight glass is clear. An additional charge or 1/2 lb. should be added as a reserve after the glass clears. In no case should the system be overcharged.

ELECTRICAL SYSTEM DIAGNOSIS

For electrical connections and routings, refer to the wiring diagram at the end of the manual. Also see figure 45.

VACUUM SYSTEM DIAGNOSIS

Start the engine and allow it to idle—move the selector lever to each position and refer to

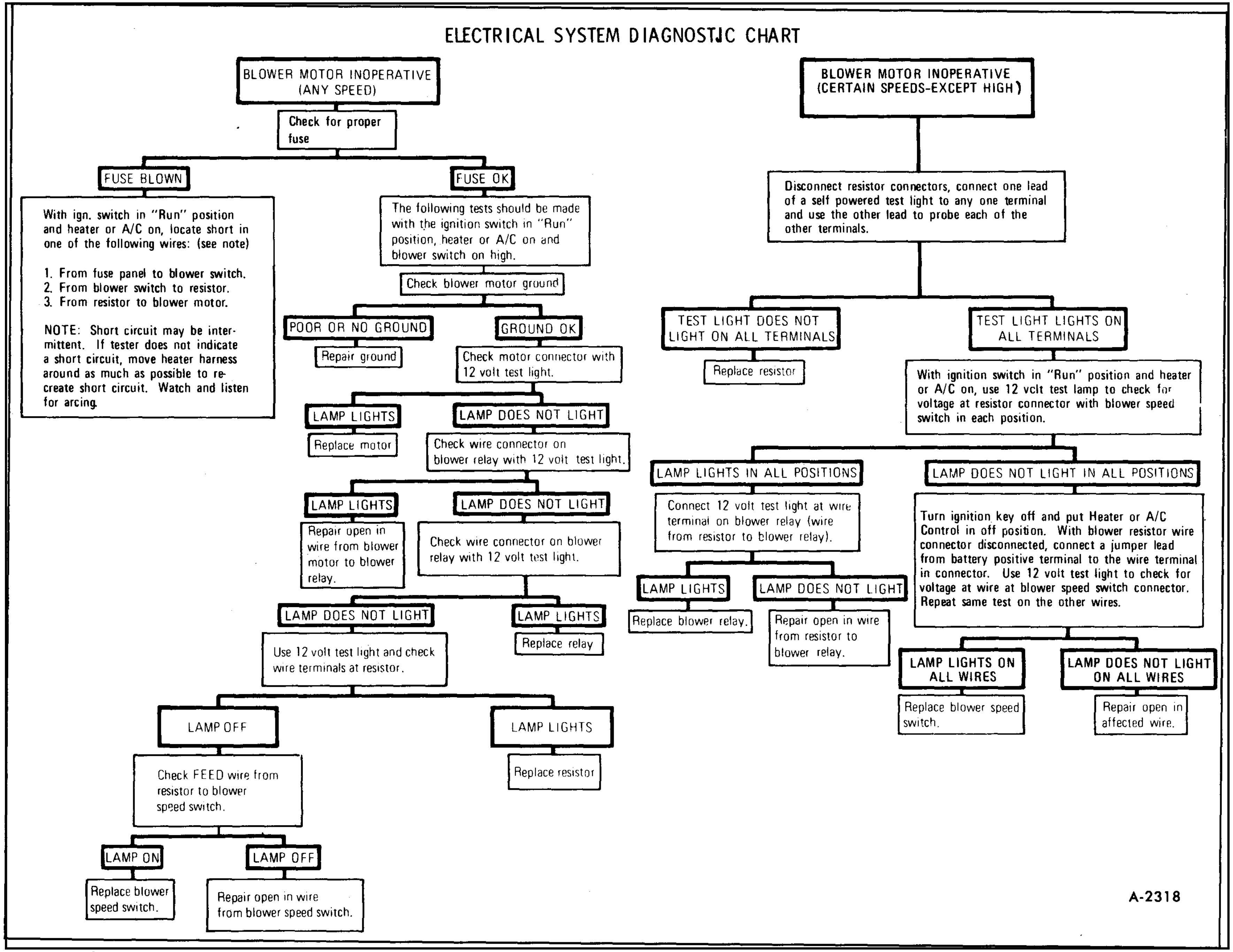


Figure 45—Electrical System Diagnosis Chart

Vacuum Control Diagram vacuum operational schematics and air flow drawings for proper air flow, air door functioning and vacuum circuit operation. If air flow is not out of the proper outlets at each selector lever position, then proceed as follows:

1. Check for good hose connection—at the vacuum actuators, control head valves, vacuum reservoir, tees, etc.

2. Check the vacuum source circuit as follows:

Install vacuum tee and gauge (with restrictor) at the vacuum tank outlet (see Vacuum Diagram). Idle the engine and read the vacuum (a normal vacuum is equivalent to manifold vacuum) at all selector lever positions.

a. Vacuum Less Than Normal At All Positions—

Remove the tee and connect the vacuum gauge line directly to the tank—read the vacuum. If still low, then the problem lies in the feed circuit, the feed circuit to the tank or in the tank itself. If vacuum is now normal, then the problem lies downstream.

b. Vacuum Less Than Normal at Some Positions—

If vacuum was low at one or several of the selector lever positions, a leak is indicated in these circuits.

c. Vacuum Normal at All Positions—

If vacuum is normal and even at all positions, then the malfunction is probably caused by improperly connected or plugged lines or a defective vacuum valve or valves.

3. Specific Vacuum Circuit Check

Place the selector lever in the malfunctioning position and check for vacuum at the pertinent vacuum actuators. If vacuum exists at the actuator but the door does not move, then the actuator is defective or the door is mechanically bound. If low or no vacuum exists at the actuator, then the next step is to determine whether the cause is the vacuum harness or the vacuum valve. Check the vacuum harness first.

LEAK TESTING THE SYSTEM

Whenever a refrigerant leak is suspected in the system or a service operation performed which results in disturbing lines or connections, it is advisable to test for leaks. Common sense should be the governing factor in performing any leak test, since the necessity and extent of any such test will, in general, depend upon the nature of the complaint and the type of service performed on the system.

NOTE: The use of a leak detecting dye within the system is not recommended for the following reasons:

1. Refrigerant leakage can exist without any oil leakage. In this case the dye will not indicate leak.

2. The addition of additives may alter the stability of the refrigeration system and cause malfunctions.

3. Dye-type leak detectors which are insoluble form a curdle which can block the inlet screen of the expansion valve.

LIQUID LEAK DETECTORS

There are a number of fittings and surface areas throughout the air conditioning system where a liquid leak detector solution may be used to pinpoint leaks.

When solution is applied to the area with a swab that is attached to the bottle cap, bubbles will form within seconds if there is a leak.

For confined areas, such as sections of the evaporator and condenser, electronic leak detectors are more practical for determining leaks.

ELECTRONIC LEAK DETECTORS

Electronic leak detector J-26934 is available for detecting refrigerant leaks. Instructions for use are included with leak detector.

NOTE: A refrigerant leak in the high pressure side of the system may be more easily detected when, if possible, the system is in operation. A leak on the low pressure side may be most easily detected after the engine has been shut off for several minutes to allow system pressures to equalize. This particularly applies to a front seal leak.

REFRIGERANT PROBLEMS

SHORTAGE OF REFRIGERANT

There should always be sufficient liquid in the receiver shell to completely submerge the inlet to the liquid pickup tube. If there is a shortage of refrigerant, the liquid level will fall below the inlet to the tube and a mixutre of gas and liquid will pass into the expansion valve cavity and sight glass area.

HEATING DIAGNOSIS (INSUFFICIENT HEAT)

INSUFFICIENT HEATING

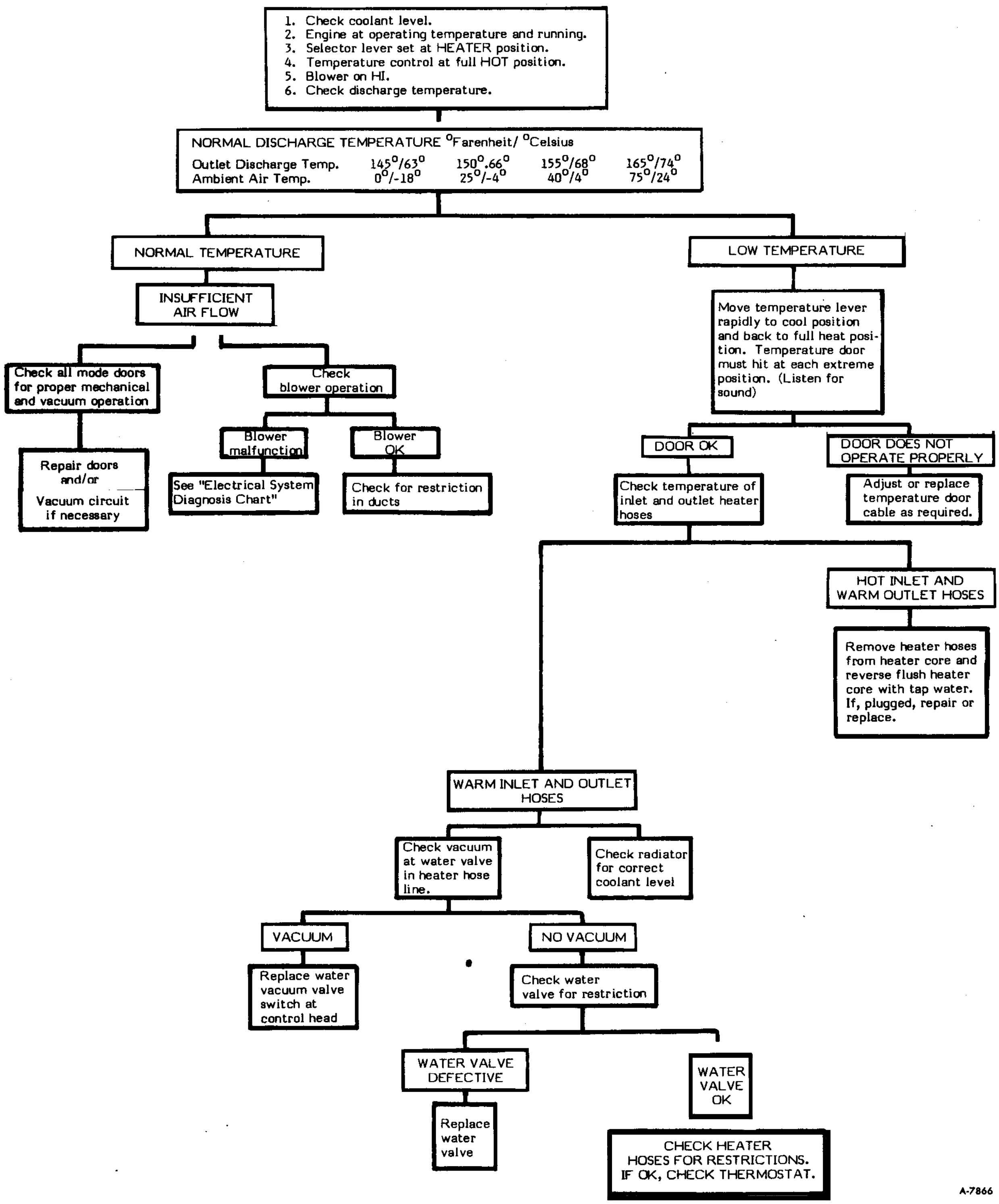


Figure 46—Insufficient Heating Diagnosis Chart

Bubbles will appear in the sight glass — the larger the bubbles, the more severe the refrigerant shortage; there may also be a hissing or whistle at the expansion valve. If the shortage is severe, the suction line will be relatively warm while the suction pressure will be low due to little or no liquid being supplied to the evaporator.

OVERCHARGE OF REFRIGERANT

Overcharge of refrigerant will cause high discharge pressures. The liquid will back up in the condenser and decrease the amount of surface available for condensing. In extreme cases, pressure may rise to a point to cause the pressure relief valve at line end of compressor to "pop" open.

REFRIGERANT QUICK-CHECK PROCEDURE

The following procedure can be used to quickly determine whether or not an air conditioning system has a proper charge of refrigerant. This check can be made in a matter of minutes, thus facilitating system diagnosis by pinpointing the problem to an improper charge in the system or by eliminating this possibility from the overall checkout.

Start engine and place on fast idle. Set controls for "MAX" cold with blower on "HI".

Bubbles present in sight glass. System low on charge. Check with leak detector. Correct leak, if any, and fill system to proper charge.

No bubbles. Sight glass clear. System is either fully charged or empty. Feel high and low pressure pipes at compressor. High pressure pipe should be warm; low pressure pipe should be cold.

No appreciable temperature differential noted at compressor. System empty or nearly empty. Turn off engine and connect Charging Station. Induce 1/2# of refrigerant in system (if system will not accept charge, start engine and draw 1/2# in through low pressure side). Check system with leak detector.

Temperature differential noted at compressor. Even though a differential is noted, there exists a possibility of overcharge. An overfilled system will result in poor cooling during low speed operation (as a result of excessive head pressure). An overfill is easily checked by disconnecting the compressor clutch connector while observing the sight glass.

If refrigerant in sight glass remains clear for more than 45 seconds (before foaming and then settling away from sight glass) an overcharge is indicated. Verify with a performance check.

If refrigerant foams and then settles away from sight glass in less than 45 seconds, it can be assumed that there is a proper charge of refrigerant in system. Continue checking out system using performance checks outlined previously.

SPECIAL TOOLS FOR DISCHARGING, EVACUATING AND CHARGING

CHARGING STATION J-24410

Charging Station J-24410 (figure 47) is a portable assembly consisting of a vacuum pump, two compound gauges, shut-off valves, refrigerant supply connection, and a 5-lb.

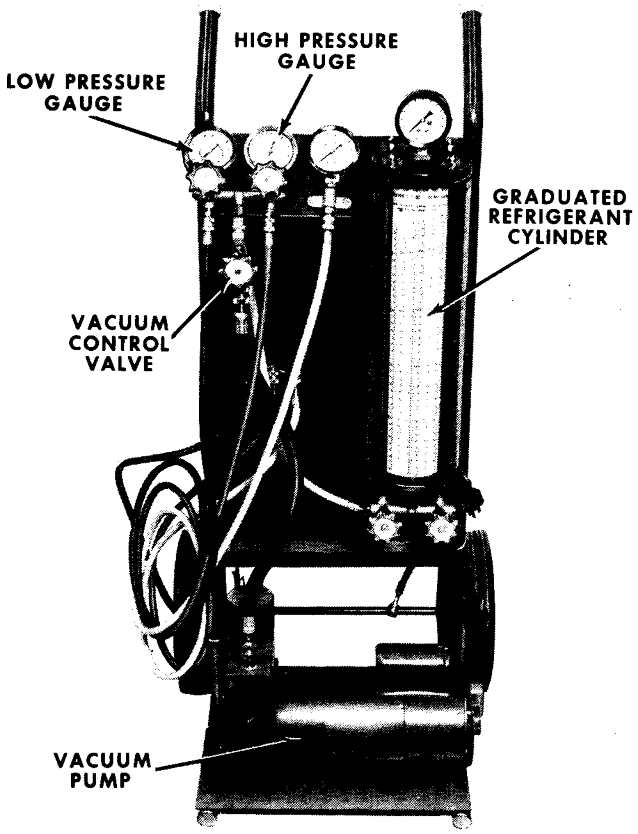


Figure 47—Charging Station J-24410

metering refrigerant charging cylinder. The use of the charging cylinder eliminates the need for scales, hot water pails, etc.

The vacuum pump on this service station evacuates at the rate of three cubic feet per minute, and has a vented exhaust to aid in the removal of moisture.

The cylinder (which can be heated to provide a positive pressure advantage during charging) is graduated for both Refrigerant-12 and Refrigerant 22. Refrigerant-22 is used in some of the refrigerant systems on recreational vehicles.

All the necessary evacuating and charging equipment is hooked together in a compact portable unit. Use of a charging station brings air conditioning service down to the basic problem of hooking on two hoses, and manipulating clearly labeled valves.

MANIFOLD GAUGE SET

The Manifold Gauge Set (or Manifold Assembly) J-23575-01 (figure 48) is used when discharging, evacuating, charging or diagnosing trouble in the system.

The gauge at the left is known as the low

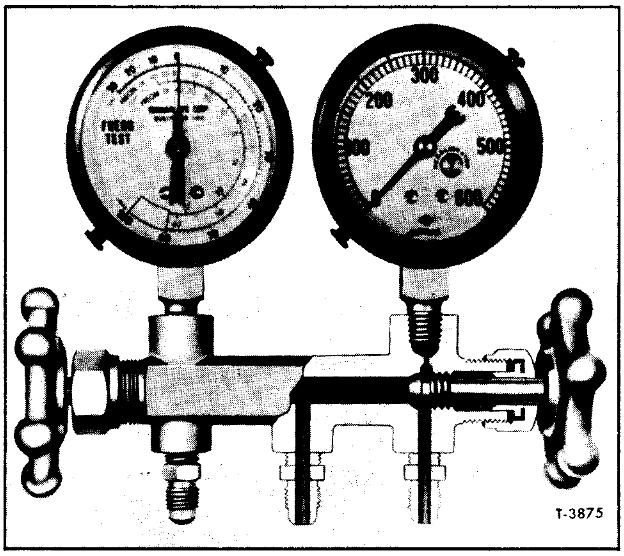


Figure 48—Manifold Gauge Set J-23575-01

pressure gauge. The face is graduated into pounds of pressure and, in the opposite direction from "O" pounds, in inches of vacuum. This is the gauge that should always be used in checking pressures on the low pressure side of the system. When all parts of the system are functioning properly, the refrigerant pressure on the low pressure side never falls below 0 pounds pressure. However, several abnormal conditions can occur that will cause the low pressure to fall into a partial vacuum. Therefore, a low pressure gauge is required.

The high pressure gauge is used for checking pressures on the high pressure side of the system.

The connection at the far left is for attaching the low pressure gauge line and the one at the right is for attaching the high pressure gauge line. The center connector is common to both and is for the purpose of attaching a line for adding refrigerant to a system, discharging refrigerant, evacuating the system and other uses. When not required, this line or connection should be capped.

NOTE: Gauge fitting connections should be installed hand-tight only and the connection leak-tested before proceeding with leak testing or charging with R-12 through the low side only.

The hand shutoff valves on the gauge manifold do not control the opening or closing off of pressure to the gauges. They merely close each opening to the center connector and to each other. During most diagnosing and service operations, the valves must be closed. The only occasion for opening both at the same

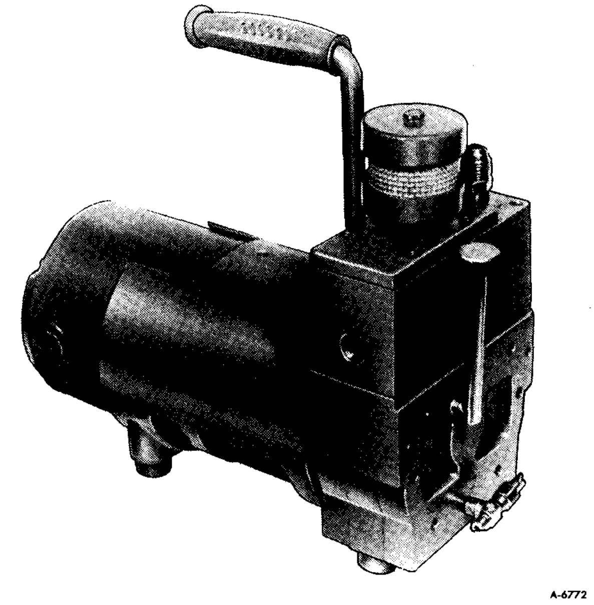


Figure 49—Vacuum Pump J-24364

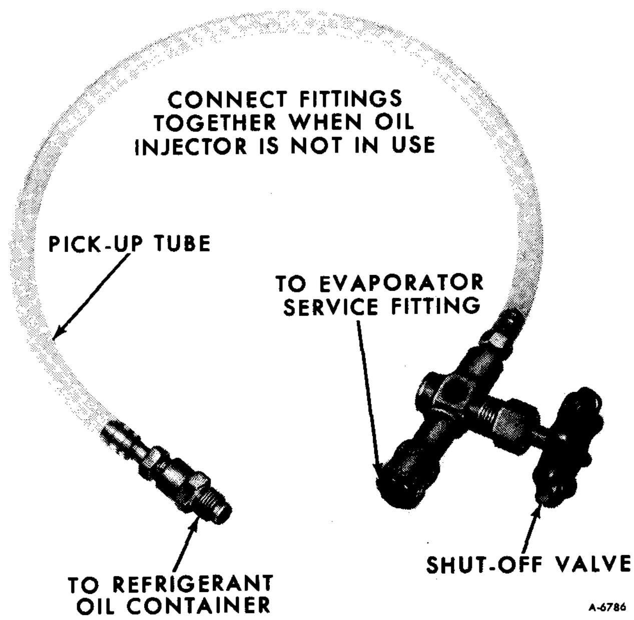


Figure 51—Compressor Oil Injector Tool J-24095

time would be to bypass refrigerant vapor from the high pressure to the low pressure side of the system, or in evacuating both sides of the system.

The Gauge Set Asembly includes three color coded flexible hoses for connecting the gauge set to the system.

VACUUM PUMP

A vacuum pump should be used for evacuating air and moisture from the air conditioning system.

Figure 50—Leak Detector J-26934

Vacuum Pump J-24364 (figure 49) is available for this purpose. It can be used together with a Manifold Gauge Set. A vacuum pump is a component part of the Charging Station described previously. The following precautions should be observed relative to the operation and maintenance of the vacuum pump:

1. Make sure dust cap on discharge outlet of vacuum pump is removed before operating.
2. Keep all openings capped when not in use to avoid moisture being drawn into the system.
3. Oil should be changed as recommended by manufacturer.

NOTE: Improper lubrication will shorten the life of the pump.

4. If this pump is subjected to extreme or prolonged cold, allow it to remain indoors until oil has reached approximately room temperature.
5. If the pump is being utilized to evacuate a burnt-out system, a filter must be connected to the intake fitting to prevent any sludge from contaminating the working parts. Contamination will result in malfunction of the pump.
6. Do not use the vacuum pump as an air compressor.

LEAK TESTERS

Electronic Leak Detector J-26934 (figure 50) is available for detecting refrigerant leaks.

For information on leak testing, refer to "Leak Testing the System" (AIR CONDITIONING DIAGNOSIS") earlier in this section.

COMPRESSOR OIL INJECTOR TOOL J-24095

Oil can be added to the refrigeration system after discharge and before evacuation using Compressor Oil Injector Tool J-24095 (figure 51). Before the tool is used on the system, however, it must be flushed with clean Refrigerant-12 to eliminate possible contamination. Tool ends should be joined together when tool is not in use. Refer to "Adding Oil" procedure later in this section for usage instructions.

REFRIGERANT HANDLING PROCEDURES AND PRECAUTIONS

In any vocation or trade, there are established procedures and practices that have been developed after many years of experience. In addition, occupational hazards may be present that require the observation of certain precautions or use of special tools and equipment. Observing the procedures, practices and precautions of servicing refrigeration equipment will greatly reduce the possibilities of damage to the customers' equipment as well as virtually eliminate the element of hazard to the serviceman.

Before any service is attempted which requires opening of refrigerant lines or components, the person doing the work should be thoroughly familiar with the following information on "Precautions in Handling Refrigerant-12", and should follow very carefully the instructions given for the unit being serviced. The major reasons behind these measures are safety and the prevention of dirt and moisture in the system. Dirt contaminant is apt to cause leaky valves or wear in the compressor, and moisture can freeze into ice at the expansion valve, causing the valve stem to freeze. The presence of moisture can also cause the formation of hydrochloric or hydrofluoric acids in the system. Air in the system can cause high head pressure and also carries into the system varying amounts of moisture.

PRECAUTIONS IN HANDLING REFRIGERANT-12

Refrigerant-12 is transparent and colorless in both the gaseous and liquid state. It has a boiling point of -21.7°F (-30°C) and, therefore, at all normal temperatures and pressures it will be a vapor. The vapor is heavier than air, and is nonflammable, nonexplosive, nonpoisonous (except when in contact with an open flame) and noncorrosive (except when in contact with water).

WARNING: THE FOLLOWING PRECAUTIONS IN HANDLING R-12 SHOULD BE OBSERVED AT ALL TIMES:

1. REFRIGERANT SHOULD NOT BE EXPOSED TO THE RADIANT HEAT OF THE SUN SINCE THE RESULTING INCREASE IN PRESSURE MAY CAUSE THE SAFETY VALVE TO RELEASE OR THE CYLINDER OR CAN TO BURST.
2. CYLINDERS OR DISPOSABLE CANS SHOULD NEVER BE SUBJECTED TO HIGH TEMPERATURE WHEN ADDING REFRIGERANT TO THE SYSTEM. IN MOST INSTANCES, HEATING THE CYLINDER OR CAN IS REQUIRED TO RAISE THE PRESSURE IN THE CONTAINER HIGHER THAN THE PRESSURE IN THE SYSTEM DURING THE OPERATION. IT WOULD BE UNWISE TO PLACE THE CYLINDER ON A GAS STOVE OR RADIATOR OR TO USE A BLOW TORCH WHILE PREPARING FOR THE CHARGING OPERATION, FOR A SERIOUS ACCIDENT CAN RESULT. REMEMBER, HIGH PRESSURE MEANS THAT GREAT FORCES ARE BEING EXERTED AGAINST THE WALLS OF THE CONTAINER. A BUCKET OF WARM WATER, NOT OVER 125°F (52°C) OR WARM WET RAGS AROUND THE CONTAINER IS ALL THE HEAT THAT IS REQUIRED.
3. DO NOT WELD OR STEAM CLEAN ON OR NEAR THE SYSTEM. WELDING OR STEAM CLEANING CAN RESULT IN A DANGEROUS PRESSURE BUILDUP IN THE SYSTEM.
4. DISCHARGING SMALL QUANTITIES OF R-12 INTO A ROOM CAN USUALLY BE DONE SAFELY AS THE VAPOR WOULD PRODUCE NO ILL EFFECTS; HOWEVER, IN THE EVENT OF AN ACCIDENTAL RAPID DISCHARGE OF THE SYSTEM, THE REFRIGERANT MAY DISPLACE ALL THE OXYGEN IN THE ROOM. IT IS RECOMMENDED THAT INHALATION OF LARGE QUANTITIES OF R-12 BE AVOIDED AND ADEQUATE VENTILATION BE PROVIDED. THIS CAUTION IS ESPECIALLY IMPORTANT IF THE AREA CONTAINS A FLAME PRODUCING DEVICE SUCH AS A GAS HEATER. WHILE R-12 NORMALLY IS NONPOISONOUS, HEAVY CONCENTRATIONS OF IT IN CONTACT WITH A LIVE FLAME WILL PRODUCE A TOXIC GAS. THE SAME GAS WILL ALSO ATTACK ALL BRIGHT METAL SURFACES.

5. PROTECTION OF THE EYES IS OF VITAL IMPORTANCE. WHEN WORKING AROUND A REFRIGERATING SYSTEM, AN ACCIDENT MAY CAUSE LIQUID REFRIGERANT TO HIT THE FACE. IF THE EYES ARE PROTECTED WITH GOGGLES OR GLASSES (FIGURE 52), NO SERIOUS DAMAGE CAN RESULT. JUST REMEMBER ANY R-12 LIQUID THAT TOUCHES YOU IS AT LEAST 22°F (6°C) BELOW ZERO. IF R-12 LIQUID SHOULD STRIKE THE EYES, HERE IS WHAT TO DO.

A. KEEP CALM.

B. DO NOT RUB THE EYES. SPLASH THE AFFECTED AREA WITH QUANTITIES OF COLD WATER TO GRADUALLY GET THE TEMPERATURE ABOVE THE FREEZING POINT. THE USE OF MINERAL, COD LIVER OR AN ANTISEPTIC OIL IS IMPORTANT IN PROVIDING A PROTECTIVE FILM TO REDUCE THE POSSIBILITY OF INFECTION.

C. AS SOON AS POSSIBLE, CALL OR CONSULT AN EYE SPECIALIST FOR IMMEDIATE AND FUTURE TREATMENT.

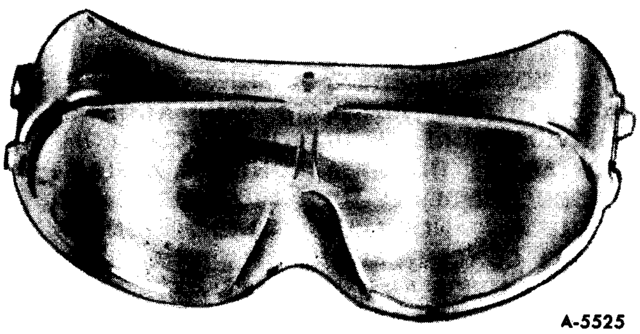
PRECAUTIONS IN HANDLING REFRIGERANT LINES

CAUTION: *The following precautions should be observed when handling refrigerant lines:*

1. All metal tubing lines should be free of kinks, because of the restriction that kinks will offer to the flow of refrigerant. The refrigeration capacity of the entire system can be greatly reduced by a single kink. Kinks can lead to early tube fatigue-type failures.
2. The flexible hose lines should never be bent to a radius of less than 10 times the diameter of the hose.
3. The flexible hose lines should never be allowed to come within a distance of 2-1/2" of the exhaust manifold.
4. Flexible hose lines should be inspected at least once a year for leaks or brittleness. If found brittle or leaking, they should be replaced wth new lines.
5. Use only new lines that have been sealed during storage.
6. When disconnecting any fitting in the refrigeration system, the system must first be discharged of all refrigerant. However, proceed very cautiously regardless of gauge readings. Open very slowly, keeping face and hands away so that no injury can occur if there happens to be liquid refrigerant in the line. If pressure is noticed when fitting is loosened, allow it to bleed off as described under "Discharging the System" in this section.

WARNING: ALWAYS WEAR SAFETY GOGGLES WHEN OPENING REFRIGERANT LINES.

7. In the event any line is opened to atmosphere, it should be immediately capped to prevent entrance of moisture and dirt.
8. The use of the proper wrenches when making connections on O-rings fittings is important. The use of improper wrenches may damage the connections. The opposing fitting should always be backed up with a wrench to prevent distortion of connecting lines or components. When connecting the flexible hose connections it is important that the swagged fitting and the flare nut, as well as the coupling to which it is attached, be held at the same time, using three different wrenches to prevent turning the fitting and damaging the ground seat.
9. O-rings and seals must be in perfect condition. A burr or piece of dirt may cause a leak.
10. Sealing beads on hose clamp connections must be free of nicks and scratches to assure a perfect seal.



A-5525

Figure 52—Goggles

MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM

The efficient operation of the air conditioning refrigeration system is dependent upon the pressure-temperature relationship of pure Refrigerant-12. As long as the system contains pure R-12 (plus a certain amount of 525 viscosity compressor oil which mixes with the R-12), it is considered to be chemically stable.

However, when foreign materials, such as dirt, air or moisture are allowed to enter the system, the chemical stability may be upset. When accelerated by heat, these contaminants may form acids and sludge and eventually cause the breakdown of components within the system. In addition, contaminants affect the temperature-pressure relationship of R-12, resulting in improper operating temperature and pressures and decreased efficiency of the system.

The following general practices should be observed to insure chemical stability in the system:

1. Whenever it becomes necessary to disconnect a refrigerant or gauge line, the opening should be immediately capped. Capping the tubing will also prevent dirt and foreign matter from entering.
2. Tools should be kept clean and dry. This also includes the gauge set and replacement parts.
3. When adding oil, the container should be exceptionally clean and dry due to the fact that the refrigeration oil in the container is as moisture-free as it is possible to make it; therefore, it will quickly absorb any moisture with which it comes in contact. For this same reason the oil container should not be opened until ready for use and then it should be capped immediately after use.
4. When it is necessary to open a system, have everything you will need ready and handy so that as little time as possible will be required to perform the operation. Don't leave the system open any longer than is necessary.
5. Finally, after the operation has been completed and the system sealed again, air and moisture should be evacuated from the system before recharging.

AVAILABILITY OF REFRIGERANT—12

Refrigerant-12 is available in 10-and 25-lb. drums and in 14-oz. disposable containers.

Normally, air conditioning systems are charged making use of an air conditioning charging station which uses the 25-lb. container. All Refrigerant-12 drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is good practice to replace the cap after each use of the drum for the same reason.

If the occasion arises to fill a small Refrigerant-12 drum from a large one, never fill the drum completely. Space should always be allowed above the liquid for expansion. If the R-12 drum were completely full and the temperature was increased, tremendous hydraulic force could be developed.

The 14-oz. disposable cans are generally used for miscellaneous operations such as flushing, adding refrigerant to the system charge, and purging.

WARNING: THE FOLLOWING PRECAUTIONS SHOULD BE OBSERVED WHEN ADDING REFRIGERANT TO A SYSTEM USING 14-OZ. DISPOSABLE CANS:

1. Do not charge while compressor system is hot.
2. Empty container completely before disposing.
3. Use opening valves designed for use with container. Follow valve manufacturers directions carefully.
4. Always use pressure gauges before and during charging.
5. NEVER connect disposable-type cans on high pressure side of system or to any system having a pressure higher than pressure limit indicated on refrigerant containers.
6. If inexperienced, seek professional assistance.

DISCHARGING, EVACUATING AND CHARGING THE SYSTEM, AND RELATED SERVICE PROCEDURES

The refrigeration system may be discharged, evacuated and charged using air conditioning Charging Station J-24410 or complete Manifold and Gauge Assembly J-23575-01 with 14-oz. disposable cans (or a drum) of Refrigerant-12.

Procedures following are written for Charging Station J-24410 or Manifold Assembly J-23575-01. Different charging stations or manifold gauge sets may be used. For other than the units specified above, consult the operating instructions included with the equipment being used.

PRECAUTIONARY SERVICE MEASURES

Persons doing air conditioning service work should be thoroughly familiar with safety

PIPE AND HOSE CONNECTION TORQUE CHART

METAL TUBE OUTSIDE DIAMETER	THREAD AND FITTING SIZE	STEEL TUBING TORQUE FT. LBS.	STEEL TUBING TORQUE N.m	ALUMINUM OR COPPER TUBING TORQUE FT. LBS.	ALUMINUM OR COPPER TUBING TORQUE N.m	NOMINAL TORQUE WRENCH SPAN
1/4	7/16	10-15	14-20	5-7	7-9	5/8
3/8	5/8	30-35	41-48	11-13	15-18	3/4
1/2	3/4	30-35	41-48	15-20	20-27	7/8
5/8	7/8	30-35	41-48	21-27	29-37	1-1/16
3/4	1-1/16	30-35	41-48	28-33	38-45	1-1/4

A-6795

CAUTION: *Tighten all tubing connections as shown in torque chart. Insufficient or excessive torque when tightening can cause loose joints or deformed joint parts. Either condition can result in refrigerant leakage. Where steel-to-aluminum connections are being made, use torque for aluminum tubing to prevent damage to the tubing.*

Figure 53—Pipe and Hose Connection Torque Chart

measures covered earlier in this section under "REFRIGERANT HANDLING PROCEDURES AND PRECAUTIONS": this includes "Precautions in Handling R-12", "Precautions in Handling Refrigerant Lines and Fittings", "Maintaining Chemical Stability in the Refrigerant System", and "Refrigerant Charging Precautions". Any person servicing Motorhome or TransMode air conditioning systems should follow very carefully the DISCHARGING, EVACUATING AND CHARGING PROCEDURES outlined in this section, and the ADDING OIL and ADDING REFRIGERANT procedures included here also.

The purpose for these precautionary measures is two-fold: (1) to insure the safety of the mechanic working on the system, and (2) to prevent the entrance of dirt and moisture into the system (which can restrict refrigerant flow). The presence of moisture can also cause the formation of hydrochloric or hydrofluoric acids in the system.

FURTHER PRECAUTIONS

All sub-assemblies are dehydrated and sealed prior to shipping. They are to remain sealed until just prior to making connections. All sub-assemblies should be at room temperature before uncapping (this prevents condensation of moisture from the air that enters the system). If, for any reason, caps are removed

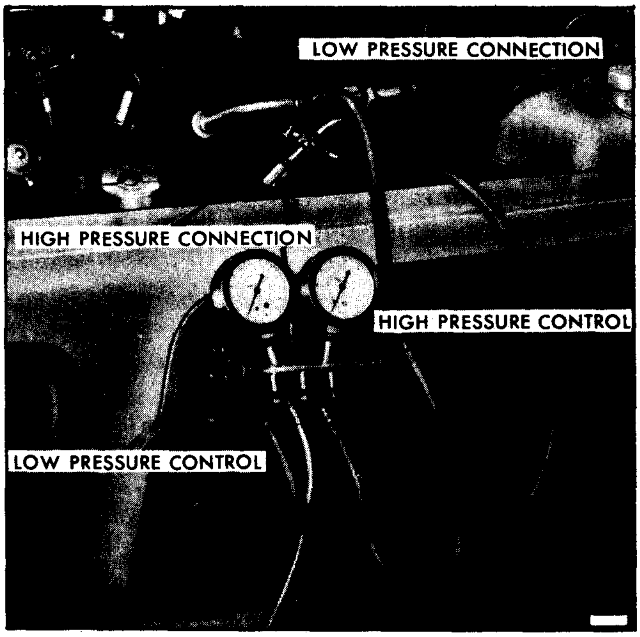


Figure 54—Manifold Gauge Set Installed To High and Low Side Service Fittings

but the connections are not made, parts should be resealed as soon as possible.

All precautions should be taken to prevent damage to fittings or connections. Any fittings getting grease or dirt on them should be wiped clean with a cloth dampened with trichlorethylene (naphtha, stoddard solvent or kerosene may be used). Make sure fittings are dry prior to reassembly. If dirt, grease or moisture get inside pipes and cannot be removed, the pipe should be replaced.

Sealing caps should be removed from subassemblies just prior to making connections for final assembly. Use a small amount of clean 525 viscosity refrigerant oil on all tube and hose joints. Always use new O-rings dipped in the clean refrigerant oil when assembling joints. The oil will aid in assembly and help provide a leak-proof joint. When tightening joints, use a second wrench to hold stationary part of connection so that a solid feel can be attained. This will indicate proper assembly.

High and low pressure gauge line fittings are provided in the air conditioning system for attaching the charging station or the manifold gauge set to the vehicle. Both high and low pressure fittings are accessible on Motorhome and TransMode vehicles in the engine compartment, under the right front (passenger side) access door. The HIGH PRESSURE or HIGH-SIDE fitting is located on the evaporator inlet line and the LOW PRESSURE or LOW-SIDE service fitting is located on the evaporator outlet. Service fittings can be seen in figure 54, showing a manifold gauge set installed on the vehicle.

However, charging lines from the Charging Station or Manifold and Gauge Set require the use of gauge adapters to connect to system service fittings. A straight gauge adapter (J-5420) and a 90-degree angle gauge adapter (J-9459) are available. High and low pressure fittings on all 1978 vehicles and on late model 1977 vehicles are different sizes, to prevent error in attachment of lines. The low pressure fitting is a 7/16"-20 thread while the high pressure fitting is smaller—3/8"-24 thread. Straight gauge adapter J-25498 (or 90-degree angle J-25499) is required when servicing a vehicle equipped with the smaller size high pressure fitting (figure 55).

WARNING: ALWAY WEAR SAFETY GOGGLES AND WRAP A CLEAN CLOTH AROUND FITTINGS AND CONNECTIONS WHEN DOING WORK THAT INVOLVES OPENING THE REFRIGERATION SYSTEM. IF LIQUID REFRIGERANT COMES INTO CONTACT WITH THE SKIN OR EYES, INJURY CAN RESULT.

CHARGING STATION METHOD OF DISCHARGING, EVACUATING AND CHARGING THE SYSTEM

NOTE: For charging stations other than that shown in figure 47, consult the operating instructions included with the charging station being used.

DISCHARGING

In replacing any of the air conditioning components, the system must be completely discharged or drained of Refrigeration-12. The purpose is to remove the pressure inside the system so that a component part can be safely removed.

While discharging, keep these precautions in mind:

*KEEP HIGH PRESSURE VALVE ON MANIFOLD GAUGE SET CLOSED AT ALL TIMES.

*DO NOT CONNECT THE HIGH PRESSURE LINE TO THE VEHICLE AIR CONDITIONING SYSTEM.

1. Be certain that ignition key is in "OFF" position.
2. Remove protective cap from the LOW-SIDE service fitting at evaporator outlet. Remove center manifold hose from the vacuum pump connection.

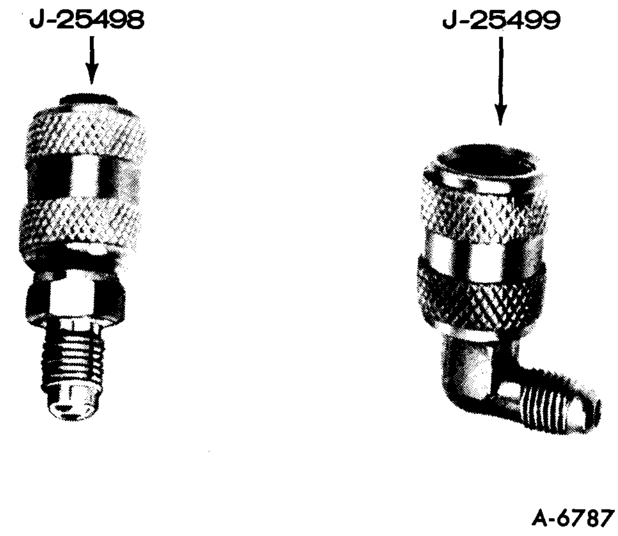


Figure 55—Charging Line Adapters

3. Close all the control valves on the manifold gauge set, including the gauge set vacuum valve. If low pressure gauge line does not have a built-in Schrader type core depressor, install Gauge Adapter J-5420 onto the low pressure line of the Manifold Assembly. Place end of center manifold hose into an empty refrigerant bottle or covered can as shown in figure 56.

NOTE: An empty 3-lb. coffee can with a plastic cover as shown in figure 56 which has been cross-slit (X'ed) works well for this purpose. This will allow refrigerant to be discharged safely. Container will also collect any oil lost due to rapid discharge of system, and will allow for later measurement of oil loss.

4. Connect Low Side gauge hose (with J-5420 adapter if necessary) to the Low Side service fitting at evaporator outlet as rapidly as possible to prevent the possibility of liquid R-12 coming in contact with the skin. See Warning Note under "Precautions in Handling Refrigerant-12". After the hose or adapter is tightened down onto the access fitting, open the low side gauge valve and partially open the vacuum valve to allow the system refrigerant to discharge from the system into the oil collection container. It will be necessary to regulate the refrigerant flow out of the system with the vacuum valve, to keep the hose in the collection container and prevent spewage of oil out of the container. If no discharge occurs, check for a missing or deformed Schrader valve depressor in the hose end or in the J-5420 adapter fitting

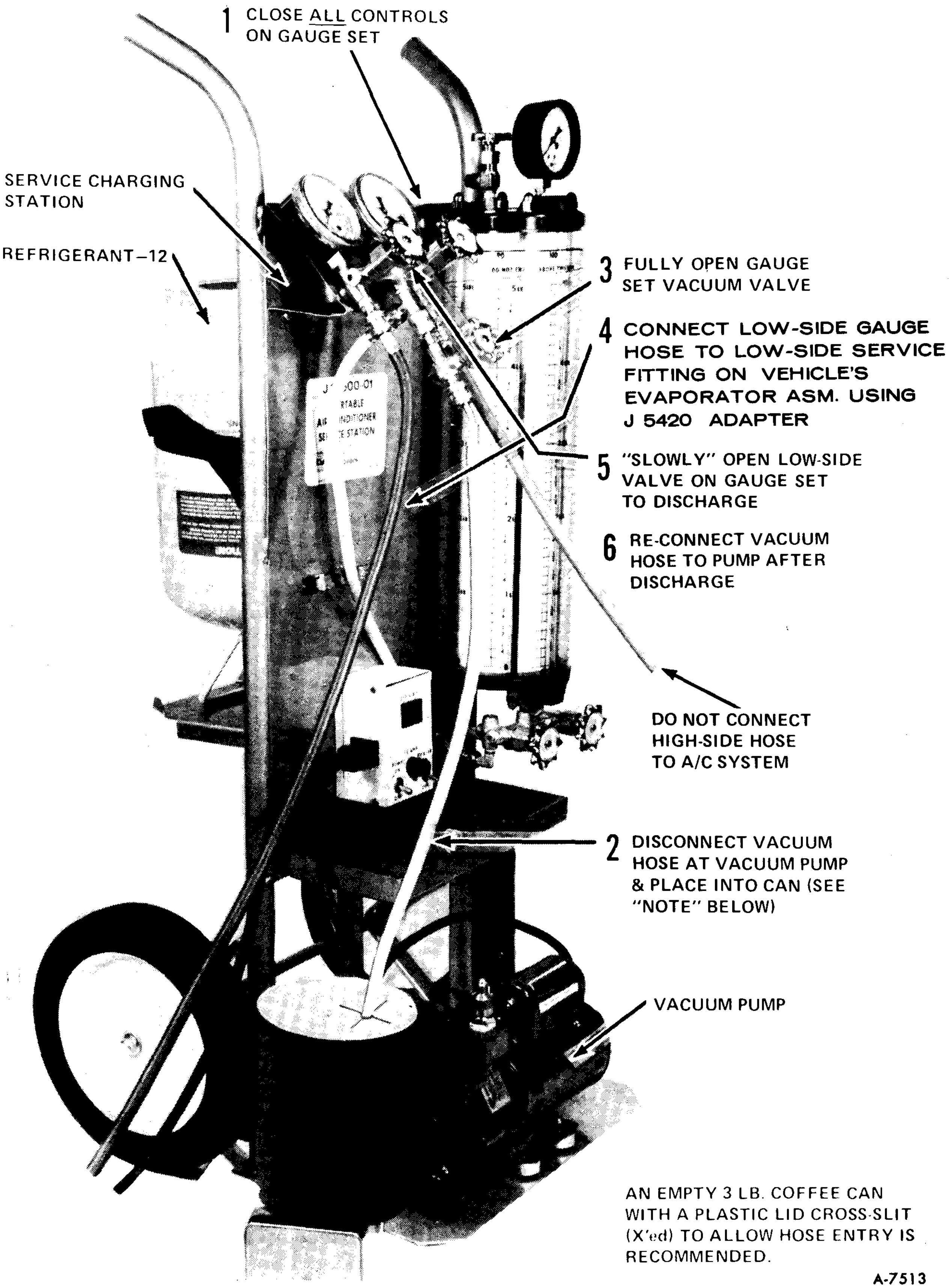


Figure 56—Discharging the A/C System with Charging Station

5. When system appears fully discharged from the LOW SIDE, check the HIGH SIDE system fitting at evaporator inlet line for any sign of remaining pressure. Do this by connecting a downward directed 36" section J-5418-36B charging line with an attached J-24598 straight or J-24599 90-degree angle fitting adapter to the HIGH SIDE service fitting at the evaporator inlet. Slowly tighten down the adapter to depress the valve fitting to determine if pressure is present.

6. IF PRESSURE IS FOUND ON THE HIGH SIDE of the system, the system is not completely discharged of refrigerant. Attempt to discharge high side, using same procedure as used for low-side.

> **NOTE:** This condition indicates a restriction (i.e., possible plugged expansion valve screen, kinked line or kinked condenser pass). HIGH-SIDE components should be removed and/or diagnosed to determine the area restricted.

> **WARNING: AS ALWAYS, PERSONAL CARE MUST BE TAKEN WHENEVER A COMPONENT IS REMOVED WHERE ENTRAPMENT OR REFRIGERANT IS SUSPECTED.**

7. When the system is completely discharged (no vapor escaping with hose fully tightened down), measure, record and discard any collected oil. (Loss should be minimal.) If this quantity is 1/2 ounce or more, an equivalent amount of new oil must be added to the system, plus any oil trapped in removed parts, BEFORE evacuation and charging with Refrigerant-12.(See "Adding Oil" later in this section for complete instructions.)

EVACUATION

When the refrigerant system has been discharged and opened for any repair, or the Refrigerant-12 charge lost, the complete system must be evacuated prior to charging, to remove any trace of air or moisture. Evacuating is the process of removing all air from the system, thereby creating a vacuum in the system.

Evacuation and Charging is a combined procedure, with all lines and gauges, as well as the vehicle air conditioning system, to be purged with Refrigerant-12 and evacuated immediately prior to charging.

> **CAUTION:** *Under no circumstances should alcohol be used in the system in an attempt to remove moisture, regardless of the successful use of alcohol in other refrigerant systems.*

> **NOTE:** ADDING OIL TO THE CCTXV SYSTEM should take place AFTER discharge and BEFORE evacuation. Refer to "Adding Oil" in this section for procedure.

Prior to Evacuation, check the low pressure gauge on the Manifold Gauge Assembly for proper calibration. With the gauge hose disconnected from the vehicle refrigeration system, be sure that the pointer indicates to the center of "O". Lightly tap gauge a few times to be sure pointer is not sticking. If necessary, calibrate gauge according to the instructions included with the Charging Station.

Adjust as necessary to position pointer through center of "O" position. Tap gauge a few times to be sure pointer is not sticking.

When evacuating and charging with Charging Station manifold gauge assembly and vacuum pump, follow instructions included with the Charging Station and particularly the following precautions;

1. DO NOT CONNECT THE HIGH PRESSURE LINE OF MANIFOLD GAUGE ASSEMBLY TO THE VEHICLE AIR CONDITIONING SYSTEM. During evacuation, High Pressure Gauge Line connects to Vacuum Pump.
2. KEEP THE HIGH PRESSURE VALVE ON THE MANIFOLD GAUGE ASSEMBLY CLOSED DURING CHARGING.
3. PERFORM THE ENTIRE EVACUATE AND CHARGE PROCEDURE THROUGH THE VEHICLE LOW-SIDE SERVICE FITTING.

> **NOTE:** Before evacuating, be certain system is completely discharged, thus preventing refrigerant from entering the vacuum pump through the Manifold Assembly.

VACUUM: In all evacuation procedures, the specification of at least 28-29 inches of Mercury vacuum is used. This specification can only be reached at or near sea level. For each 1,000 feet above sea level where this operation is being performed, specification should be lowered by one inch of Mercury vacuum. Example: At 5,000 feet elevation, only 23-24 inches of vacuum can normally be attained. (See chart below.)

ELEVATION

Ambient	Sea Level	500 Feet	1000 Feet	1500 Feet	2000 Feet	2500 Feet	3000 Feet	4000 Feet
45°	29.6	29.1	28.6	28.1	27.6	27.1	26.6	25.6
59°	29.4	28.9	28.4	27.9	27.4	26.9	26.4	25.4
69°	29.2	28.7	28.2	27.7	27.2	26.7	26.2	25.2
76°	29.0	28.5	28.0	27.5	27.0	26.5	26.0	25.0
80°	28.9	28.4	27.9	27.4	26.9	26.4	25.9	24.9
86°	28.7	28.2	27.7	27.2	26.7	26.2	25.7	24.7

+ Vacuum Requirements in Inches Hg. to Boil Water A-6796

Figure 57—Vacuum Chart

Before attempting to evacuate the system, check the vacuum pump to determine how much vacuum the pump is capable of reaching. To do this, attach the Low Side gauge line to the vacuum pump and make sure that the pump electrical cord is plugged into 110-volt outlet. With the Low Side Gauge Valve on the manifold "closed", turn on vacuum pump and look for vacuum reading of at least 28-29 inches of Mercury vacuum at sea level (see chart for altitude adjustment). If vacuum reading does not come up to minimum specification for the respective altitude, it indicates a leak in the connections or a defective pump. In any case, there will not be enough vacuum to boil out moisture that may be trapped in the air conditioning system. Repair pump or substitute another that is capable of reaching minimum vacuum. Then proceed with evacuation instructions.

Check oil level in vacuum pump according to Charging Station or vacuum pump service instructions and, if necessary, add vacuum pump oil. Make sure dust cap on discharge side of vacuum pump has been removed, and that vacuum pump electrical cord is connected to 110-volt outlet.

TO EVACUATE:

1. Connect the Charging Station gauge lines similar to that as shown in figure 56, attaching low pressure gauge line to LOW SIDE service fitting. If hose is not equipped with Schrader-type valve depressor add J-5420 adapter to the gauge line before connecting line to LOW SIDE service fitting. Attach high pressure gauge line to the vacuum pump.
2. Close the gauge set vacuum valve located in the center line from the gauge manifold assembly.
3. Start vacuum pump and slowly open low and high pressure control valves on Manifold Assembly, to avoid forcing oil out of refrigerant system and pump. Pressure is now being reduced in the vehicle system through the LOW-SIDE.
4. Observe low pressure gauge. Run pump until at least 28-29 inches of vacuum is obtained. Close HIGH SIDE gauge valve and turn off vacuum pump. Watch LOW SIDE gauge to be sure vacuum holds for five (5) minutes. Proceed to charging if vacuum is held.

If prescribed vacuum cannot be reached, it indicates a leak in the system or gauge connections. In this case it will be necessary to check the system for leaks. With vacuum pump turned "off" and High Side pressure gauge valve "closed", pressurize the A/C system with R-12 vapor from the charging cylinder or drum of refrigerant to drum pressure, (preferably 70 psi or above). Using appropriate method, locate and repair all leaks and release pressure from system. Repeat evacuation procedure.

CHARGING

WARNING: ALWAYS WEAR GOGGLES AND WRAP A CLEAN CLOTH AROUND FITTINGS AND CONNECTIONS WHEN DOING WORK THAT INVOLVES ACCESS OR OPENING THE REFRIGERATION SYSTEM. IF LIQUID REFRIGERANT COMES INTO CONTACT WITH THE SKIN OR EYES, INJURY CAN RESULT.

CHARGING IS TO BE DONE THROUGH THE LOW-SIDE SERVICE FITTING ONLY. DO NOT CONNECT HIGH PRESSURE LINE TO HIGH SIDE OF THE VEHICLE AIR CONDITIONING SYSTEM.

KEEP HIGH SIDE GAUGE VALVE ON THE MANIFOLD OF CHARGING STATION CLOSED AT ALL TIMES DURING THE CHARGING SEQUENCE.

USE THE COMPRESSOR TO HELP DRAW IN THE R-12 CHARGE **AS INDICATED IN THE CHARGING PROCEDURE BELOW.**

NOTE: It is important that the compressor be operated as recommended during the charging procedure. If the compressor is not operated as recommended the liquid R-12 entering the system during charging may pick-up, and float, refrigerant oil from internal surfaces of the compressor. This oil could then be "carried" out of the compressor at system start-up, causing immediate-to-short life seizure due to shortage of internal lubrication.

With the vehicle A/C system evacuated and proper charge of R-12 in charging cylinder, charge the system according to the following procedure:

1. Pull plastic connector off of low-pressure cut-off switch (refer to figure 17 for

location). Attach jumper wire to terminals inside the connector body. This will insure that the compressor clutch does not cycle on and off during operation.

2. After checking to make sure the engine compartment is clear of obstructions, start the engine. Run with choke open and fast idle speed reduced to normal idle. A/C control panel switch must be "OFF".

3. With low pressure hose still connected to vehicle LOW-SIDE service fitting and low pressure gauge control valve on Manifold Assembly open, proceed to open the charge cylinder valve and allow 1 lb. of liquid refrigerant to enter the system through the LOW-SIDE.

4. When 1 lb. of refrigerant has been added to the system, immediately engage the compressor by setting the A/C control lever to "NORM" and blower speed to "HI" to draw in the remainder of the R-12 charge. (Total R-12 charge for 1978 and late model 1977 Motorhome and TransMode air conditioning systems is 3-3/4 lb.)

NOTE: This charging operation can be speeded by placing a large volume fan in front of the condenser. If condenser temperature is maintained below that of charging cylinder, refrigerant will enter the system more rapidly.

5. When full charge has entered the system, shut off the R-12 source valve at the cylinder.

6. Run engine for 30 seconds to clear lines and gauges. Then close low pressure gauge control valve on Manifold Assembly.

7. With the engine running, remove the charging LOW-SIDE hose adapter from the LOW-SIDE service fitting. Unscrew rapidly to avoid excess R-12 escape from the system.

WARNING: NEVER REMOVE A GAUGE LINE FROM ITS ADAPTER WHEN LINE IS CONNECTED TO A/C SYSTEM. ALWAYS REMOVE THE LINE ADAPTER FROM THE SERVICE FITTING TO DISCONNECT A LINE. DO NOT REMOVE CHARGING HOSE AT GAUGE SET WHILE ATTACHED TO VEHICLE LOW-SIDE SERVICE FITTING. THIS WILL RESULT IN COMPLETE DISCHARGE OF SYSTEM DUE TO THE DEPRESSED SCHRADER VALVE IN SERVICE LOW-SIDE FITTING.

8. Replace protective cap on low-side service fitting.

9. Leak check the system with Electronic Leak Detector J-26934 or other suitable leak detector. Do not use propane gas burning torch as a leak detector.

10. Remove jumper from low pressure switch connector and reattach connector to switch.

11. With system fully charged and leak checked, continue to operate system and test for proper system pressures as outlined under "Performance Data" and "Performance Test".

DISPOSABLE CAN OR REFRIGERANT DRUM METHOD OF DISCHARGING, EVACUATING AND CHARGING THE SYSTEM

NOTE: For manifold gauge sets other than that shown in figure 48, consult the operating instructions included with the manifold gauge set being used.

DISCHARGING

In replacing any of the air conditioning components, the system must be completely discharged or drained of Refrigerant-12. The purpose is to remove the pressure inside the system so that a component part can be safely removed.

While discharging, keep these precautions in mind:

*KEEP HIGH PRESSURE VALVE ON MANIFOLD GAUGE SET CLOSED AT ALL TIMES.

*DO NOT CONNECT THE HIGH PRESSURE LINE TO THE VEHICLE AIR CONDITIONING SYSTEM.

1. Be certain that ignition key is in "OFF" position.

2. Remove protective cap from the LOW-SIDE service fitting at evaporator outlet.

3. Close all the control valves on the manifold gauge set. If low pressure gauge line does not have a built-in Schrader type core depressor, install Gauge Adapter J-5420 onto the low pressure line of the Manifold Assembly. Place end of center manifold hose into an empty refrigerant bottle or covered can as shown in figure 58.

NOTE: An empty 3-lb. coffee can with a plastic cover as shown in figure 58 which has been cross-slit (X'ed) works well for this purpose. This will allow refrigerant to be discharged safely. Container will also collect any oil lost due to rapid discharge of system, and will allow for later measurement of oil loss.

4. Connect Low Side gauge hose (with J-5420 adapter if necessary) to the Low Side

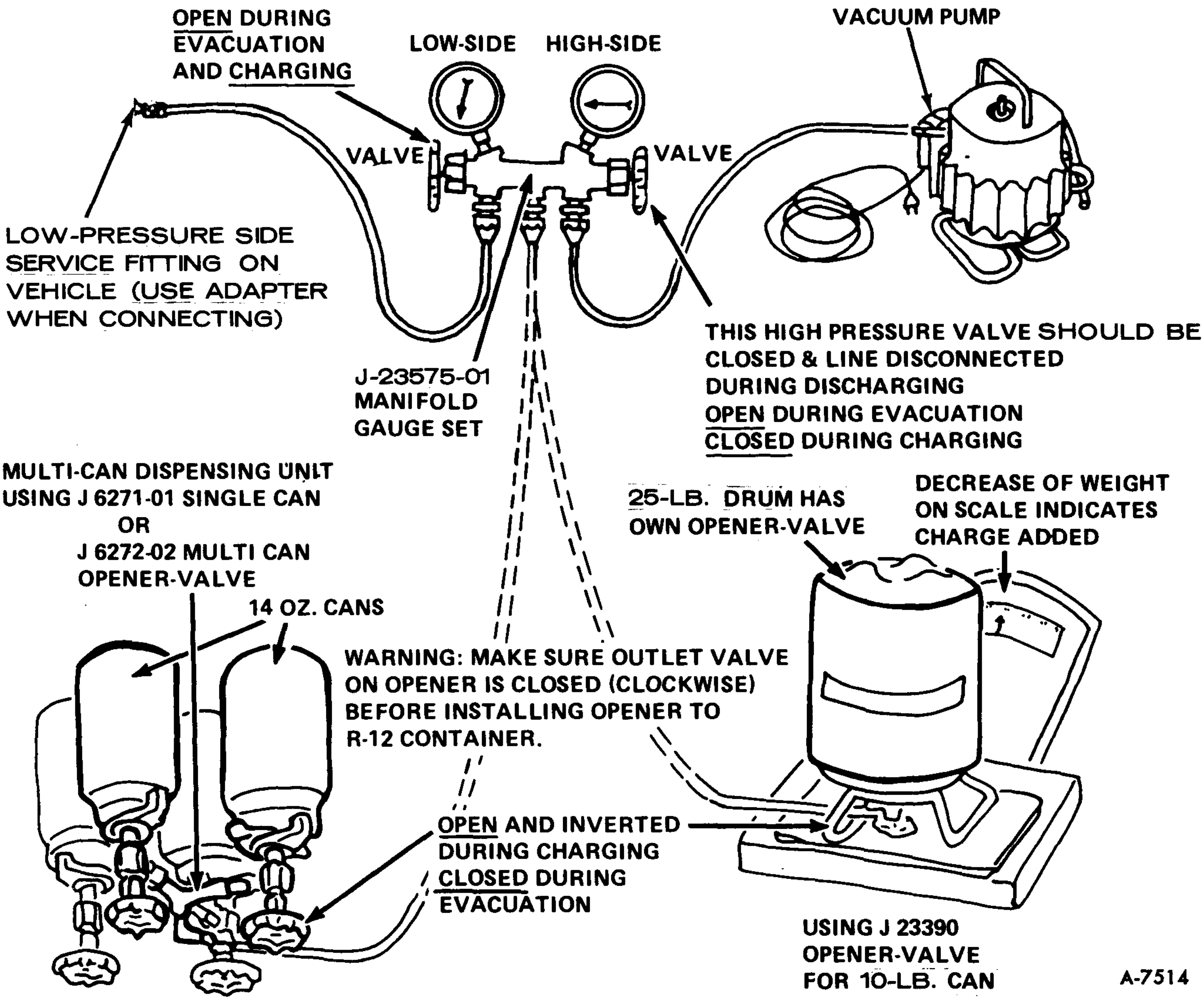


Figure 58—Charging the 1977 A/C System with Disposable Can or Refrigerant Drum

service fitting at evaporator outlet as rapidly as possible to prevent the possibility of liquid R-12 coming in contact with the skin. See Warning Note under "Precautions In Handling Refrigerant- 12". After the hose or adapter is tightened down onto the access fitting, open the low side gauge valve partially and allow the system refrigerant to discharge from the system into the oil collection container. It will be necessary to regulate the refrigerant flow out of the system with the low side gauge valve, to keep the hose in the collection container and prevent spewage of oil out of the container. If no discharge occurs, check for a missing or deformed Schrader-type valve depressor in the hose end of J-5420 adapter fitting.

5. When system appears fully discharged from the LOW SIDE, check the HIGH SIDE system fitting at evaporator inlet line for any sign of remaining pressure. Do this by connecting a downward directed 36" section J-5418-36B charging line with an attached J-24598 straight or J-24599 90-degree angle fitting adapter to the HIGH SIDE service fitting at the evaporator inlet. Slowly tighten down the adapter to depress the valve fitting to determine if pressure is present.

6. IF PRESSURE IS FOUND ON THE HIGH SIDE of the system, the system is not completely discharged of refrigerant. Attempt to discharge high side, using same procedure as used for low-side.

NOTE: This condition indicates a restriction (i.e., possible plugged expansion valve screen, kinked line or kinked condenser pass). HIGH-SIDE components should be removed and/or diagnosed to determine the area restriced.

WARNING: AS ALWAYS, PERSONAL CARE MUST BE TAKEN WHENEVER A COMPONENT IS REMOVED WHERE ENTRAPMENT OF REFRIGERANT IS SUSPECTED.

7. When the system is completely discharged (no vapor escaping with hose fully tightened down), measure, record and discard any collected oil. (Loss should be minimal.) If this quantity is 1/2 ounce or more, an equivalent amount of new oil must be added to the system, plus any oil trapped in removed parts, BEFORE evacuation and charging with Refrigerant-12. (See "Adding Oil" later in this section for complete instructions.)

EVACUATION

When the refrigerant system has been discharged and opened for any repair, or the Refrigerant-12 charge lost, the complete system must be evacuated prior to charging, to remove any trace of air or moisture. Evacuating is the process of removing all air from the system, thereby creating a vacuum in the system.

Evacuation and Charging is a combined procedure, with all lines and gauges, as well as the vehicle air conditioning system, to be purged with Refrigerant-12 and evacuated immediately prior to charging.

CAUTION: *Under no circumstances should alcohol be used in the system in an attempt to remove moisture, regardless of the sucessful use of alcohol in other refrigerant systems.*

NOTE: ADDING OIL TO THE CCTXV SYSTEM should take place AFTER discharge and BEFORE evacuation. Refer to "Adding Oil" later in this section for procedure.

Prior to Evacuation, check the low pressure gauge on the Manifold Gauge Assembly for proper calibration. With the gauge hose disconnected from the vehicle refrigeration system, be sure that the pointer indicates to the center of "O". Lightly tap gauge a few times to be sure pointer is not sticking. If necessary, calibrate gauge according to the instructions included with the Manifold Gauge Set.

Adjust as necessary to position pointer through center of "O" position. Tap gauge a few times to be sure pointer is not sticking.

When evacuating and charging with Manifold Gauge Assembly and Vacuum Pump, follow instructions below, particularly the following precautions:

1. DO NOT CONNECT THE HIGH PRESSURE LINE OF MANIFOLD GAUGE ASSEMBLY TO THE VEHICLE AIR CONDITIONING SYSTEM. (High Pressure Gauge Line connects to Vacuum Pump as shown in figure 58)
2. KEEP THE HIGH PRESSURE VALVE ON THE MANIFOLD GAUGE ASSEMBLY CLOSED DURING CHARGING.
3. PERFORM THE ENTIRE EVACUATE AND CHARGE PROCEDURE THROUGH THE VEHICLE LOW-SIDE SERVICE FITTING.

Following these precautions (particularly during charging) will prevent disposable refrigerant cans from being accidentally subjected to high vehicle system pressure in the event an error is made in valve sequence. This is particularly applicable when the compressor is being used during charging to draw in the remainder of the R-12 charge.

NOTE: Before evacuating, be certain system is completely discharged, thus preventing refrigerant from entering the vacuum pump through the Manifold Assembly.

VACUUM: In all evacuation procedures, the specification of at least 28-29 inches of Mercury vacuum is used. This specification can only be reached at or near sea level. For each 1,000 feet above sea level where this operation is being performed, specification should be lowered by one inch of Mercury vacuum. Example: At 5,000 feet elevation, only 23-24 inches of vacuum can normally be attained. (Refer to figure 56.)

Before attempting to evacuate the system, check the vacuum pump to determine how much vacuum the pump is capable of reaching. To do this, attach the Low Side gauge line to the vacuum pump and make sure that the pump electrical cord is plugged into 110-volt outlet. With the Low Side gauge valve on the manifold "Closed", turn on vacuum pump and look for vacuum reading of at least 28-29 inches of Mercury vacuum at sea level (see above for altitude adjustment). If vacuum reading does not come up to minimum specification for the respective altitude, it indicates a leak in the connections or a defective pump. In any case, there will not be enough vacuum to boil out moisture that may be trapped in the system. Repair pump or substitute another that is capable of reaching minimum vacuum. Then proceed with evacuation instructions. Check oil level in vacuum pump according to the vacuum pump service instructions and, if necessary, add vacuum pump oil. Make sure dust cap on discharge side of vacuum pump has been removed, and that vacuum pump electrical cord is connected to 110-volt outlet.

TO EVACUATE:

1. Connect manifold gauge assembly J-23575-01 as shown in figure 58, attaching low pressure gauge line to LOW SIDE service fitting. If hose is not equipped with Schrader-type valve depressor add J-5420 adapter to the gauge line before connecting line to LOW SIDE service fitting. Attach high pressure gauge line to the vacuum pump. Connect center hose of manifold to the R-12 source. If a Refrigerant-12 drum is used, place it on a scale and note the total weight before charging. Watch the scale during charging to determine the amount of R-12 used.

If disposable R-12 14-oz. cans are used, rotate tapping valve handle counterclockwise until point of valve needle is recessed far enough into the valve body to prevent puncturing the refrigerant can top when the can adapter is installed and valve body tightened in place.

NOTE: Refrigerant cans must not be punctured until evacuation is complete and system is ready to charge. With valve needle(s) retracted, the line to the single or multi-can adapter(s) will be evacuated through to the top of the can(s) to be punctured. Follow the instructions included with the tap valve being used.

If using Multi-Opener J-6272-02 or Single Can Opener J-6271-01, proceed as follows:

1. Rotate valve handle(s) counterclockwise to back stem(s) out of the valve body(s) until the piercing needle end is approximately 1/8" to the rear of the contact surface of the adapter valve to can top rubber seal(s). Remove the valve body from the can adapter(s).

NOTE: For "flat top" cans, the brass bushing over the valve body threads is removed; for "spud" or threaded type cans the brass bushing over the valve threads is left in place over the threads when installing the valve body into the can adapter(s).

2. Move the locking cam of the can adapter to the left to permit placing can adapter on refrigerant can(s). Move the locking cam all the way to the right to lock the adapter(s) in place.

3. Screw the valve assembly into the adapter(s) hand tight, with or without brass bushing per Step 1.

4. Check valve stem packing nut(s) (tighten if necessary to seal valve stem). Attach charging line to valve or multi-can connection DO NOT pierce refrigerant can(s) before system is evacuated and ready to charge the system. Steps covering the piercing of the cans will be covered under "CHARGING THE SYSTEM".

5. Start vacuum pump and slowly opne lwo and high pressure control valves on Manifold Assembly, to avoid forcing oil out of refrigerant system and pump. Pressure is now being reduced in the vehicle system through the LOW-SIDE.

6. Observe low pressure gauge. Run pump until at least 28-29 inches of vacuum is obtained. Close High Side gauge valve and turn off vacuum pump. Watch Low Side gauge to be sure vacuum holds for five (5) minutes. Proceed to charging if vacuum is held.

If prescribed vacuum cannot be reached, it indicates a leak in the system or gauge connections. In this case it will be necessary to check the system for leaks. With vacuum pump turned "off" and High Side pressure gauge valve "closed", pressurize the A/C system with R-12 vapor, from a can or drum of refrigerant, to drum pressure (preferably 70 psi or above). Using appropriate method locate and repair all leaks and release pressure from system. Repeat evacuation procedure.

CHARGING

WARNING: ALWAYS WEAR GOGGLES AND WRAP A CLEAN CLOTH AROUND FITTINGS AND CONNECTIONS WHEN DOING WORK THAT INVOLVES ACCESS OR OPENING THE REFRIGERATION SYSTEM. IF LIQUID REFRIGERANT COMES INTO CONTACT WITH THE SKIN OR EYES, INJURY CAN RESULT.

CHARGING IS TO BE DONE THROUGH THE LOW-SIDE SERVICE FITTING ONLY. DO NOT CONNECT HIGH PRESSURE LINE TO HIGH SIDE OF THE VEHICLE AIR CONDITIONING SYSTEM.

KEEP HIGH SIDE GAUGE VALVE ON THE MANIFOLD OF CHARGING STATION CLOSED AT ALL TIMES DURING THE CHARGING SEQUENCE.

***USE THE COMPRESSOR TO HELP DRAW IN THE R-12 CHARGE* AS INDICATED IN THE CHARGING PROCEDURE BELOW.**

NOTE: It is important that the compressor be operated as recommended during the charging procedure. If the compressor is not operated as recommended, the liquid R-12 entering the system during charging may pick-up, and float, refrigerant oil from internal surfaces of the compressor. This oil could then be "carried" out of the compressor at system start-up, causing immediate-to-short life seizure due to shortage of internal lubrication.

With the vehicle A/C system evacuated and R-12 source containers attached to openers, as indicated in figure 58, charge the system using the following procedure:

1. Pull plastic connector off of low-pressure cut-off switch (refer to figure 17 for location). Attach jumper wire to terminals inside the connector body. This will insure that the compressor clutch does not cycle on and off during charging operation.
2. After checking to make sure the engine compartment is clear of obstructions, start the engine. Run with choke open and fast idle speed reduced to normal idle. A/C control panel switch must be "OFF".
3. With low pressure hose still connected to vehicle LOW-SIDE service fitting and low pressure control valve on Manifold Assembly fully open, invert refrigerant drum or cans and open refrigerant source valve. Allow 1 lb. (or 1 to 2 14-oz. cans) of liquid refrigerant to enter the system through the LOW-SIDE. (Multi-Opener J-6272-02 or Single-Can Opener J-6272-01).

Turn valve handles clockwise to pierce refrigerant can(s). To release refrigerant from can into the system during charging sequence, turn the valve handles counterclockwise serveral turns until the refrigerant flows into the system. To shut off the refrigerant flow, turn valve handle(s) clockwise until the stem seats in the valve body.

NOTE: Until refrigerant can is empty and pressure in line between can and Low Side control valve is released, DO NOT release can adapter. Always close the Low Side control valve before removing Single or Multi-Can adapters.

For other type adapters, consult Use Instructions included with the adapter.

4. When 1 lb. or 1 to 2 14-oz. cans of refrigerant have been added to the system, immediately engage the compressor by setting the A/C control lever to "NORM" and blower speed to "HI" to draw in the remainder of the R-12 charge. (Total R-12 charge for 1978 and late model 1977 Motorhome and TransMode air conditioning systems is 3-3/4 lb.)

NOTE: This charging operation can be speeded by placing a large volume fan in front of the condenser. If condenser temperature is maintained below that of charging cylinder, refrigerant will enter the system more rapidly.

5. When full charge has entered the system, shut off the R-12 source valve.
6. Run engine for 30 seconds to clear lines and gauges. Then close low pressure gauge control valve on Manifold Assembly. Release the pressure from the charging cylinder or charging adapter line and remove line from fitting.
7. With the engine running, remove the charging LOW-SIDE hose adapter from the LOW-SIDE service fitting. Unscrew rapidly to avoid excess R-12 escape from the system.

WARNING: NEVER REMOVE A GAUGE LINE FROM ITS ADAPTER WHEN LINE IS CONNECTED TO A/C SYSTEM. ALWAYS REMOVE THE LINE ADAPTER FROM THE SERVICE FITTING TO DISCONNECT A LINE. DO NOT REMOVE CHARGING HOSE AT GAUGE SET WHILE ATTACHED TO VEHICLE LOW-SIDE SERVICE FITTING. THIS WILL RESULT IN COMPLETE DISCHARGE OF SYSTEM DUE TO THE DEPRESSED SCHRADER VALVE IN SERVICE LOW-SIDE FITTING.

8. Replace protective cap on low-side service fitting.
9. Leak check the system with Electronic Leak Detector J-26934 or other suitable leak detector. Do not use propane gas burning torch as a leak detector.
10. Remove jumper from low pressure switch connector and re-attach connector to switch.
11. With system fully charged and leak checked, continue to operate system and test for proper system pressures as outlined under "Performance Data" and "Performance Test".

ADDING OIL

If necessary, refrigeration oil may be added to the refrigeration system after discharge and before evacuation, using Compressor Oil Injector Tool J-24095 (refer to figure 51). Before the tool is used on the system, however, it must be flushed with clean Refrigerant-12 to eliminate possible contamination.

TO CLEAN TOOL J-24095:

1. Disconnect refrigerant line at refrigerant supply tank (back of Charging Station, beneath refrigerant container) or refrigerant can opener dispensing valve.
2. Disconnect ends of tool J-24095 and connect injector end of tool to refrigerant supply.
3. With shut-off valve on tool J-24095 open, flush tool for approximately 3 seconds by cracking open valve at refrigerant tank (or opener dispensing valve). Then close supply valve on refrigerant tank (or dispensing valve) and close shut-off on tool.
4. Disconnect tool from refrigerant supply. Temporarily refasten tool ends to each other, and reconnect refrigerant supply line to tank (or dispensing valve).

TO ADD OIL TO THE SYSTEM:

CAUTION: *When removing the gauge lines from the fittings, be sure to remove the adapters from the system fittings rather than gauge lines from the adapter.*

NOTE: This adding oil procedure is based on the use of Charging Station J-24410. If using Manifold Gauge Assembly and separate vacuum pump, there is no vacuum control valve on the gauge assembly. After necessary amount of oil is added to the system, close the HIGH-PRESSURE valve on the Manifold Assembly first. Then close shut-off valve on Oil Injector Tool and turn off vacuum pump.

1. If not already done, measure oil loss collected as a result of discharging the system.
2. Using Charging station J-24410, connect vacuum line to vacuum pump. (This is done only after system has been discharged of refrigerant.)
3. Connect high pressure hose of Charging Station to vehicle HIGH-SIDE service fitting at evaporator inlet. Make sure high pressure control valve on Charging Station is closed.
4. Disconnect Charging Station low pressure line (blue hose) from vehicle LOW-SIDE service fitting. Disconnect ends of tool J-24095 and install injector end of tool (with shut-off valve closed) onto the vehicle LOW-SIDE service fitting. Insert pick-up end of tool into graduated container of clean refrigerant oil. Make certain that pick-up end of tool is completely submerged in oil so that system does not draw in any air.

NOTE: Tool J-24095 will hold 1/2 ounce of oil in the tool itself. So if one ounce has to be added to the refrigeration system, the level of the oil in the bottle should decrease 1-1/2 ounces to add one ounce to the system.

5. Turn on the vacuum pump and open the vacuum control valve on Charging Station. Then open the high pressure control valve on the charging station SLOWLY, to avoid forcing oil out of the refrigerant system and pump.

NOTE: When shut-off valve on Tool J-24095 is opened, the vacuum applied to the high (discharge) side of the system will force oil into the system from the container. Therefore, close observation of oil level in the container is necessary.

6. Note oil level in container. Next, open shut-off valve on oil injector tool until oil level in container is reduced by an amount equal to that lost during discharge of system PLUS 1/2 ounce, then close shut-off valve on tool J-24095.
7. Close high pressure valve on Charging Station. Disconnect high pressure hose from vehicle HIGH-SIDE service fitting. Replace protective cap on service fitting.
8. Turn off vacuum pump and close vacuum control valve on Charging Station.
9. Disconnect Tool J-24095 from vehicle and connect ends of tool. Refastening tool in this fashion will protect tool from moisture and foreign material.

COMPRESSOR OIL

The refrigerant system with six-cylinder axial (A-6) compressor requires approximately 10-1/2 fluid ounces of 525 viscosity oil. When the system is operated, oil circulates throughout the system with the refrigerant, leaving the compressor with the high pressure gas and returning to the compressor with the suction gas.

This oil is as free from moisture and contaminants as it is possible to attain by human processes. This condition should be preserved by immediately capping the oil bottle when not in use.

Refer to "Performance Data Chart" for the total system oil capacity.

Due to the porosity of the refrigerant hoses and connections, the system refrigerant level will show a definite drop after a period of time. Since the compressor oil is carried throughout the entire system mixed with the refrigerant, a low refrigerant level will cause a dangerous lack of lubrication at the compressor. Therefore, the refrigerant charge in the system has a definite tie-in with the amount of oil found in the compressor. An insufficient charge may also eventually lead to an oil build-up in the evaporator.

CHECKING COMPRESSOR OIL CHARGE

It is not recommended that the compressor oil level be checked as a matter of course. Generally, oil level should be checked only where there is evidence of a major loss of system oil such as might be caused by:

- Broken refrigerant hose or line.
- Severe connection leak.
- Very badly leaking compressor shaft or O-ring seal.
- Collision damage to the system components.

NOTE: The oil may appear foamy. This is considered normal.

To check the compressor oil charge, it is necessary to determine that the system is properly charged with refrigerant. Operate the system as specified and then remove the compressor from the vehicle, drain and measure the oil as outlined below:

1. Run the A/C system for 10 minutes at 2000 engine rpm with controls set for "MAX" cooling and "HI" blower speed. During operation, check for proper refrigerant charge so that the oil will have normal distribution through the system.
2. Turn off engine, discharge the system and remove compressor from vehicle.
3. Place compressor in horizontal position with the drain plug downward. Remove the drain plug and drain the oil into a clean container. Remove the compressor from the horizontal position to the vertical position, shaft end up, and allow any remaining oil to drain through the suction and discharge ports of the rear head. Then measure and discard the oil.
4. Add new refrigeration oil to the compressor as follows:

a. If the quantity drained was 4 fluid ounces or more, add the same amount of new refrigeration oil to the replacement compressor.

b. If the quantity drained was less than 4 fluid ounces, add 6 fluid ounces of new refrigeration oil to the replacement compressor.

c. New service compressors are shipped with 10-1/2 fluid ounces of oil already inside. Therefore, if a new service compressor is being installed, sufficient oil must be drained to leave only a like amount to that drained and measured from the old compressor.

NOTE: The oil drain screw must be torqued to 10-15 ft. lbs. if the screw has either been loosened or removed.

d. If a field repaired compressor is being installed, add one more additional fluid ounce of new oil to the compressor than that determined to be added in Step 4a or 4b above.

5. In the event that it is not possible to idle the compressor as outlined in Step 1 to effect oil return to compressor, proceed as follows:

a. Remove the compressor, drain, measure and discard the oil.

b. If the amount drained is more than 1-1/2 fluid ounces, and the system shows no signs of a major leak, add the same amount to the replacement compressor.

c. If the amount drained is less than 1-1/2 fluid ounces and the system appears to have lost an excessive amount of oil, add 6 fluid ounces of clean refrigeration oil to replacement compressor, 7 fluid ounces to a repaired compressor.

If the oil contains chips or other foreign material, replace the receiver-dehydrator, repair the compressor as required and flush or replace all component parts as necessary. Add the full specified volume of new refrigeration oil to the system.

6. Add additional oil in the following amounts for any system components being replaced:

Evaporator	1 fluid ounce
Condenser	1 fluid ounce
Receiver-Dehydrator	1 fluid ounce
Compressor	See above

NOTE: When adding oil to the compressor, it will be necessary to tilt the rear end of the compressor up so that the oil will not run out of the suction and discharge ports. Do not set the compressor on the shaft end. A compressor suction discharge port shipping plate in good condition or test plate may be used as a closure during installation until the refrigerant line connector block is to be attached.

ADDING REFRIGERANT CHARGING STATION METHOD)

See "WARNING" under "Precautions in Handling Refrigerant-12" on page 1B-51 of this section.

The following procedures should be used in adding small amounts of refrigerant such as that lost due to a leak in the system. Before adding refrigerant to replace that lost by leaks, check for evidence of oil loss and add oil if necessary. See "Adding Oil" and "Compressor Oil" earlier in this section.

1. Pull plastic connector off of low-pressure cut-off switch (located in the evaporator inlet line). Attach jumper wire to terminals inside the connector body. This will insure that the compressor clutch does not cycle on and off during operation.
2. Remove protective caps from gauge fittings and connect charging station. Refer to "Charging Station Method of Discharging, Evacuating and Charging the System" covered earlier in this section.
3. Start engine and set A/C control panel for A/C mode, "HI" fan speed and full "COLD" position. Operate engine at low idle for a few minutes to stabilize system.
4. Observe sight glass in receiver-dehydrator assembly for evidence of bubbles. If no bubbles are evident, and temperature is above $70^{\circ}F$ ($21^{\circ}C$) system is operating normally. If bubbles appear, continue as described following.
5. Fill charging cylinder according to charging station instructions.
6. Turn charging cylinder sight glass to match pressure reading on cylinder pressure gauge. Crack open refrigerant and low pressure control valves on charging station and allow refrigerant to slowly enter low pressure side of system until system sight glass shows clear (no bubbles). Close both valves.
7. Note refrigerant level in charging cylinder. Re-open control valves and allow an additional 1/2 lb. of refrigerant to enter the system. Close both valves.
8. Make sure all control valves on charging station are closed. Test for leaks and check system pressures as outlined under "Performance Data" later in this section.
9. Disconnect and cap charging lines and return protective caps to system gauge fittings. Disconnect jumper wire from low-pressure cut-off switch and reattach plastic connector to switch.

ADDING REFRIGERANT (DISPOSABLE CAN METHOD)

See "WARNING" under "Precautions in Handling Refrigerant-12" on page 1B-51 of this section.

The following procedures should be used in adding small amounts of refrigerant such as that lost due to a leak in the system. Before adding refrigerant to replace that lost by leaks, check for evidence of oil loss and add oil if necessary. See "Adding Oil" and "Compressor Oil" earlier in this section.

NOTE: This procedure will only apply if the air inlet temperature is above $70^{\circ}F$ ($21^{\circ}C$) at the condenser.

1. Pull plastic connector off of low-pressure cut-off switch (located in the evaporator inlet line). Attach jumper wire to terminals inside the connector body. This will insure that the compressor clutch does not cycle on and off during operation.
2. Remove protective caps from gauge fittings on vehicle. Attach Manifold Gauge Set (J-23575 or equivalent), making sure low pressure gauge hose is connected to low pressure fitting and high pressure gauge hose connects to high pressure gauge fitting. Use gauge adapters to make connections, when necessary.
3. Start engine, turn air conditioning temperature control lever to full "COLD" position, fan switch to "HI" and system selector lever to "A/C" mode. Operate for a few minutes at low idle to stabilize system.
4. Observe sight glass in receiver-dehydrator assembly for evidence of bubbles. If no bubbles are evident, and temperature is above $70^{\circ}F$ ($21^{\circ}C$) system is operating normally. If bubbles appear, continue as described following.
5. Attach flexible hose from center fitting of gauge set loosely to disposable can valve with 14-oz. or 10-lb. can attached. Open high and low pressure valves on gauge set slightly to purge lines of air. Tighten fitting at refrigerant can valve when satisfied that all air has been removed from gauge lines. Close (in clockwise direction) both hand shut-off valves of gauge set.
6. Open low pressure valve on gauge set. Slowly open valve on refrigerant can and allow refrigerant to flow into system (through manifold gauge set and low pressure hose) until system sight glass shows clear (no bubbles). Immediately shut-off valves at gauge set and

refrigerant can. Check weight of can and valve assembly and record.

7. Add an additional 1/2-lb. of refrigerant by adding refrigerant from can just weighed until can weighs appropriate amount less.

8. Close valves at gauge set and refrigerant can.

9. Test for leaks and make pressure check of system as outlined under "Performance Data" later in this section.

10. Disconnect and cap charging lines and return protective caps to system gauge fittings. Disconnect jumper wire from low-pressure cut-off switch and reattach plastic connector to switch.

PERFORMANCE TEST AND PERFORMANCE DATA

PERFORMANCE TEST

This test may be conducted to determine if the system is performing in a satisfactory manner and should be used as a guide by the serviceman in diagnosing trouble within the system. Testing is a measurement of the air conditioning system performance, to determine if discharge air temperature, pressure in suction line, and pressure in discharge line are within specific limitations.

The following fixed conditions must be adhered to in order to make it possible to compare the performance of the system being tested with the standards below:

1. Windows and curtains open. (Vehicle inside or in shade).

2. Vehicle in NEUTRAL with engine running at 2000 rpm.

3. Air conditioning controls set for—

- Upper control on "MAX" A/C.
- Lower control on "Cold".
- "HI" blower speed.

4. Temperature sensor on engine cooling fan disconnected.

5. Gauge set installed on vehicle service fittings.

6. System settled out (run—in approximately 10 minutes).

7. A thermometer placed in front of vehicle grille and another in the center diffuser outlet inside the vehicle (lower center instrument panel).

PERFORMANCE DATA

The following "Performance Data" defines normal operation of the system under above conditions. A properly operating, tuned engine, with choke open and fast idle speed having been reduced to a normal idle, should be idled at 2000 rpm for a minimum of 7-10 minutes with air conditioning system operating <u>prior</u> to evaluation of test readings. Compare the actual pressures and temperatures with the pressures and temperatures indicated below.

Should excessive head pressures be encountered at higher ambient temperatures, an 18-inch fan placed in front of the vehicle and blowing into the condenser will provide the extra circulation of air needed to bring the pressures to within the limits specified.

NOTE: Higher temperatures and pressures will occur at higher ambient temperatures. In areas of high humidity it is possible to have thermometer and gauge readings approach but not reach the figures listed in the "Performance Data Chart" and still have a satisfactorily operating unit. However, it is important to remember that low pressure has a direct relationship to nozzle outlet temperature. If pressure is too low, ice will gradually form on the evaporator fins, restricting air flow into the passenger area and resulting in insufficient or no cooling.

PERFORMANCE DATA
REFRIGERANT CHARGE 3.75 LBS.
ENGINE RPM-2000 RPM
HEAD PRESSURE (EVAP. "IN" CHARGE PORT)*

Temp. Of Air Entering Condensor Relative Humidity	70°F (21°C)	80°F (27°C)	90°F (32°C)	100°F (38°C)	110°F (43°C)
30%				230-245	270-285
40%			190-205	237-252	283-298
60%		157-172	202-217	242-257	
80%	127-142	167-182	210-225		

SUCTION PRESSURE (EVAPORATOR "OUT" CHARGE PORT)*

Temp. Of Air Entering Condensor Relative Humidity	70°F (21°C)	80°F (27°C)	90°F (32°C)	100°F (38°C)	110°F (43°C)
30%				14.0-29.0	18.0-33.0
40%			1.0-26.0	15.5-30.5	20.5-35.5
60%		9.5-24.5	13.8-28.8	19.0-34.0	
80%	6.5-21.5	11.0-26.0	16.2-31.2		

DISCHARGE AIR TEMP. AT RIGHT UPPER OUTLET*

Temp. Of Air Entering Condensor Relative Humidity	70°F (21°C)	80°F (27°C)	90°F (32°C)	100°F (38°C)	110°F (43°C)
30%				60-64	68-72
40%			57-61	65-69	74-78
60%		52-56	63-67	71-75	
80%	45-50	57-61	65-69		

*Just prior to compressor clutch disengagement.

COMPONENT REPLACEMENT AND REPAIR PROCEDURES

CAUTION: *See "Caution" on page two of this section.*

PREPARING SYSTEM FOR REPLACEMENT OF COMPONENT PARTS

WARNING: REFER TO "SAFETY PRECAUTIONS (REFRIGERANT-12)" PREVIOUSLY IN THIS SECTION UNDER "PRECAUTIONS IN HANDLING REFRIGERANT-12" TO PREVENT PERSONAL HARM.

Air conditioning, like many other things, is fairly simple to service once it is understood. However, there are certain procedures, practices, and precautions that should be followed to prevent costly repairs, personal injury or damage to equipment. For this reason it is strongly recommended that the preceding information in this section be studied thoroughly before attempting to service the system.

Great emphasis must be placed upon keeping the system clean. Use plugs or caps to close system components and hoses when they are opened to the atmosphere. Keep your work area clean.

In removing and replacing any part which requires unsealing the refrigerant circuit, the following operations, which are described in this section, must be performed in the sequence shown:

1. Purge the system by releasing the refrigerant to the atmosphere.
2. Remove and replace the defective part.
3. Evacuate and charge the system with R-12 refrigerant.

WARNING: ALWAYS WEAR PROTECTIVE GOGGLES WHEN WORKING ON REFRIGERATION SYSTEMS. ALSO, BEWARE OF THE DANGER OF CARBON MONOXIDE FUMES BY AVOIDING RUNNING THE ENGINE IN CLOSED OR IMPROPERLY VENTILATED GARAGES TO PREVENT PERSONAL HARM.

FOREIGN MATERIAL IN THE SYSTEM

Whenever foreign material is found in the system, it must be removed before restoring the system to operation.

In the case of compressor mechanical failure, perform the following operations:

1. Remove the compressor.
2. Remove the receiver-dehydrator and discard the unit.
3. Flush the condenser to remove foreign material which has been pumped into it.
4. Disconnect the line at the evaporator core inlet or inlet line to the expansion valve.

Inspect the screen of the expansion valve for the presence of metal chips or other foreign material. If the tube or screen is plugged, replace it. Reconnect the line to the evaporator core or expansion valve.

5. Install the replacement compressor.
6. Add the necessary quantity of oil to the system. Remember to add one (1) ounce for the new receiver-dehydrator.
7. Evacuate, charge and check system.

REFRIGERANT LINE CONNECTIONS

O-RINGS

Always replace the O-ring when a connection has been broken. When replacing the O-ring, first dip it in clean refrigeration oil. Always use a backing wrench on O-ring fittings to prevent the pipe from twisting and kinking or damaging the O-ring. Do not overtighten. Correct torque specifications for O-ring fittings can be found in figure 53.

HOSE CLAMPS

When hose clamp connections are encountered, special procedures are necessary for both removal and installation.

Removal

1. Carefully, with a sharp knife, make an angle cut in the hose as shown in figure 59. This should loosen the hose so that it may be worked off the fitting.
2. Cut off slit end of hose.

CAUTION: *Use only approved refrigeration hose. Never use heater hose. Use extreme care not to nick or score the sealing beads when cutting off the hose. Cutting the hose lengthwise may result in this problem.*

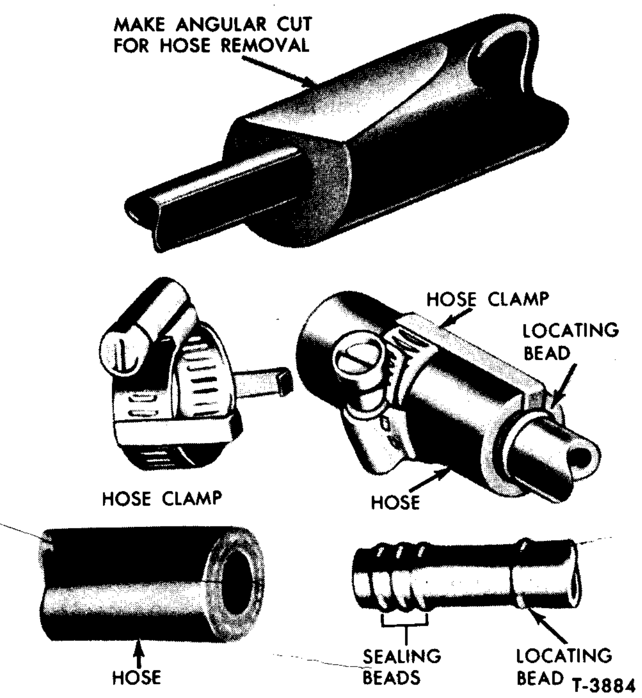


Figure 59—Hose Clamp Connections

Installation

1. Coat tube and inside of hose with clean refrigeration oil.
2. Carefully insert hose over the three beads on the fitting and down as far as the fourth, or locating bead. Hose must butt against this fourth bead.

CAUTION: *Use no sealer of any kind.*

3. Install clamps on hose, hooking the locating arms over the cut end of the hose.
4. Tighten the hose clamp screw to 35-42 in. lbs. torque. DO NOT RETORQUE. The clamp screw torque will normally decrease as the hose conforms to the force of the clamp. The screw should be retorqued only if its torque falls below 10 in. lbs. In this case, retorque to 20-25 in. lbs. Further tightening may damage the hose.

REPAIR OF REFRIGERANT LEAKS

Any refrigerant leaks found in the system should be repaired in the manner given below:

LEAKS AT O-RING CONNECTION

1. Check the torque on the fitting and, if too loose, tighten to the proper torque. Always use a backing wrench to prevent twisting and damage to tube or the O-ring. Do not overtighten. Again leak test the joint.
2. If the leak is still present, discharge the refrigerant from the system as described under "Evacuating and Charging Procedures."
3. Inspect the O-ring and the fitting and replace if damaged in any way. Coat the new O-ring with clean refrigeration oil and install carefully.
4. Retorque the fitting, using a backing wrench.
5. Evacuate, charge and check the system.

LEAKS AT HOSE CLAMP CONNECTION

1. Check the tightness of the clamp itself and tighten if necessary. Recheck for leak.
2. If leak has not been corrected, discharge the system and loosen clamp and remove hose from connection. Inspect condition of hose and connector. Replace scored or damaged parts.
3. Coat inside of new hose with clean refrigeration oil and carefully reinstall over connector. Never push end of hose beyond the locating bead. Properly torque the clamp.
4. Evacuate, charge and check the system.

COMPRESSOR LEAKS

If leaks are located around the compressor shaft seal or shell, replacement of necessary seals should be made.

NOTE: A slight amount of oil leakage past the compressor front seal is considered normal.

REFRIGERANT HOSE FAILURE

After a leak or rupture has occurred in a refrigerant hose, or if a fitting has loosened and caused a considerable loss of refrigerant and oil, the entire system should be flushed and recharged after repairs have been made.

Because of the length of the hoses on these systems, hose leaks may be repaired using the following procedure:

1. Locate the leak.
2. Discharge the system.
3. Cut out the leaking portion of the hose, making sure that all of the failed portion is removed. If only a very small portion of the hose was removed, it may be possible to splice the two ends together, using a special hose connector and two hose clamps. If several inches of hose had to be removed, a new piece of hose should be spliced in using two connectors and four hose clamps. Coat the insides of the hose ends in clear refrigeration oil before

installing the hoses onto the connector. Never push the end of the hose beyond the locating bead of the connector. Torque the clamp to 35-42 in. lbs.

NOTE: Be sure to replace the hose in the body in the same manner as when removed. The hose must be routed and supported properly.

4. Evacuate, charge and check the system.

COMPRESSOR FAILURE

If the compressor has failed mechanically to the extent that metal chips and shavings are found in it, the system should be checked for foreign material and cleaned as described under "Foreign Material in the System".

FALSE COMPRESSOR SEIZURE

Slipping or broken air conditioning drive belts and/or scored clutch surfaces may be experienced on initial start up of an air conditioning compressor after an extended period of storage or non-operation of the compressor. This would indicate a seized compressor; however, an overhaul or replacement of the compressor may not be necessary.

During extended periods of non-operation, changes in temperature cause the refrigerant in the air conditioning compressor to expand and contract. During this movement, lubricating oil carried by the refrigerant tends to migrate from highly polished surfaces in the compressor such as the ball seats and axial plate. Without lubricating oil at these polished surfaces, they "wring" together and appear to be seized.

Before the time and expense of an overhaul is invested, use the following check to determine if the compressor is actually seized. With a Spanner Wrench J-7624 on the clutch drive plate, "rock" the shaft in the opposite direction of normal rotation. After the compressor is broken loose, rotate the shaft back and forth. This should be sufficient to return lubricating oil to the "wrung" surfaces and allow the compressor shaft to be turned by hand. Once the compressor turns freely, rotate the compressor at least three complete turns counterclockwise. Start the engine and operate the compressor for a minimum of one minute or until normal operating pressures are reached for a stabilized operating condition.

This procedure will not affect a compressor that is actually seized by should be attempted before overhauling a compressor known to be idle for a month or longer.

COLLISION PROCEDURE—ALL SYSTEMS

Whenever a vehicle equipped with an air conditioning unit is involved in a collision or wreck, it should be inspected and repaired as soon as possible. The extent of damage to any or all of the component parts and the length of time the system has been exposed to the atmosphere will determine the replacement of parts and processing that will be required. The greater the length of time of exposure to the atmosphere, the greater will have been the chances for air, moisture and dirt to have entered and damaged the system. Every case may be entirely different so it is not possible to establish a hard and fast procedure to follow each time. Good judgement must be used to determine what steps should be taken in each specific case.

The following procedure is presented as a guide for use when inspecting a damaged vehicle equipped with air conditioning.

1. Remove the drive belt.
2. Visually inspect the condenser, receiver-dehydrator, compressor, mounting brackets, conditioning unit, all connecting lines and all controls to determine the extent and nature of the damage.

a. No repairs, such as soldering, welding or brazing, should be attempted on the condenser because of its construction. If the vapor passages in the horizontal tubes or return bends or manifolds have been damaged in any way, the condenser should be replaced with a new one.

b. The receiver-dehydrator should be replaced if there is any evidence of its having sustained either internal damage or a fracture at any of the lines or welded joints or if the system has been exposed to the atmosphere for an undertermined period of time.

c. Examine the compressor for any visible external damage.

d. The evaporator should be examined for damage and, if necessary, removed or replaced or the entire unit processed where damaged or exposed to the atmosphere.

e. All connecting lines and flexible hoses should be examined throughout their entire length for damage. If damaged in any manner, replace with new lines.

f. Check all controls and connecting

wires for damage and replace with new parts where needed.

g. Check the drive plate assembly and the clutch pulley for proper operation and freedom from damage.

3. Install Charging Station or Gauge Set.
4. Discharge the system of R-12.

COMPRESSOR REPLACEMENT

REMOVAL

1. If possible, operate compressor which is to be replaced for 10 minutes at 1500-2000 engine rpm with A/C controls set for "MAX" cooling and "HI" fan speed. This operation is performed to effect return of oil to the compressor from other system parts and a normal distribution of oil in the system.
2. Disconnect battery ground cable.
3. Lift up engine access cover (inside vehicle) to gain access to engine components.
4. If necessary, remove the engine air cleaner to gain access to the A/C compressor.
5. Discharge the system of refrigerant as described under "Discharging, Evacuating and Charging the System" earlier in this section.
6. After the A/C system is completely depressurized, very slowly loosen bolt which retains high and low pressure line fitting assembly to compressor rear head (refer to figure 60). As bolt is being loosened, carefully work fitting assembly back and forth to break seal, and bleed off any remaining pressure before removing the mounting bolt completely.

WARNING: HIGH PRESSURE MAY STILL EXIST AT THE DISCHARGE FITTING. IF THIS PRESSURE IS RELEASED TOO RAPIDLY, THERE WILL BE A CONSIDERABLE DISCHARGE OF REFRIGERANT AND OIL.

7. When all pressure has been relieved, remove bolt, fitting assembly and O-ring seals.
8. Immediately cap or plug all openings in hoses and compressor. Test plate J-9625 may be used to seal compressor.
9. Disconnect electrical lead from clutch coil. (Refer to figure 7.)
10. Disconnect hose holding clamp at clamp mounting bracket (compressor front bracket). Refer to figure 60.
11. Remove bolt securing support strut at compressor rear head (figure 60). Loosen bolt securing other end of strut to engine, and move strut out of way, leaving attached to engine.
12. Remove remaining fastener securing rear support bracket to compressor mounting bracket (figure 60).
13. Loosen brace and pivot bolts at the compressor brace adjustment. Detach drive belt from compressor.
14. At compressor front head remove bolt and nut (lower fastener) and stud nut (upper fastener) securing compressor bracket to the mounting bracket (figure 60). Stud will remain in engine mounting bracket. Compressor may now be removed from vehicle.
15. Remove compressor and attaching brackets by sliding compressor rearward, tipping up and lowering compressor and bracket assembly out from underneath vehicle. Be sure compressor is removed with attaching brackets as shown in figure 61.
16. If there is any possibility that broken parts from the compressor have entered the discharge line or the condenser, all refrigerant system parts should be checked and cleaned and a new receiver-dehydrator assembly installed. This should be done in case any broken parts have been trapped in the desiccant inside of the receiver-dehydrator.
17. Remove bolts securing rear support bracket to compressor and front support bracket to compressor. Remove brackets.
18. Before beginning any compressor disassembly, drain and measure oil from compressor. Check for evidence of contamination to determine if remainder of A/C system requires servicing.

INSTALLATION

1. Attach support brackets to front and rear of compressor.
2. If oil previously drained from compressor upon removal showed no evidence of contamination, replace compressor oil with new 525 viscosity refrigeration oil. Refer to "Compressor Oil Charge Chart" later in this section for specified amount of oil charge. If it was necessary to service the entire A/C system because of excessive contamination in the oil removed, install a full charge of fresh refrigeration oil into the compressor.
3. Position compressor on mounting bracket and install all fasteners. Be sure to secure support strut at compressor rear head. Tighten all fasteners to specifications listed at the end of this section.

NOTE: If front support bracket stud hole does not line up with engine mounting bracket stud, it may be necessary to loosen mounting bracket bolts where they attach to the engine. With mounting bracket fasteners loose, align compressor to mount-

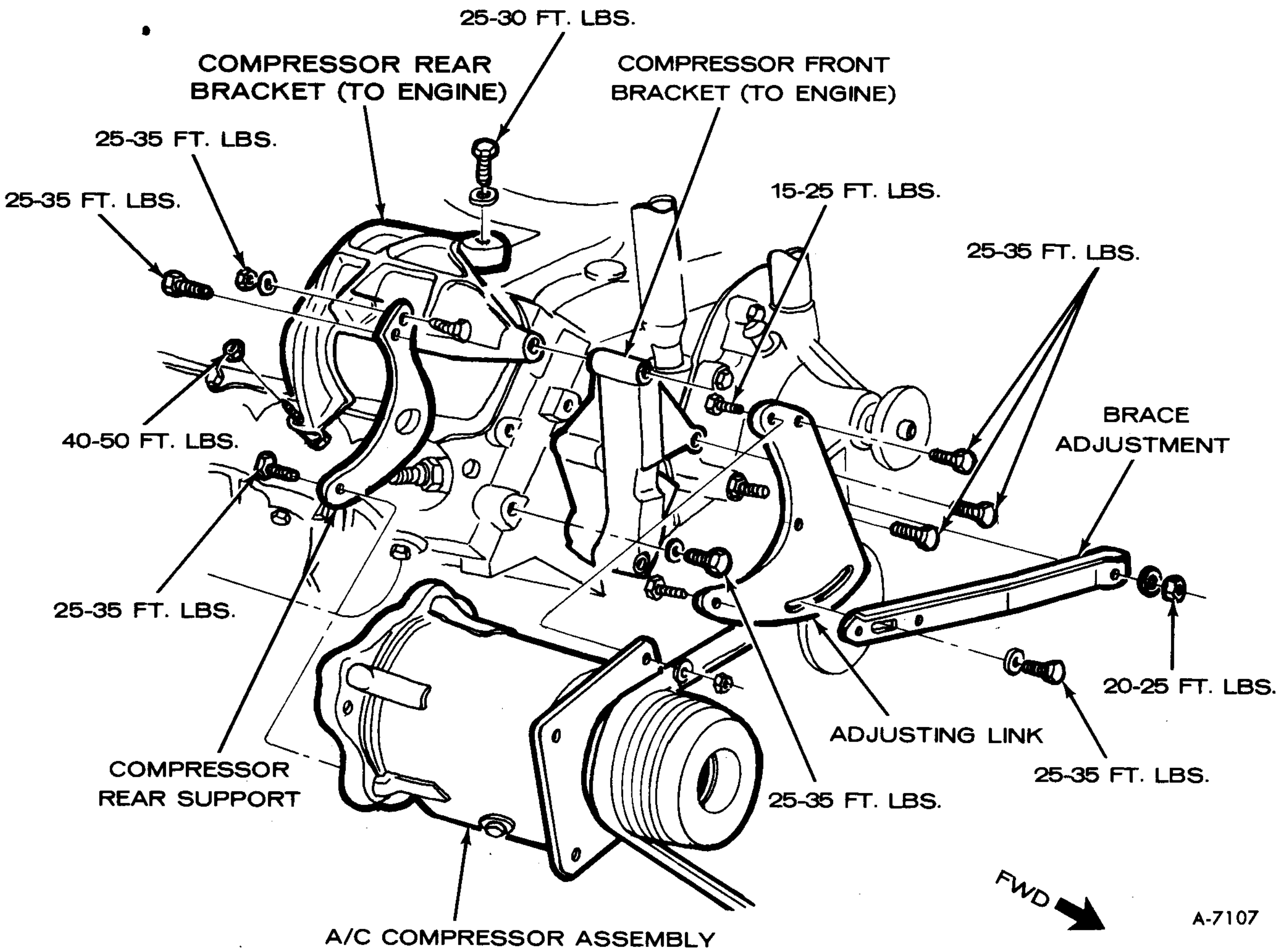


Figure 60—Air Conditioning Compressor Mounting

ing brackets. Thread stud through stud hole, install stud nut and tighten. Tighten to specification any other compressor fasteners that were loosened, and secure mounting bracket to engine block. Tighten to specification.

4. Remove Test Plate J-9625 (or plugs if used) from compressor.

NOTE: New compressors are charged with 11 fluid ounces of 525 viscosity refrigerant oil and have a minimal holding charge. If installing a new compressor, remove the compressor cover slowly to release any pressure from the unit.

5. Position hose fitting assembly at compressor rear head. Using new O-rings coated with clean refrigeration oil, secure fitting with single bolt. Tighten to specification listed at the end of this section.
6. Connect electrical lead to clutch coil.

7. Install and adjust compressor drive belt.

NOTE: Adjust compressor belt using belt tension gauge BT-33-73-F or other suitable

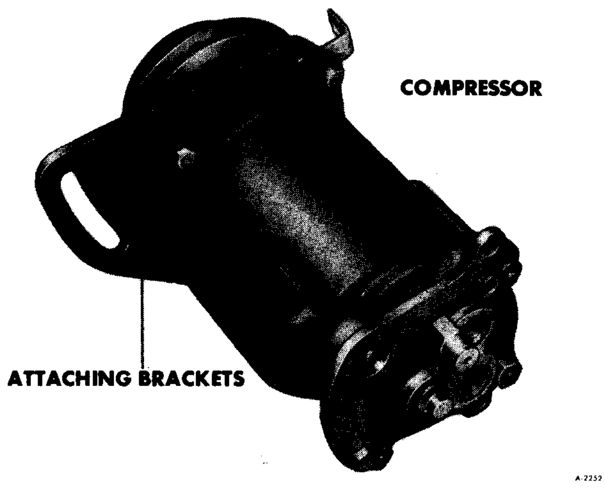


Figure 61—Compressor Removed from Vehicle

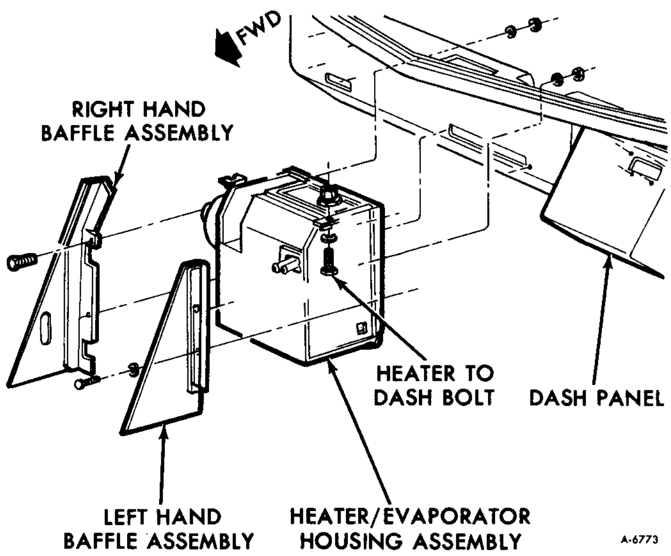


Figure 62—Heater/Evaporator Housing Assembly with Baffles (403 cu. in. Engine)

gauge. Tension should be within 70-80 lbs. (used belt) or 110-140 lbs. (new belt). For complete discussion of belt tensioning or replacement, refer to "Engine Cooling" (SEC. 6K) of this supplement.

8. Install hose holding clamp at clamp mounting bracket (compressor front head).
9. Connect battery ground cable.
10. Evacuate, charge and leak check the refrigeration system. Specifically, leak test all compressor connections. (Refer to "Compressor Leak Testing-- External and Internal," discussed later in this section.)

CAUTION: *All leaks must be repaired. Under no circumstances should a compressor be operated when a leak exists. Loss of refrigerant prevents proper oil return to the compressor and operating compressor under such conditions may damage it.*

HEATER CORE REPLACEMENT

REMOVAL

NOTE: In most 1977 vehicles it is not necessary to purge the system of refrigerant when only the heater core is being removed. All 1978 model vehicles and some late model 1977 vehicles have an aluminum tube assembly connected from the receiver-dehydrator outlet fitting to the evaporator inlet. This aluminum tube assembly is inflexible and does not permit the receiver-dehydrator to be "swung" over to the passenger side and out of the way of the heater/evaporator housing face panel. Consequently, all vehicles equipped with this aluminum tube assembly must have the A/C system discharged of refrigerant so that fittings at the receiver-dehydrator can be disconnected. This is necessary before the heater core can be serviced. Make certain that all open refrigerant line connections are capped or plugged immediately.

1. Disconnect battery ground cable.
2. If necessary, discharge the system of refrigerant as described under "Discharging, Evacuating and Charging the System" earlier in this section. (See "NOTE" above.)
3. Remove baffle from passenger side of heater/evaporator housing. (1977 model vehicles equipped with 403 cubic inch engines, and all 1978 model vehicles will have an additional baffle mounted on the driver's side of the heater/evaporator housing. Remove this baffle also.) (Refer to figure 62).
4. Unclip right hand windshield wiper connector arm at wiper motor. If necessary, move right hand windshield wiper out of way to allow working room at heater/evaporator housing face panel.
5. Remove bracket mounting screws (2) from receiver-dehydrator. If hose and tube assembly is used at receiver-dehydrator, swing dehydrator over toward passenger side of vehicle and position out of way of evaporator face panel. Hoses can be left connnected to the dehydrator. If the newer aluminum tube assembly is used at receiver-dehydrator, lines to dehydrator must be disconnected. (In this case the refrigerant system must be dis-

charged first.) Be sure to use a wrench on the square portion of the receiver-dehydrator for support. This will prevent twisting and possible breaking of the aluminum lines. Cap or plug all open refrigerant lines immediately.

6. Disconnect electrical connection at windshield washer reservoir. Disconnect hose from reservoir and remove reservoir.

7. Disconnect hoses from coolant recovery tank. Remove tank and mounting bracket (4 screws). Drain any coolant from hoses into a pan.

8. Disconnect vacuum line from water valve at heater hose.

9. Remove heater hose clamps. Carefully pull heater hoses off of core inlet and outlet pipes. Let heater core fluid drain into pan when hoses are removed.

NOTE: The heater core can be easily damaged in the area of the core tube attachment seams whenever undue force is exerted on them. Whenever the heater hoses do not readily come off the tubes, the hoses should be cut just forward of the core tubes. The portion of the hose remaining on the core tubes should then be split longitudinally. Once the hoses have been split, they can be removed from the tubes without damage to the core.

10. Remove cap screws retaining face panel to heater/evaporator housing assembly.

11. Remove sponge pad from behind heater hose connecting tubes (at face panel). Evaporator housing face panel can now be lifted off.

12. Remove heater core mounting screws and brackets (two screws on passenger side of core, one screw on driver's side of core) and carefully remove heater core.

INSTALLATION

1. Position heater core carefully in heater/evaporator housing.

2. Install core mounting brackets. Bracket on passenger side of core mounts with two screws; bracket on driver's side of core mounts with one screw. Tighten screws until snug.

3. Position evaporator housing face panel in place. Tighten all but two lower screws on passenger side of panel. Receiver-dehydrator bracket will mount with these screws.

4. Replace sponge pad behind heater hose outlet and inlet lines (at face panel).

5. Install heater hoses, and clamp to specification listed at the end of this section.

6. Connect vacuum line to water valve in heater hose.

7. Install coolant recovery tank mounting bracket. Replace tank and connect hoses to tank.

8. Replace windshield washer reservoir. Connect hose.

9. Secure electrical lead to windshield wiper reservoir.

10. Clip right hand windshield wiper connector arm at wiper motor.

11. Install receiver-dehydrator in brackets (two screws). Tighten to specification listed at the end of this section. Evaporator housing face panel is now secured.

12. If disconnected, reconnect inlet and outlet lines to receiver-dehydrator.

NOTE: Use new O-rings coated with clean refrigeration oil when connecting all refrigerant lines.

13. Replace baffle(s) removed from sides of evaporator/heater housing.

14. If refrigeration system was opened, evacuate and charge the system as described under "Discharging, Evacuating and Charging the System" covered earlier in this section.

15. Leak check the system.

16. Connect battery ground cable.

EVAPORATOR CORE REPLACEMENT

REMOVAL

CAUTION: *When repair or replacement of the evaporator core or expansion valve is necessary, be sure to remove both, as the method of attaching the sensing tube to the evaporator outlet line will cause it to be damaged if you try to remove only one item.*

1. Remove six screws and washers retaining grille to front of vehicle. Lift grille out.

2. Disconnect battery ground cable.

3. Discharge the system of refrigerant as described under "Discharging, Evacuating and Charging the System" earlier in this section.

4. Remove baffle from passenger side of heater/evaporator housing. (1977 model vehicles equipped with 403 cubic inch engines, and all 1978 model vehicles will have an additional baffle mounted on the driver side of the heater/evaporator housing. Remove this baffle also,) (Refer to figure 62.)

5. Unclip right hand windshield wiper connector arm at wiper motor. If necessary, move right hand windshield wiper out of way

to allow working room at housing face panel.

6. Disconnect high and low pressure lines from evaporator (just under blower fan housing) and seal all line connections.

> **NOTE:** Openings must be plugged or sealed <u>immediately</u> to prevent entry of dirt and moisture into the system.

7. Remove bracket mounting screws (2) from receiver-dehydrator. If flexible hose and tube assembly is used at receiver-dehydrator, swing dehydrator away from evaporator housing units. Hoses may be left connected to receiver. However, if aluminum tube assembly is used at receiver-dehydrator, this assembly is inflexible and fittings must be disconnected before receiver-dehydrator can be moved away from face panel. System must be discharged first. Make certain that all open connections are capped or plugged immediately after the refrigeration system is opened.

8. Disconnect electrical connection at windshield washer reservoir. Disconnect hose from reservoir and remove reservoir.

9. Disconnect hose fom coolant recovery tank and remove tank and mounting bracket. Drain any coolant from hoses into a pan.

10. Disconnect vacuum line from water valve at heater hose.

11. Remove heater hose clamps. Carefully pull heater hoses off of core inlet and outlet pipes. Plug heater core pipes immediately.

> **NOTE:** The heater core can be easily damaged in the area of the core tube attachment seams whenever undue force is exerted on them. Whenever the heater core hoses do not readily come off the tubes, the hoses should be cut just forward of the core tubes. The portion of the hose remaining on the core tube should then be split longitudinally. Once the hoses have been split, they can be removed from the tubes without damage to the core.

12. Remove cap screws retaining face panel to heater/evaporator housing.

13. Remove padding from behind heater hose connecting tubes. Heater/evaporator housing face panel can now be lifted off.

14. With face panel removed, carefully remove thermostatic switch probe which is held to front face of evaporator core by nylon clips. Do not bend this tube excessively.

15. Remove two screws securing thermostatic switch to heater/evaporator housing assembly. Disconnect electrical connection at the switch and remove switch.

16. Remove two screws from bracket securing high and low pressure line hold down clamp (passenger side of heater/evaporator housing, just under blower fan housing).

17. Remove evaporator core mounting screws.

18. Carefully pull out evaporator core. The expansion valve will be removed with the core.

> **NOTE:** It may be necessary to remove bottom panel of air conditioning unit to obtain sufficient leverage to remove evaporator core from isolator material which seals top of core to housing. If installing new evaporator core, add one fluid ounce of clean refrigerant oil to new core.

INSTALLATION

1. Position evaporator core carefully in evaporator housing, aligning high and low pressure refrigerant lines with openings in housing (passenger side of housing). Be certain core-to-housing sealer is intact before installing core. Use new sealer if necessary.

2. Install evaporator core mounting screws at top of core, i.e., two on each side of core.

3. Install thermostatic switch and sensing tube. Make sure that electrical leads are securely connected at the switch.

> **NOTE:** Be sure to install thermostatic switch capillary in the same position as on previous coil.

4. Using two screws, install bracket which secures high and low pressure line hold down clamp (located on passenger side of heater/evaporator housing, just under blower fan housing).

5. Connect high and low pressure lines, using new O-rings coated with clean refrigeration oil.

6. Replace evaporator housing face panel. Tighten mounting screws on side, except the two lower screws on passenger side of panel. Receiver-dehydrator bracket will mount with these screws.

7. Replace sponge padding at heater core inlet and outlet lines. Install heater hoses and clamp to specification.

8. Connect vacuum line to water valve in heater hose line.

9. Install coolant recovery tank mounting bracket. Replace tank and connect hoses to tank.

10. Replace windshield wiper reservoir. Connect hose.

11. Secure electrical lead to windshield wiper reservoir.

12. Clip right hand windshield wiper connector arm at wiper motor.
13. Install receiver-dehydrator in brackets (two screws). Tighten to specification listed at the end of this section. Evaporator housing face panel is now secured.
14. Connect inlet and outlet lines to receiver-dehydrator (if disconnected).

NOTE: Use new O-rings coated with clean refrigeration oil when connecting all refrigerant lines.

15. Replace baffle (one or two) removed from side of heater/evaporator housing.
16. Evacuate and charge refrigeration system as described udner "Discharging, Evacuating and Charging the System" earlier in this section.
17. Leak check the system. Connect battery ground cable and install grille.

CONDENSER REPLACEMENT

REMOVAL

1. Disconnect battery ground cable.
2. Remove grille assembly.
3. Discharge the system of refrigerant.
4. If vehicle is equipped with 403 cubic inch engine, remove lower baffle and two side baffles from condenser (figure 63).
5. Disconnect condenser inlet and outlet lines. Cap or plug all open connections at once.
6. Remove the condenser-to-radiator mounting screws.
7. Remove condenser assembly from vehicle by pulling it forward and then lowering it from the vehicle through the grille opening.
8. If installing a new condenser, transfer mounting brackets.

INSTALLATION

1. Add one fluid ounce of clean refrigerant oil to new condenser. (See "Adding Oil" procedure discussed earlier in this section.)
2. With top of condenser tipped rearward, lower condenser into position until mounting brackets line up with attaching points at radiator assembly.
3. Secure condenser to radiator mounting brackets with screws (both sides). Refer to figure 64.
4. Connect high pressure vapor line to condenser. Be sure to use a new O-ring coated with clean refrigerant oil.
5. Connect liquid line from receiver-dehydrator to condenser at outlet pipe. Be sure to use a new O-ring coated with clean refrigerant oil.
6. Install condenser baffles (where applicable). (Refer to figure 63.)
7. Evacuate system.
8. Charge system with refrigerant as described in "Discharging, Evacuating and Charging the System" earlier in this section. Leak test condenser connections.
9. Install grille assembly.
10. Connect battery ground cable.

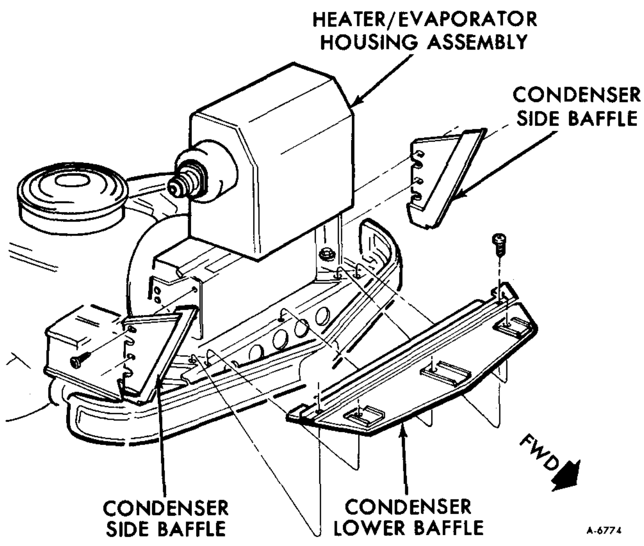


Figure 63—Condenser Baffles (403 cu. in. Engine)

AIR CONDITIONING REGISTER REPLACEMENT

REMOVAL

1. Using Remover and Installer Tool J-24612 (figure 65), compress grille release tabs.

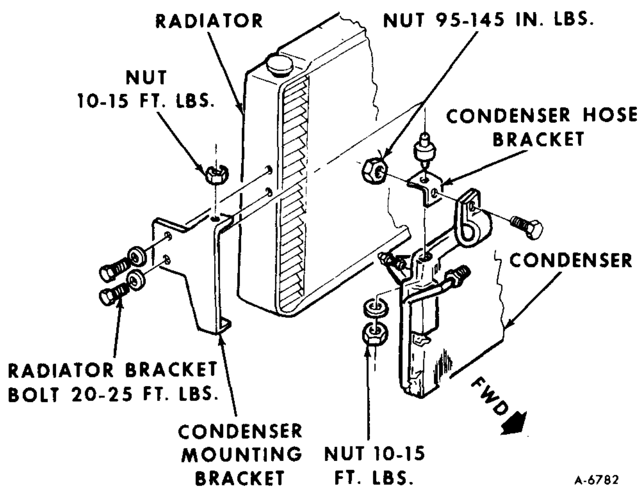


Figure 64—Condenser Mounting

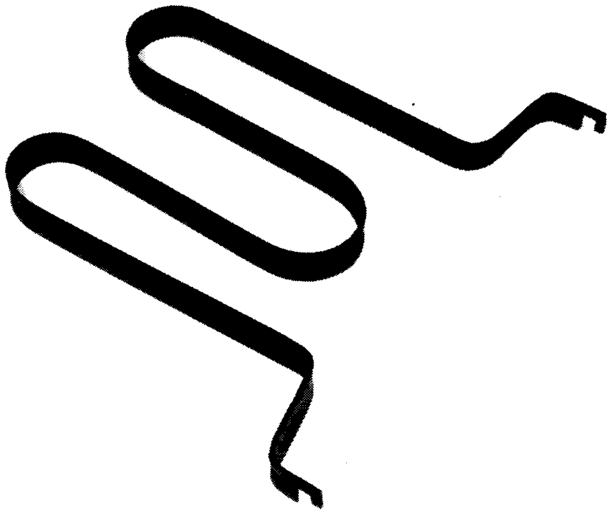


Figure 65—Air Conditioning Outlet Remover and Installer Tool J-24612

2. Rotate grille upward and remove grille.

INSTALLATION

1. Using Remover and Installer Tool J-24612, compress release tabs and position grille in instrument panel.
2. Remove tool and position grille so that tabs snap into retaining holes.

TIME DELAY RELAY REPLACEMENT

The time delay relay is mounted above the blower motor relay at the electrical component mounting plate (refer to figure 20). This is located in the engine compartment on the firewall, behind the passenger side access door.

REPLACEMENT

1. Disconnect battery ground cable.
2. Disconnect wiring harness at the time delay relay.
3. Remove the relay-to-case attaching screws and remove the relay.
4. Place the new relay in position and mount with screws.
5. Connect the relay wiring connector.
6. Connect the battery ground cable.

RECEIVER-DEHYDRATOR REPLACEMENT

The receiver-dehydrator assembly for the air conditioning system has a service replacement which includes two O-rings for the inlet and outlet connections. The desiccant within the shell is not serviced separately — it is part of the sealed receiver-dehydrator assembly.

REPLACEMENT

1. Disconnect battery ground cable.
2. Discharge system of refrigerant.
3. Disconnect receiver-dehydrator inlet and outlet connections, being sure to use a wrench on the square portion of the receiver-dehydrator for support. This will prevent twisting and possible breaking of the aluminum lines (refer to figure 66).
4. Loosen holding straps and slide out receiver-dehydrator.
5. Check amount of refrigeration oil in old receiver-dehydrator, and install the same amount of fresh 525 viscosity refrigerant oil into the new receiver-dehydrator. Then install an additional one ounce to replace the amount of oil captured in the old desiccant of the replaced receiver-dehydrator. (See Oil Chart later in this section.)
6. Install replacement unit, using clean 525 viscosity refrigerant oil on O-rings.
7. Evacuate and recharge the system. Leak check.
8. Connect battery ground cable.

A/C CONTROL HEAD REPLACEMENT

REMOVAL

1. Disconnect battery ground cable.
2. Remove retaining screw from passenger side of instrument cluster cowl panel (refer to Section 12 (CHASSIS ELECTRICAL) in this supplement). Lift cowl panel up and back to allow hand clearance behind instrument panel bezel.
3. Remove instrument panel bezel. Refer to "Instrument Panel Bezel Replacement" in Section 12 (CHASSIS ELECTRICAL) of this supplement.
4. Remove four screws securing control assembly to instrument panel foam ring cluster assembly.
5. Pull A/C control forward to gain access to rear of control assembly.

> **CAUTION:** *Be careful not to kink the bowden cable.*

6. Disconnect light bulb at the A/C control. Disconnect select valve electrical connector, all vacuum connections and blower fan switch.
7. Disconnect bowden cable at control panel by removing cable mounting screw underneath control panel.

INSTALLATION

1. Connect vacuum connector, electrical connector, blower fan switch and bulb to control panel.
2. Secure bowden cable with mounting screw underneath control panel. Adjust cable for full temperature lever travel.
3. Install control panel to foam ring with four mounting screws.
4. Install instrument panel bezel. Refer to "Instrument Panel Bezel Replacement" in Section 12 (CHASSIS ELECTRICAL) of this supplement.
5. Attach cowl panel to bezel.
6. Connect battery ground cable.

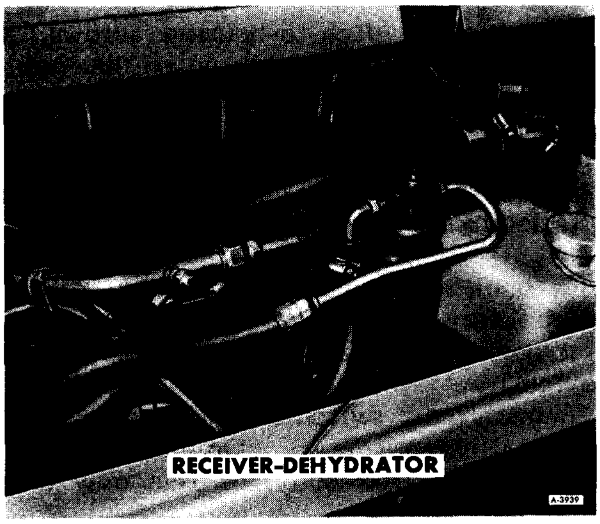


Figure 66—Lines to Receiver-Dehydrator

THERMOSTATIC SWITCH REPLACEMENT

The thermostatic switch is mounted to the blower side of the evaporator/heater housing (behind face panel), with a sensing tube that extends out across the face of the evaporator core.

REPLACEMENT

1. Disconnect battery ground cable.
2. If vehicle has an aluminum tube assembly connected from the receiver-dehydrator outlet fitting to the evaporator inlet, system must be discharged of refrigerant before receiver-dehydrator can be moved out of way of evaporator housing face panel. If necessary, discharge the system of refrigerant as described under "Discharging, Evacuating and Charging the System" earlier in this section.
3. Remove baffle from passenger side of heater/evaporator housing. (1977 model vehicles equipped with 403 cubic inch engine, and all 1978 model vehicles will have an additional baffle mounted on the driver's side of the heater/evaporator housing. Remove this baffle also.) (Refer to figure 62).
4. Unclip right hand windshield wiper connector arm at wiper motor. If necessary, move right hand windshield wiper out of way to allow working room at evaporator housing face panel.
5. Remove bracket mounting screws (2) from receiver-dehydrator. If hose and tube assembly is used at receiver-dehydrator, swing dehydrator over toward passenger side of vehicle and position out of way of evaporator face panel. Hoses can be left connected to the dehydrator and system does not require discharging. If newer aluminum tube assembly is used at receiver-dehydrator, system must be discharged of refrigerant before lines to dehydrator can be disconnected. Be sure to use a wrench on the square portion of the receiver-dehydrator for support. This will prevent twisting and possible breaking of the aluminum lines.
6. Disconnect electrical connection at windshield washer reservoir. Disconnect hose from reservoir. Remove reservoir.
7. Disconnnect hoses from coolant recovery tank.
8. Remove tank and mounting bracket (4 screws). Drain any coolant from hoses into a pan.
9. Disconnect vacuum line from water valve at heater hose.
10. Remove heater hose clamps. Carefully pull heater hoses off of core inlet and outlet pipes. Let heater core fluid drain into pan when hoses are removed.

NOTE: The heater core can be easily damaged in the area of the core tube attachment seams whenever undue force is exerted on them. Whenever the heater hoses do not readily come off the tubes, the hoses should be cut just forward of the core tubes. The portion of the hose remaining on the core tubes should then be split longitudinally. Once the hoses have been split, they can be removed from the tubes without damage to the core.

11. Remove cap screws retaining face panel to heater/evaporator housing assembly.
12. Remove sponge pad from behind heater hose connecting tubes (at face panel). Evaporator housing face panel can now be lifted off.
13. Remove electrical connector to the thermostatic switch.

14. Remove switch-to-housing screws, and remove the switch capillary so as not to damage the capillary tube.

NOTE: Note capillary tube position across the core so that the capillary may be reinstalled in the same position.

15. Place new switch in position, installing the capillary in the core with nylon clips. Be sure capillary tube is in same position as previously.
16. Install the switch mounting screws. Do not overtighten screws. Do not damage or distort the switch body, as this may affect switch calibration.
17. Reconnect electrical terminals to switch.
18. Reinstall face panel on evaporator housing, reinstall heater hoses and clamps, water vacuum valve and vacuum line at valve, coolant recovery tank and hoses, and windshield washer reservoir and hose.
19. Make electrical connection at windshield washer reservoir. Clip righthand windshield wiper connector arm at wiper motor.
20. Install receiver-dehydrator in brackets (two screws). Tighten to specifications listed at the end of this section. Evaporator housing face panel is now secured.
21. If disconnected, reconnect inlet and outlet lines to receiver-dehydrator.

NOTE: Use new O-rings coated with clean refrigeration oil when connecting all refrigerant lines.

22. Replace baffle(s) removed from side(s) of heater/evaporator housing.
23. If refrigeration system was opened, evacuate and charge system as described under "Discharging, Evacuating and Charging the System" covered earlier in this section.
24. Leak check the system. Connect battery ground cable.

WATER CONTROL VALVE REPLACEMENT

REMOVAL

1. Clamp off inlet and outlet hoses.
2. Disconnect vacuum line from water valve. (Refer to figure 16).
3. Loosen clamps securing water valve to heater hose and remove water valve.

INSTALLATION

1. Install new water valve in heater hose line. Clamp to specifications listed at the end of this section.
2. Remove clamps closing off heater hoses.
3. Connect vacuum line (pink striped) to water valve.
4. Replace any coolant lost.

BLOWER ASSEMBLY REPLACEMENT

1. Disconnect battery ground cable.
2. Disconnect the blower motor lead and ground wires.
3. Disconnect the blower motor cooling tube.
4. Remove the blower-to-case attaching screws and remove the blower assembly. Pry the blower flange away from the case carefully if the sealer acts as an adhesive.
5. Remove the nut attaching the blower wheel to the motor shaft and separate the assemblies.
6. To install, reverse Steps 1-5 above; replace sealer as necessary.

VACUUM TANK REPLACEMENT

The vacuum tank is mounted to the driver side of the evaporator/heater housing (see figure 21).

1. Disconnect the vacuum lines at the tank.
2. Remove the tank-to-housing screws and remove the tank.
3. To install, reverse steps 1 and 2 above.

BLOWER MOTOR RESISTOR REPLACEMENT

The blower motor resistor is located opposite the blower side of the evaporator/heater housing.

1. Disconnect battery ground cable and the wiring harness at the resistor.
2. Remove the resistor-to-case attaching screws and remove the resistor.
3. Place the new resistor in position and install the attaching screws.
4. Connect the resistor wiring harness and the battery ground cable.

LOW PRESSURE SWITCH REPLACEMENT

The low pressure cut-off switch, or discharge pressure switch, is located in the receiver-dehydrator to evaporator line (refer to figure 17).

1. Disconnect battery ground cable.
2. Discharge the system of refrigerant as described in "Discharging, Evacuating and Charging the System" earlier in this section.
3. Disconnect electrical wiring harness at the low pressure switch.
4. Remove the switch from the refrigerant line.
5. To install, reverse steps 1-4 above.

NOTE: Be sure to use new O-rings coated with clean refrigeration oil when installing the switch.

6. Evacuate, charge and check system operation.

BLOWER MOTOR RELAY REPLACEMENT

The blower motor relay is located on the firewall on the blower side of the evaporator/heater housing (figure 18).

1. Disconnect battery ground cable and the wiring harness at the relay.

2. Remove the relay-to-case attaching screws and remove the relay.

3. Place the new relay in position and install the mounting screws.

4. Connect the relay wiring harness and battery ground cable.

BLOWER SWITCH REPLACEMENT

1. Remove air conditioning control assembly as described earlier.

2. Disconnect wires to blower switch and pull knob off switch. Remove two switch attaching screws from back.

3. Install switch by reversing steps 1 and 2 above.

COMPRESSOR MINOR REPAIR PROCEDURES

The following operations to the Compressor Clutch Plate and Hub, Pulley and Bearing, and Coil Housing are covered as "Minor" because they may be performed WITHOUT FIRST DISCHARGING THE SYSTEM OR REMOVING THE COMPRESSOR from the vehicle.

The Compressor Shaft Seal assembly may also be serviced WITHOUT REMOVING THE COMPRESSOR from the vehicle but this operation is covered later in this section as "Major Repair Procedures" because the system MUST FIRST BE DISCHARGED of refrigerant.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to figures 67 and 68.

Removal and installation of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench. The work area, tools, and parts must be kept clean at all times. Parts Tray J-9402 should be used for all parts being removed, as well as for replacement parts.

Although certain service operations can be performed without completely removing the compressor from the vehicle, the operations described herein are based on bench overhaul with the compressor removed from the vehicle. They have been prepared in sequence in order of accessibility of the components.

CAUTION: *Do not kink or place excessive tension on lines or hoses.*

When a compressor is removed from the vehicle for servicing, the amount of oil remaining in the compressor should be drained and measured. This oil should then be discarded and new 525 viscosity refrigerant oil added to the compressor (figure 69).

COMPRESSOR CLUTCH PLATE AND HUB ASSEMBLY

REMOVAL

1. Place Holding Fixture J-9396 in a vise and clamp the compressor in the holding fixture.

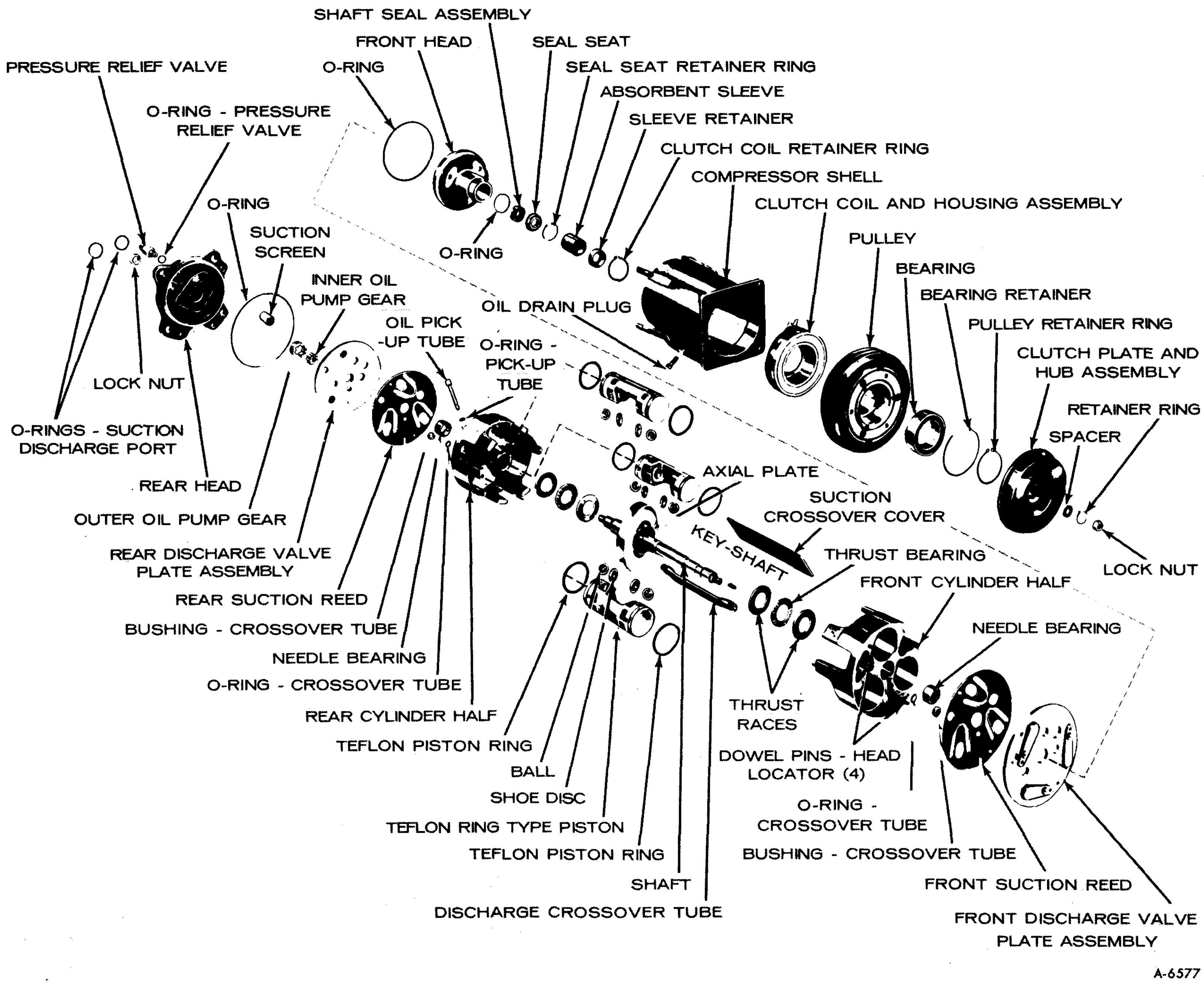


Figure 67—Compressor Components

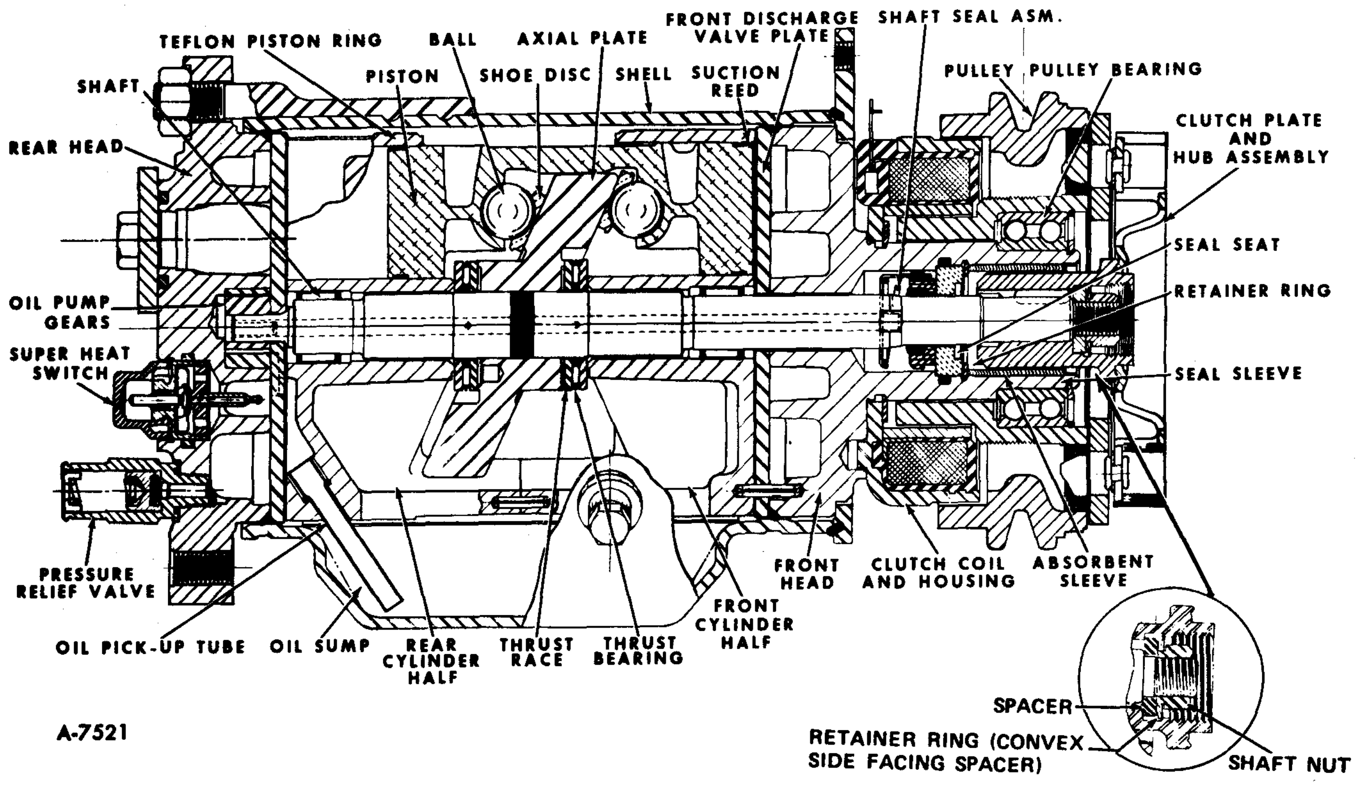


Figure 68—Sectional View of Compressor

2. Keep clutch hub from turning with Clutch Hub Holder J-25030 or J-9403, and remove lock nut from end of shaft using Thin Wall Socket J-9399 (figure 70).

CAUTION: *To avoid internal damage to the compressor, DO NOT DRIVE OR POUND on the clutch plate and hub assembly or on the end of the shaft. If proper tools to remove and replace clutch parts are not used, it is possible to disturb the position of the axial plate (keyed to the main shaft), resulting in compressor damage and seal leakage due to shifting of the crankshaft.*

3. Thread clutch plate and hub assembly remover J-9401 into hub. Hold body of remover with a wrench and tighten center screw to remove clutch plate and hub assembly (figure 71).

4. Remove square drive key from shaft or drive plate hub.

5. Remove hub spacer retainer ring using Snap-Ring Pliers J-5403 (#21), and then remove hub spacer (figure 72).

6. Inspect driven plate for cracks or stresses in the drive surface. Do not replace driven plate for a scoring condition (figure 73).

If the frictional surface shows signs of damage due to excessive heat, the clutch plate and hub and pulley and bearing should be replaced. Check further for the underlying cause of the damage (i.e., low coil voltage — coil should draw 3.2 amps at 12 volts —) or binding of the compressor internal mechanism, clutch air gap too wide, broken drive plate-to-hub assembly springs, etc.

INSTALLATION

1. Insert the square drive key into the hub of driven plate; allow it to project approximately 3/16" out of the keyway.

2. Line up the key in the hub with keyway in the shaft (figure 74).

3. Position the Drive Plate Installer J-9480-1 on the threaded end of the shaft. The Spacer J-9480-2 should be in place under the hex nut

UNIT	ADD OIL
CONDENSOR	1 OUNCE
EVAPORATOR	1 OUNCE
RECEIVER-DEHYDRATOR	1 OUNCE

COMPRESSOR CONDITION	AMOUNT OF OIL DRAINED FROM COMPRESSOR	AMOUNT OF OIL TO INSTALL
REPLACING COMPRESSOR WITH A NEW COMPRESSOR.	More Than - 4 oz.	* Drain New Compressor, Refill With New Oil (Same Amount As Drained From Old Compressor).
	Less Than - 4 oz.	** Drain New Compressor. Install New Oil In New Compressor - 6 oz.
REPLACING COMPRESSOR WITH A SERVICE REBUILT COMPRESSOR.	More Than - 4 oz.	* Same As Above Plus An Additional Ounce (More Oil Is Retained In A Drained Compressor Than One That Has Been Rebuilt).
	Less Than - 4 oz.	** Same As Above Plus An Additional Ounce.
UNABLE TO RUN COMPRESSOR BEING REPLACED, PRIOR TO REMOVAL.	More Than - 1-1/2 oz. And System Appears To Have Lost Little Or No Oil	* Same As Above.
	Less Than - 1-1/2 oz. Or System Appears To Have Lost Major Amount Of Oil.	** Same As Above.
CONTAMINATED OIL DRAINED FROM SYSTEM.	Any Amount	Drain As Much Oil As Possible From System. Flush System With Refrigerant-11. Replace Receiver-Dehydrator And Install New 525 Viscosity Oil In New Compressor: 10-1/2 ozs.

A-7495

Figure 69—Compressor Oil Charge Chart

on the tool. This tool has a left hand thread on the body (figure 75).

4. Press the driven plate onto the shaft until there is approximately 3/32" space between the frictional faces of the clutch drive plate and pulley.

CAUTION: *Make certain key remains in place when pressing hub on shaft.*

A ZERO thrust race is approximately 3/32" thick and may be used to roughly gauge this operation. Use Clutch Hub Holder J-25030 or J-9403 to hold clutch plate and hub if necessary.

5. Install the hub spacer and, using Snap-Ring Pliers J-5403 (#21), install the retainer ring (see installed retainer ring in inset of figure 68), with convex side of ring facing spacer.

6. Use Thin-Wall Socket J-9399 and Clutch Hub Holder J-25030 or J-9403 to install a new shaft lock nut with shoulder or circular projection on the lock nut facing towards retainer ring. Tighten the nut to 14-26 ft. lbs. torque. Air gap between the frictional faces should now be .022" to .057" (figure 76). If not, check for mispositioned key or shaft.

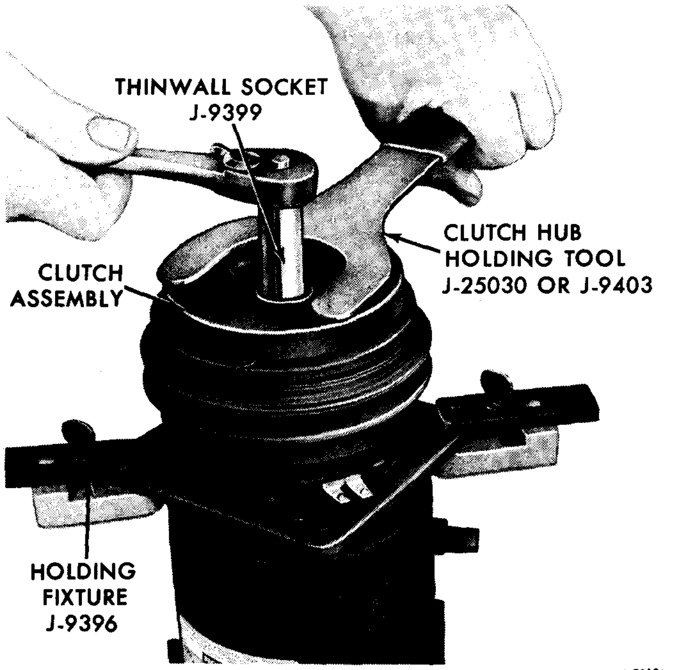


Figure 70—Removing Shaft Locknut

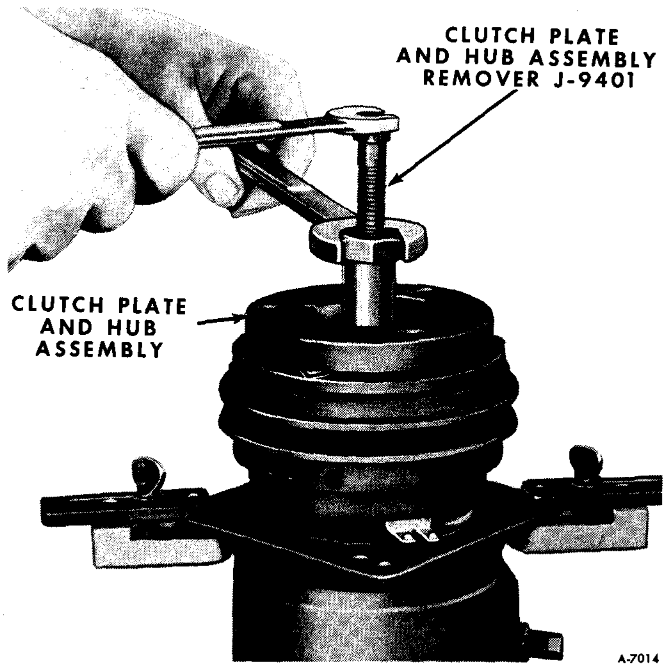


Figure 71—Removing Clutch Plate And Hub Assembly

7. The pulley should now rotate freely.
8. Operate the refrigeration system under MAXIMUM load conditions and engine speed at 2000 rpm. Rapidly cycle the clutch by turning the air conditioning on and off at least 15 times at approximately one second intervals to burnish the mating parts of the clutch.

PULLEY AND BEARING ASSEMBLY

REMOVAL

1. Remove clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Assembly" removal procedure.
2. Remove pulley retainer ring using Snap-Ring Pliers J-6435 (#26), figure 77.
3. Pry out absorbent sleeve retainer, and remove absorbent sleeve from compressor neck.
4. Place Puller Pilot J-9395 over end of compressor shaft.

CAUTION: *It is important that Puller Pilot J-9395 be used, to prevent internal damage to compressor when removing pulley. Under no circumstances should puller be used directly against drilled end of shaft.*

5. Remove Pulley and Bearing Assembly using Pulley Puller J-8433 (figure 78).

INSPECTION

Check the appearance of the pulley and bearing assembly (see figure 73). The frictional surfaces of the pulley and bearing assembly should be cleaned with suitable solvent before reinstallation.

INSTALLATION

1. If original pulley and bearing assembly is to be reinstalled, wipe frictional surface of

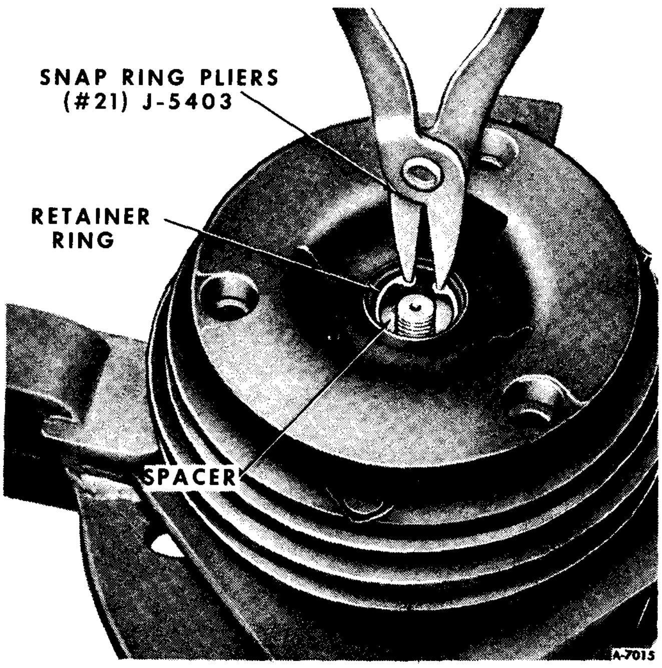


Figure 72—Replacing Retaining Ring

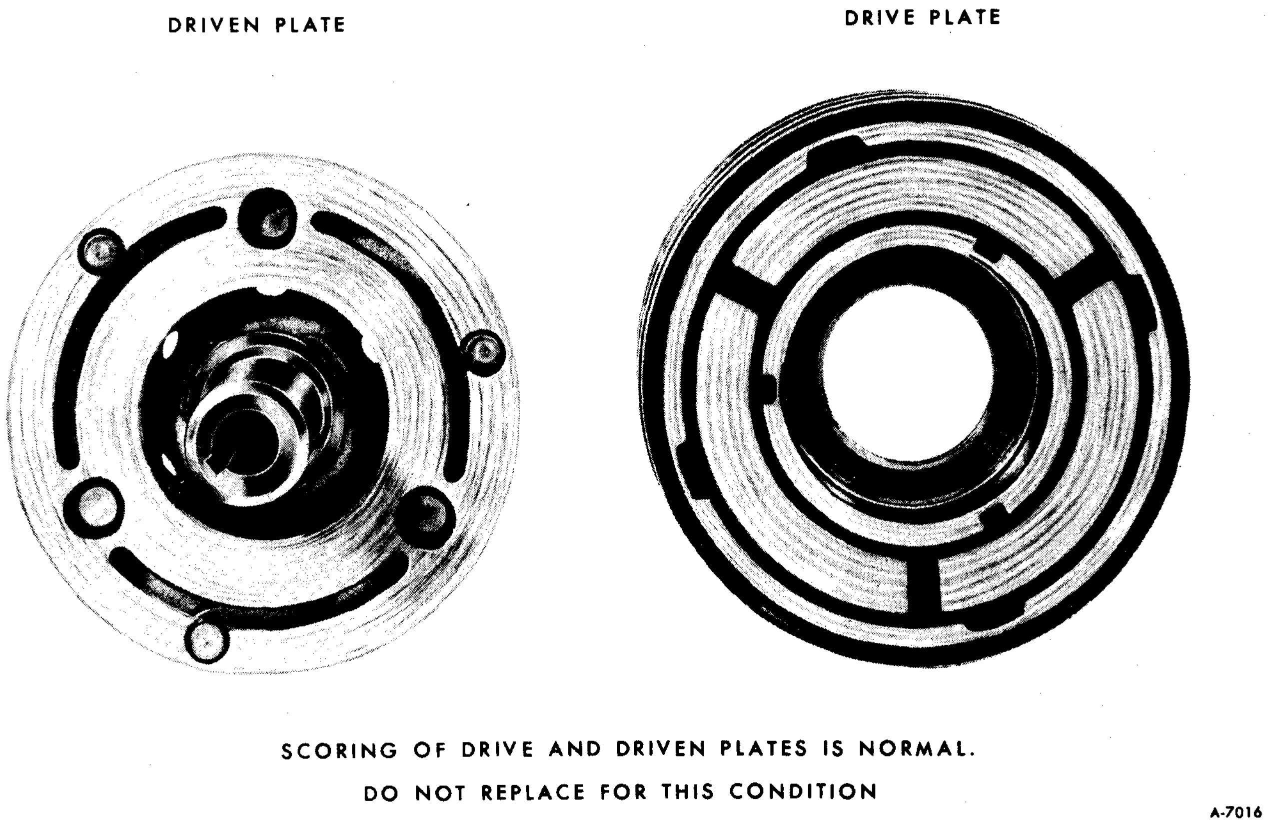


Figure 73—Clutch Driven Plate and Drive Plate

pulley clean. If frictional surface of pulley shows any indication of damage due to overheating, the pulley and bearing should be replaced.

2. Check bearing for brinelling, excessive looseness, noise, and lubricant leakage. If any of these conditions exists, bearing should be replaced. See "Compressor Pulley Bearing" Replacement Procedure.

3. Press or tap pulley and bearing assembly on neck of compressor until it seats, using Pulley and Bearing Installer J-9481 with Universal Handle J-8092 (figure 79). The Installer

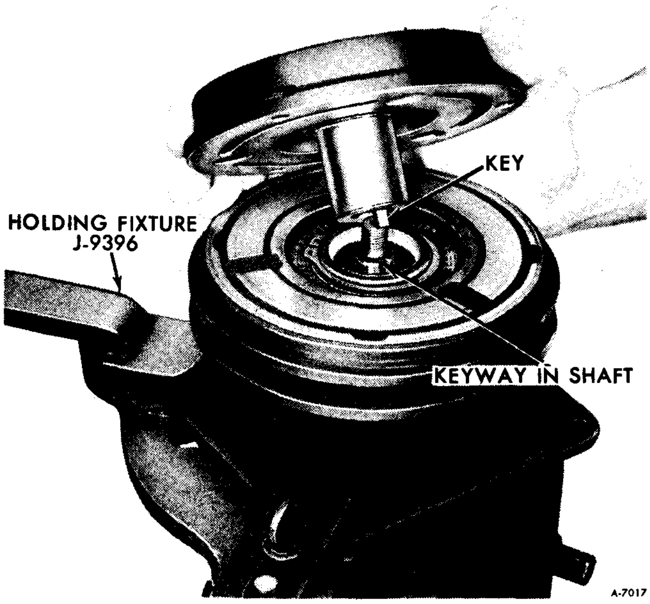


Figure 74—Aligning Drive Plate Key

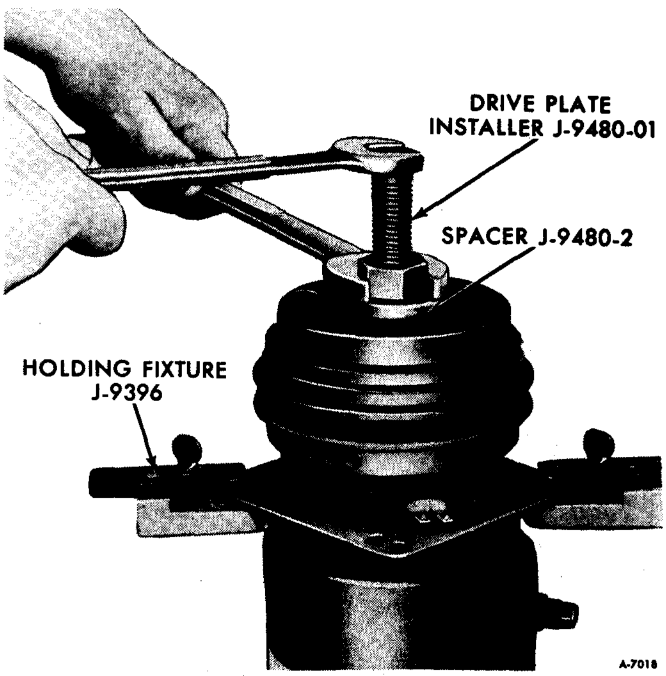


Figure 75—Installing Drive Plate

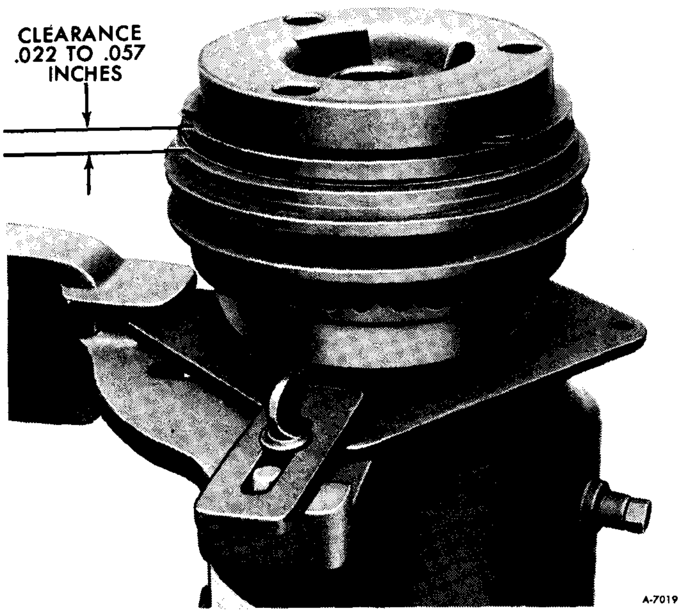


Figure 76—Checking Air Gap

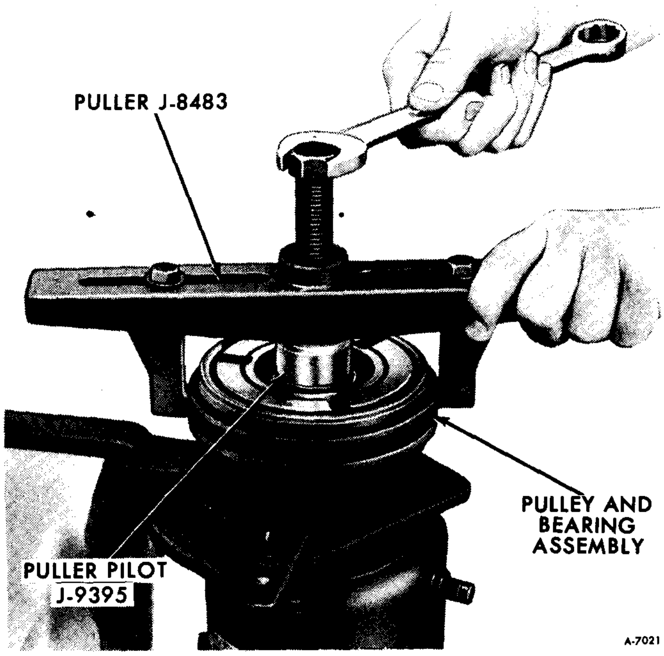


Figure 78—Removing Pulley and Bearing Assembly

will apply force to inner race of bearing and prevent damage to bearing.

4. Check pulley for binding or roughness. Pulley should rotate freely.
5. Install retainer ring, using Snap Ring Pliers J-6435 (#26).
6. Install absorbent sleeve in compressor neck.
7. Install absorbent sleeve retainer in neck of compressor. Using sleeve from Seal Seat Remover-Installer J-23128, install retainer so that outer edge is recessed 1/32" from compressor neck face.
8. Install clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Assembly" Replacement Procedure.

COMPRESSOR PULLEY BEARING

REMOVAL

1. Remove clutch plate and hub assembly as

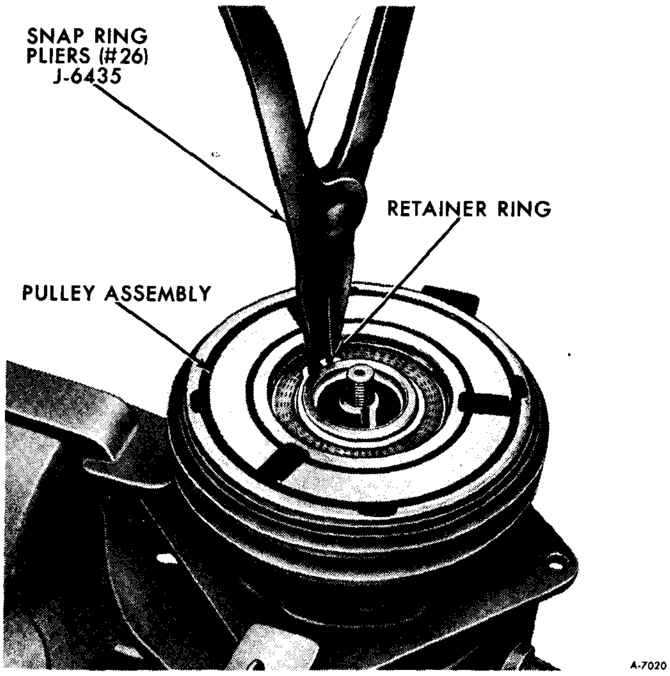


Figure 77—Removing Pulley Retainer Ring

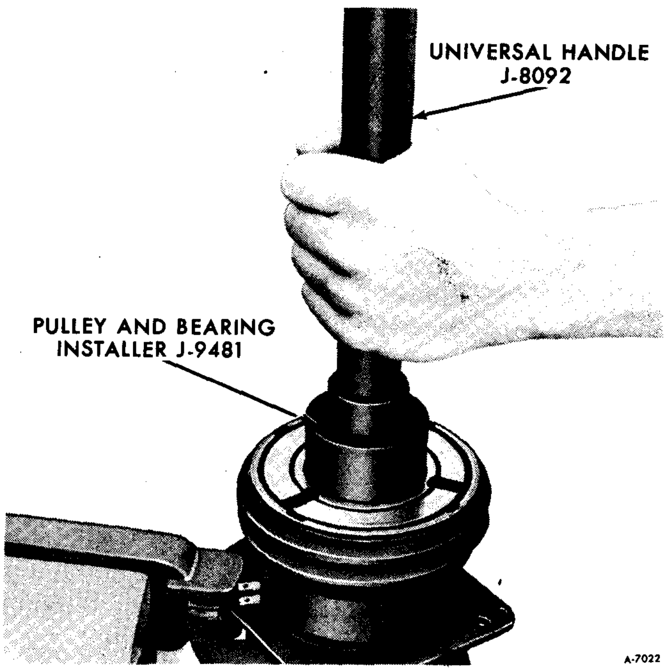


Figure 79—Installing Pulley and Bearing Assembly

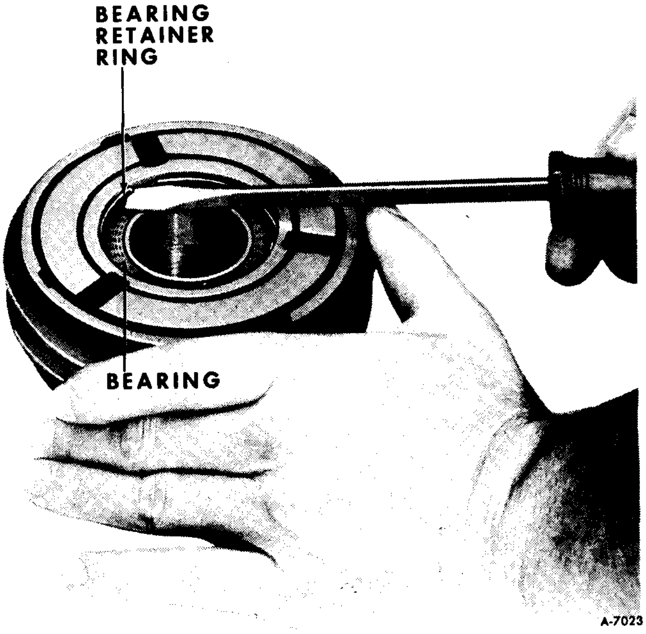


Figure 80—Removing Pulley and Bearing Retainer Ring

described in "Compressor Clutch Plate and Hub Assembly" Removal procedure.

2. Remove pulley and bearing assembly as described in "Compressor Pulley and Bearing Assembly" Removal procedure.

3. Remove pulley bearing retainer ring with a small screwdriver or pointed tool (figure 80).

4. Place pulley and bearing assembly on inverted Support Block J-21352 and, using Pulley Bearing Remover J-9398 with Universal

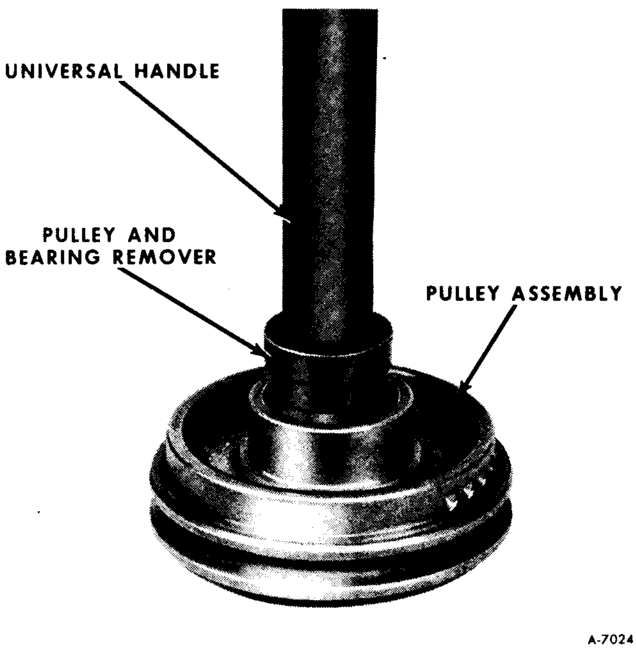


Figure 81—Removing Bearing From Pulley Assembly

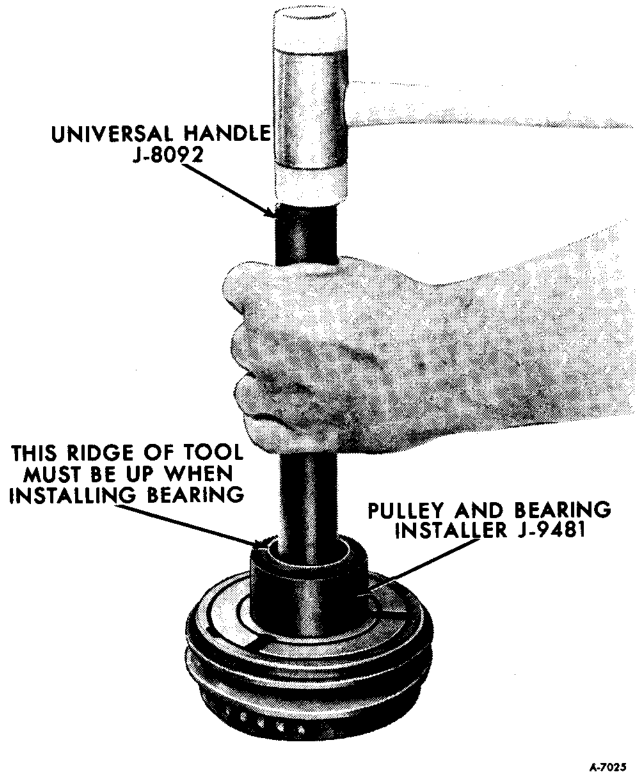


Figure 82—Installing Bearing on Pulley

Handle J-8092, drive bearing assembly out of pulley (figure 81).

INSTALLATION

1. Install new bearing in pulley using Pulley and Bearing Installer J-9481 with Universal

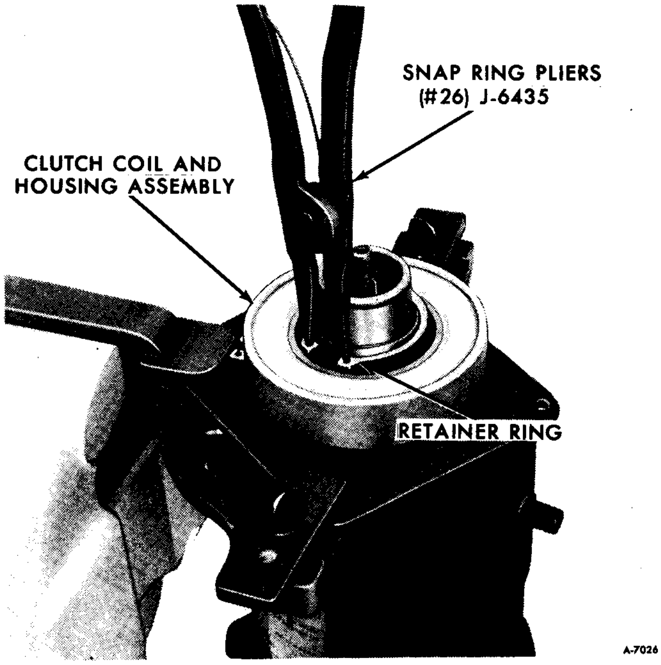


Figure 83—Removing Coil Housing Retaining Ring

Handle J-8092 (figure 82). The Installer will apply force to the outer race of the bearing.

CAUTION: *Do not clean new bearing assembly with any type of solvent. Bearing is supplied with correct lubricant when assembled and requires no other lubricant at any time.*

2. Install bearing retainer ring, making certain that it is properly seated in ring groove.
3. Install pulley and bearing assembly as described in "Compressor Pulley and Bearing Assembly" Replacement procedure.
4. Install clutch plate and hub assembly as described in "Compressor Clutch Plate Assembly" Replacement procedure.

COMPRESSOR CLUTCH COIL AND HOUSING ASSEMBLY

REMOVAL

1. Remove clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Assembly" Removal procedure.
2. Remove pulley and bearing assembly as described in "Compressor Pulley and Bearing Assembly" Removal procedure.

NOTE: Note position of terminals on coil housing and scribe location on compressor front head casting.

3. Remove coil housing retaining ring using Snap-Ring Pliers J-6435 (#26) (figure 83).
4. Lift coil and housing assembly off compressor.

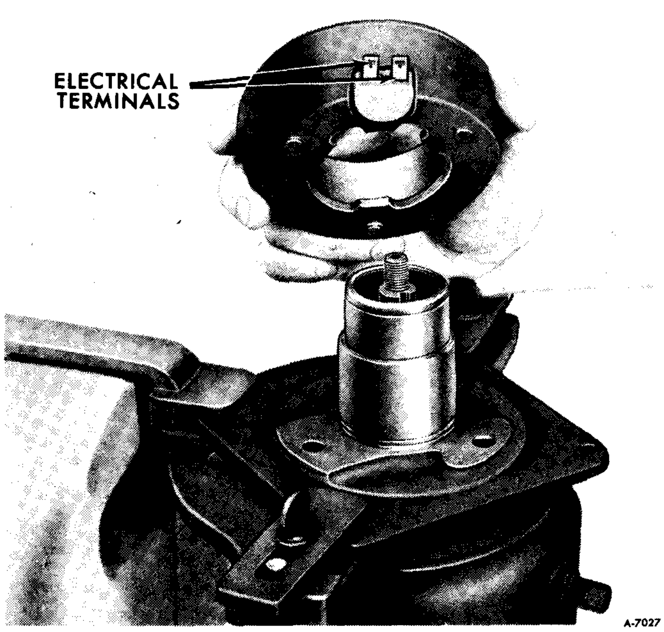


Figure 84—Installing Coil Housing

INSTALLATION

1. Position coil and housing assembly on compressor front head casting so that electrical terminals line up with marks previously scribed on compressor (figure 84).
2. Align locating extrusions on coil housing with holes in front head casting.
3. Install coil housing retainer ring with flat side of ring facing coil, using snap-ring pliers J-6435 (#26).
4. Install pulley and bearing assembly as described in "Compressor Pulley and Bearing Assembly" replacement procedure.
5. Install clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Assembly" replacement procedure.

COMPRESSOR MAJOR REPAIR PROCEDURES

Service repair procedures to the compressor shaft seal and pressure relief valve or disassembly of the internal compressor mechanism are considered "Major" since the refrigeration system must be completely discharged of refrigerant before proceeding and/or because major internal operating and sealing components of the compressor are being disassembled and serviced.

A clean workbench, preferably covered with a sheet of clean paper, orderliness in the work area and a place for all parts being removed and replaced is of great importance, as is the use of proper and clean service tools. Any attempt to use makeshift or inadequate equipment may result in damage and/or improper compressor operation.

These procedures are based on the use of the proper service tools and the condition that an adequate stock of service parts is available.

All parts required for servicing are protected by a preservation process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the mechanism assembly just as they are removed from the service package.

Piston shoe discs and shaft thrust races will

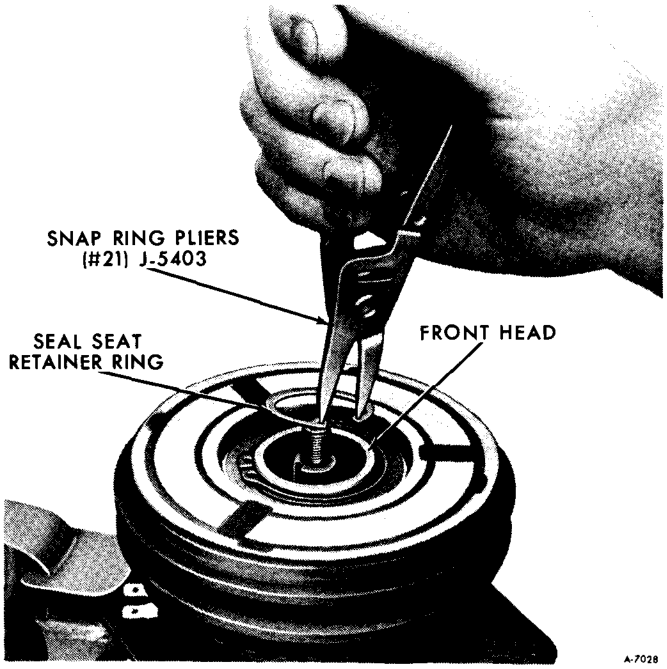


Figure 85—Replacing Shaft Seal Seat Retaining Ring

be identified by "number" on the parts themselves. For reference to determine their size and dimension see chart later in this section.

COMPRESSOR SHAFT SEAL

SEAL LEAK DETECTION

A shaft seal should not be changed because of an oil line around the seal. The seal is designed to seep some oil for lubrication purposes. Only change a shaft seal when a leak is detected by a leak-testing procedure.

When refrigerant system components other than the compressor are replaced, the compressor must be removed and oil drained from

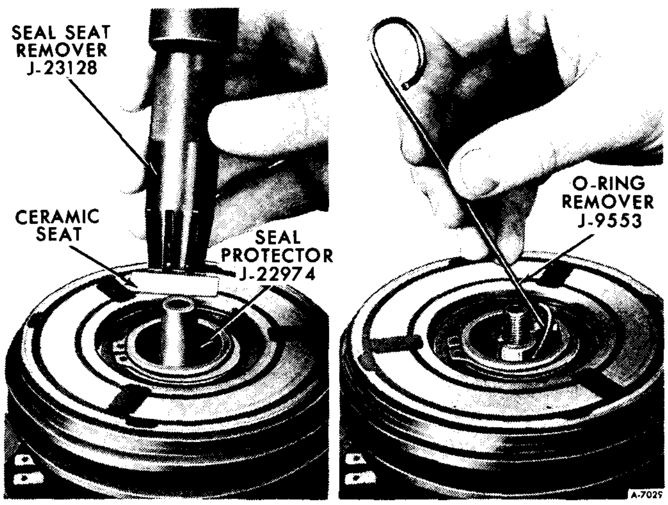
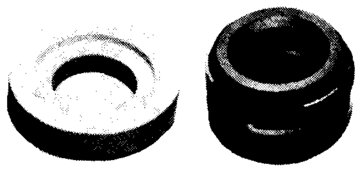


Figure 86—Removing Shaft Seal Seat And O-Ring



SPECIFICATION PARTS	
SEAL	CARBON MATERIAL. LARGE CHAMFER ON INSIDE DIAMTER.
SEAT	CERAMIC MATERIAL WITH POLISHED FACE.
O-RINGS	NEOPRENE, THUS CAPABLE OF GIVING HEAT RESISTANCE AND LIFE EXPECTANCY.

A-6797

Figure 87—Shaft Seal Kit Specifications

the compressor if oil was sprayed in large amounts due to leaks or a broken shaft seal.

Compressor shaft seals,unless replaced during a compressor overhaul, are to be replaced only on the basis of actual refrigerant leakage as determined by test with leak detector.

When replacing the shaft seal assembly, even if the compressor remains on the vehicle during the operation, it will be necessary to discharge the system of refrigerant.

REMOVAL

1. After first discharging the system of refrigerant, remove the clutch plate and hub assembly and shaft key as described in "Compressor Clutch Plate and Hub Assembly" removal procedure.

2. Pry out the sleeve retainer and remove the absorbent sleeve. Remove the shaft seal seat retaining ring, using snap ring pliers J-5403 (#21) (figure 85).

3. Thoroughly clean inside of compressor neck area surrounding the shaft, the exposed portion of the seal seat and the shaft itself. This is absolutely necessary to prevent any dirt or foreign material from getting into compressor.

4. Place seal protector J-22974 over the end of the shaft to prevent chipping the ceramic seat. Fully engage the knurled tangs of seal seat remover-installer J-23128 into the recessed portion of the seal seat by turning the handle clockwise. Lift the seat from the compressor with a rotary motion (figure 86).

CAUTION: *Do not tighten the handle with a wrench or pliers; however, the handle must be hand-tightened securely to remove the seat.*

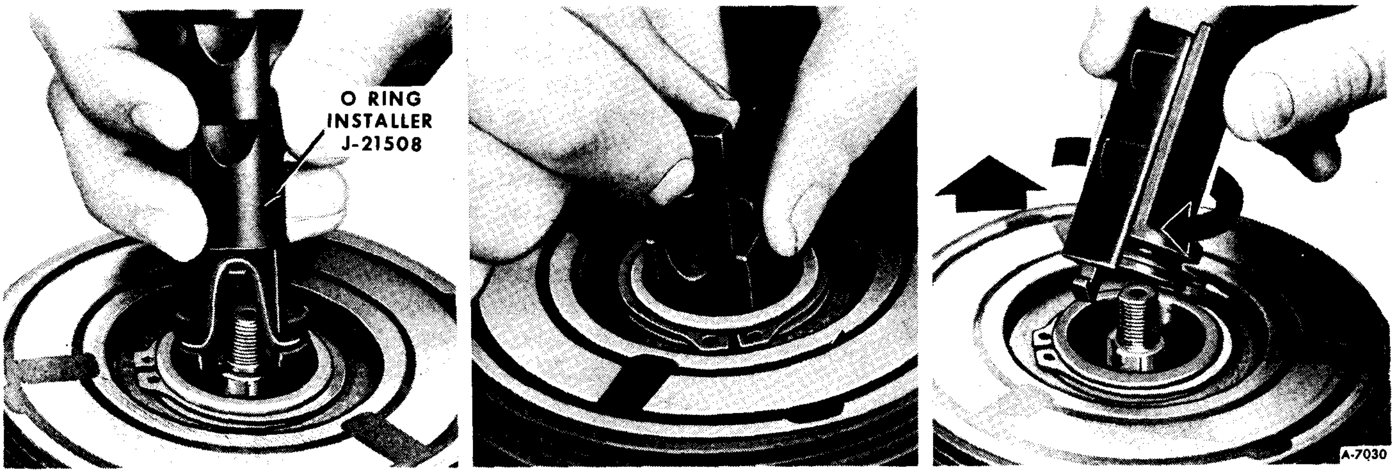


Figure 88—Replacing O-Ring

5. With seal protector J-22974 still over the end of the shaft, engage the tabs on the seal assembly with the tangs on seal installer J-9392 by twisting the tool clockwise, while pressing the tool down. Then lift the seal assembly out (figure 86).

6. Remove the seal seat O-ring from the compressor neck using O-ring remover J-9533.

7. Recheck the shaft and inside of the compressor neck for dirt or foreign material and be sure these areas are perfectly clean before installing new parts.

INSPECTION

Seals should not be reused. Always use a new seal kit on rebuild (figure 87). Be extremely careful that the face of the seal to be installed is not scratched or damaged in any way. Make sure that the seal seat and seal are free of lint and dirt that could damage the seal surface or prevent sealing.

INSTALLATION

1. Coat new seal seat O-ring with clean 525 viscosity refrigerant oil and install in compressor neck, making certain it is installed in bottom groove (figures 88 and 89). Top groove is for retainer ring. Use O-ring installer J-21508.

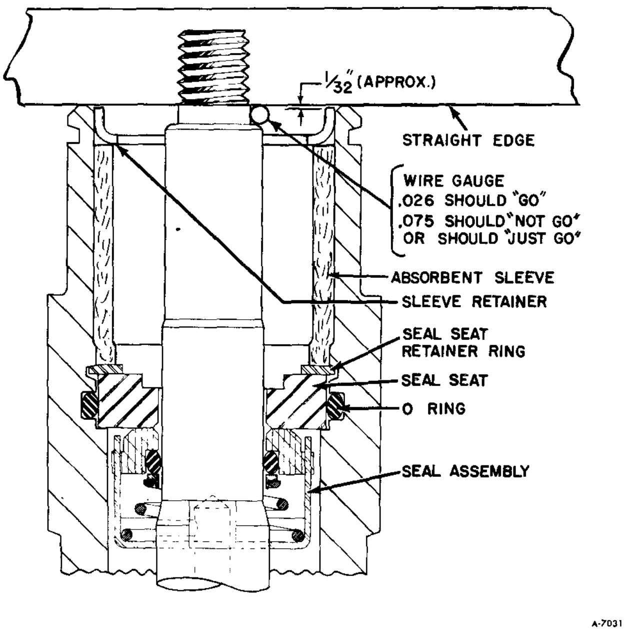


Figure 89—Compressor Shaft and Seal

Figure 90—Replacing Seal

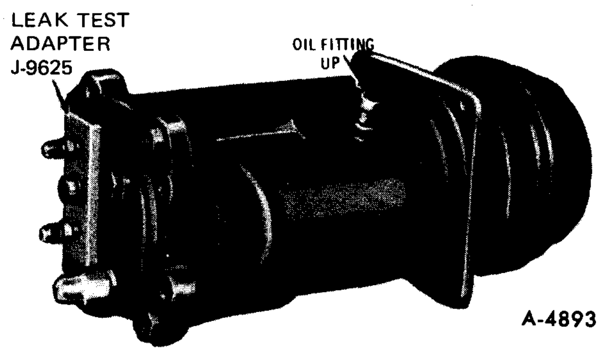


Figure 91—Leak Testing Compressor

2. Coat the O-ring and seal face of the new seal assembly with clean 525 viscosity refrigerant oil. Carefully mount the seal assembly to seal installer J-9392 by engaging the tabs of the seal with the tangs of the tool (figure 90).

3. Place seal protector J-22974 (figure 90) over end of shaft and carefully slide the new seal assembly onto the shaft. Gently twist the tool clockwise, while pushing the seal assembly down the shaft until the seal assembly engages the flats on the shaft and is seated in place. Disengage the tool by pressing downward and twisting tool counterclockwise.

4. Coat the seal face of the new seal seat with clean 525 viscosity refrigerant oil. Mount the seal seat on seal seat remover-installer J-23128 and install it in the compressor neck, taking care not to dislodge the seal seat O-ring and being sure the seal seat makes a good seal with the O-ring. Remove seal protector J-22974 from the end of the shaft (figure 86).

5. Install the new seal seat retainer ring with its flat side against the seal seat, using snap-ring pliers J-5403 (#21) (figure 85). Use the sleeve from seal seat remover-installer J-23128 (figure 86) to press in on the seal seat retainer ring so that it snaps into its groove.

6. Install compressor leak test fixture J-9625 on rear head of compressor and connect gauge charging lines as shown for bench test in figure 91 or pressurize SUCTION SIDE of compressor on vehicle with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position and oil sump down, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the seal with leak detector. Correct any leak found. Remove the shaft nut.

7. Remove any excess oil, resulting from installing the new seal parts, from the shaft and inside the compressor neck.

8. Install the new absorbent sleeve by rolling the material into a cylinder, overlapping the ends, and then slipping the sleeve into the compressor neck with the overlap towards the top of the compressor.

With a small screwdriver or similar instrument, carefully spread the sleeve until the ends of the sleeve butt at the top vertical centerline.

9. Position the new metal sleeve retainer so that its flange face will be against the front end of the sleeve. Pulley puller pilot J-9395 (figure 78) may be used to install the retainer. Press and tap with a mallet, setting the retainer and sleeve into place (retainer should be recessed approximately 1/32" from the face of the compressor neck) (figure 89).

10. Install the clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Assembly" replacement procedure.

Some compressor shaft seal leaks may be the result of mispositioning of the axial plate on the compressor shaft. The mispositioning of the axial plate may be caused by improper procedures used during pulley and driven plate removal, pounding, collisions or dropping the compressor. If the axial plate is mispositioned, the carbon face of the shaft seal assembly may not contact the seal seat and the rear thrust races and bearing may be damaged.

If there appears to be too much or insufficient air gap between the drive and driven plates, dislocation of the shaft should be suspected. If the carbon seal is not seating against the seal seat, it will not be possible to completely evacuate the system as outlined under "Evacuating and Charging the System".

To check for proper positioning of the axial plate on the shaft, remove the clutch driven plate and measure the distance between the front head extension and the flat shoulder on the shaft as shown in figure 89. To measure this distance, use a wire gauge (the clearance should be between .026" and .075"). If the shaft has been pushed back in the axial plate (measurement greater than .075"), disassemble the compressor and replace the shaft and axial plate assembly rear thrust races and thrust bearing.

11. Add oil, evacuate and charge system.

COMPRESSOR PRESSURE RELIEF VALVE

When necessary to replace the pressure relief valve, located in the compressor rear head casting (figure 92), the valve assembly should be removed after discharging the system of refrigerant and a new valve and

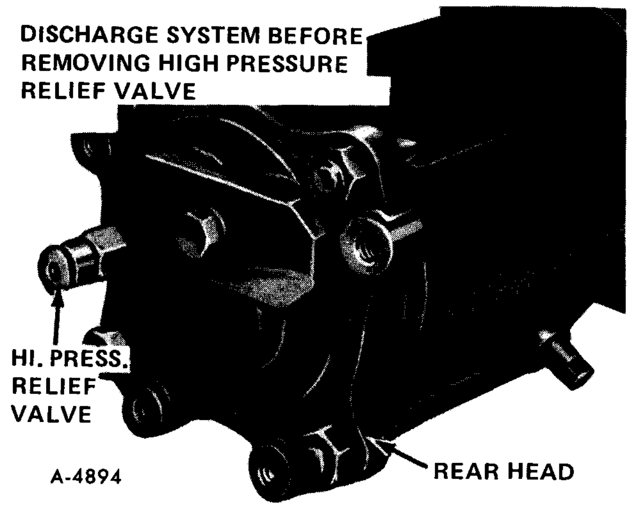


Figure 92—High Pressure Relief Valve

gasket installed. The entire system should then be evacuated and charged.

COMPRESSOR INTERNAL MECHANISM

Service operations to the rear head or internal mechanism of the compressor should be performed with the compressor removed from the vehicle to insure that the necessary degree of cleanliness may be maintained. Clean hands, clean tools and a clean bench, preferably covered with clean paper, are of extreme importance.

An inspection should be made of the internal mechanism assembly to determine if any service operation should be performed. A detailed inspection of parts should be made to determine if it is economically feasible to replace them.

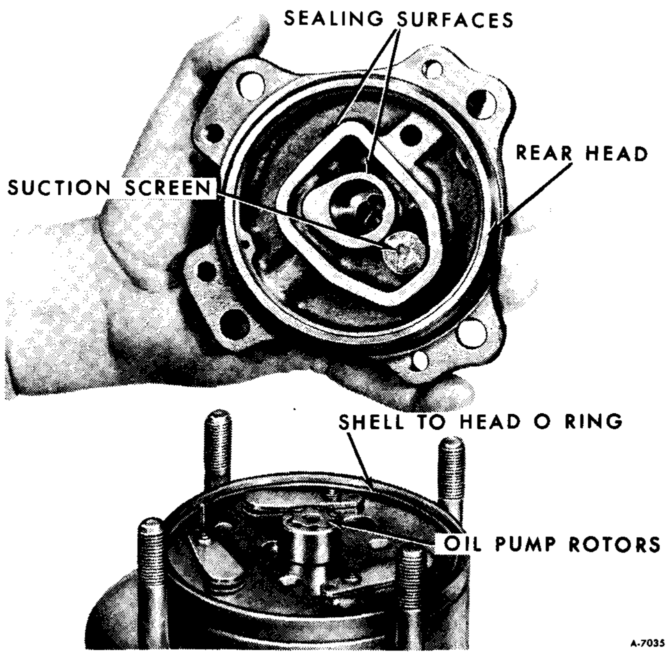


Figure 94—Rear Head Removed

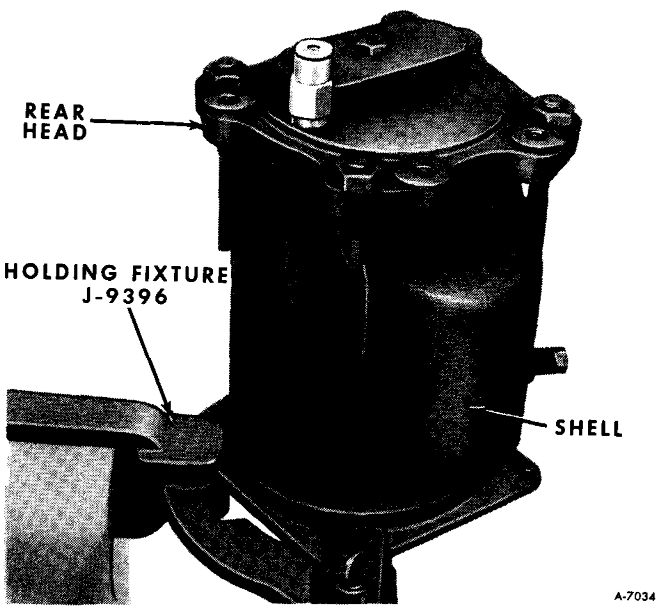


Figure 93—Compressor Installed in Holding Fixture

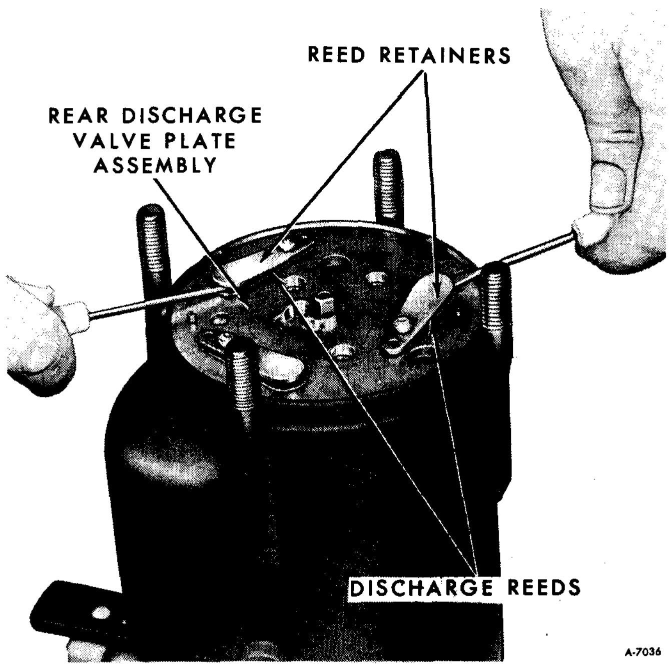


Figure 95—Removing Rear Discharge Valve Plate

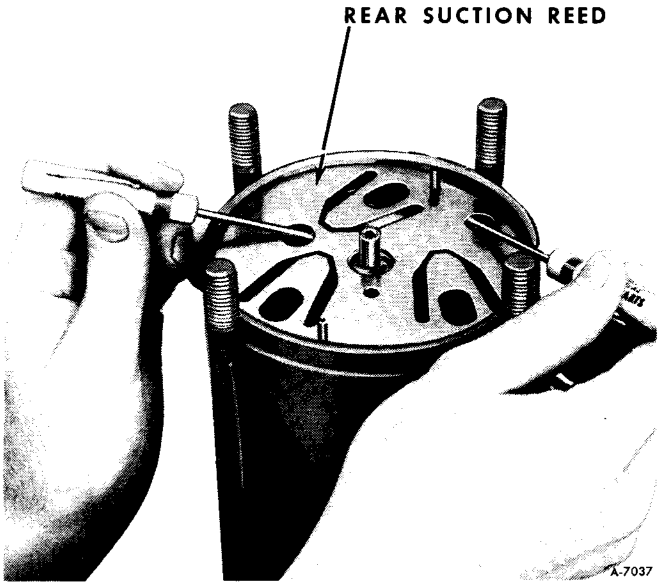


Figure 96—Removing Rear Suction Reed

REMOVAL

1. Before proceeding with disassembly, wipe exterior surface of compressor clean.

2. All oil in compressor should be drained and measured. Assist draining by positioning compressor with oil drain plug down. Record the amount of oil drained from the compressor.

3. Invert compressor and holding fixture J-9396 with front end of compressor shaft facing downward (figure 93).

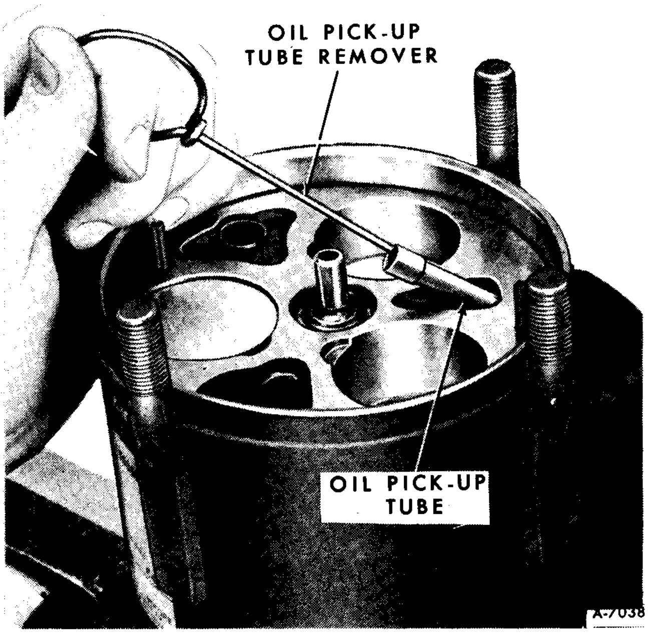


Figure 97—Removing Oil Pick-Up Tube

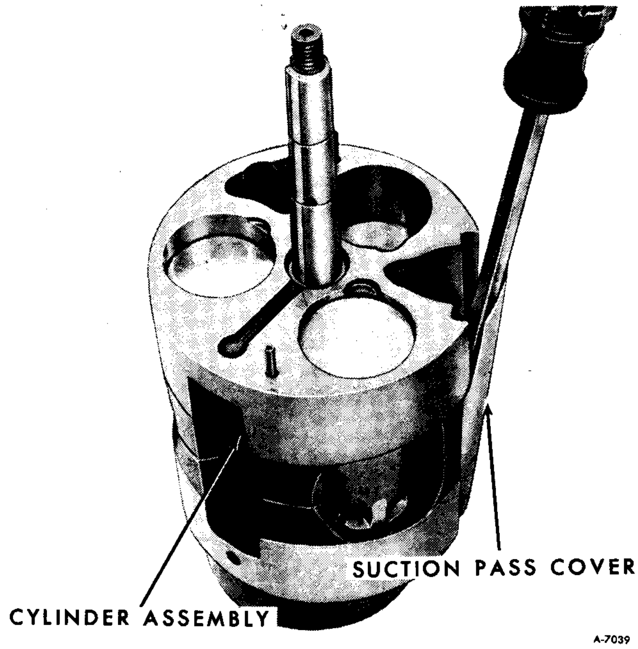


Figure 98—Removing Suction Crossover Cover

Additional oil may leak from compressor at this time. All oil must be drained into a container so that TOTAL amount can be measured. A liquid measuring cup may be used for this purpose. Drained oil should then be discarded.

4. Remove four lock nuts from threaded studs on compressor shell and remove rear head. Tap uniformly around rear head if head is binding (figure 93).

5. Wipe excess oil from all sealing surfaces on rear head casting webs, and examine sealing surfaces (figure 94). If any damage is observed, the head should be replaced.

6. Remove suction screen and examine for any damage or contamination. Clean or replace if necessary.

7. Paint an identifying mark on exposed face of inner and outer oil pump gears and

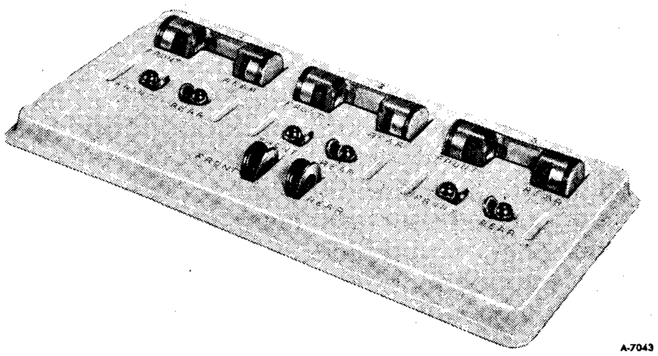


Figure 99—Parts Tray

then remove gears. Identifying marks are to assure that gears, if reused, will be installed in identical position.

8. Remove and discard rear head-to-shell O-ring.

9. Carefully remove rear discharge valve plate assembly. Use two small screwdrivers under reed retainers to pry up on assembly (figure 95). Do not position screwdrivers between reeds and reed seats.

10. Examine valve reeds and seats. Replace entire assembly if any reeds or seats are damaged.

11. Using two small screwdrivers, carefully remove rear suction reed (figure 96). Do not pry up on horseshoe-shaped reed valves.

12. Examine reeds for damage, and replace if necessary.

13. Using oil pick-up tube remover J-5139 (figure 97), remove oil pick-up tube. Remove O-ring from oil inlet.

14. Loosen compressor from holding fixture J-9396, place internal assembly support block J-21352 over oil pump end of shaft and, holding support block in position with one hand, lift compressor from holding fixture with other hand. Invert compressor and position on bench with internal assembly support block resting on bench.

15. Lift front head and compressor shell assembly up, leaving internal mechanism resting on internal assembly support block.

> **CAUTION:** *To prevent damage to shaft, do not tap on end of compressor shaft to remove internal mechanism. If mechanism will not slide out of compressor shell, tap on front head with plastic hammer.*

16. Rest compressor shell on its side and push front head assembly through compressor shell, being careful not to damage sealing areas on inner side of front head. Discard O-ring.

It may be necessary to tap on outside of front head, using a plastic hammer, to overcome friction of O-ring seal between front head and compressor shell.

17. Wipe excess oil from sealing surfaces on front head casting webs and examine sealing surface. If any surface damage is observed, the head should be replaced.

18. Remove front discharge valve plate assembly and front suction reed plate. Examine reeds and seats. Replace necessary parts.

19. Remove suction crossover cover by prying with screwdriver between cylinder casting and cover (figure 98).

20. Examine internal mechanism for any obvious damage. If internal mechanism has sustained major damage, due to loss of refrigerant or oil, it may be necessary to use a new cylinder and shaft assembly rather than replace individual parts.

DISASSEMBLY

Use parts tray J-9402 (figure 99) to retain compressor parts during disassembly.

1. Remove internal mechanism from compressor as described in "Compressor Internal Mechanism" removal procedure.

2. Identify by pencil mark, or some other suitable means, each piston, numbering them as 1, 2, and 3 (figure 100).

Number the piston bores in the front cylinder half in like manner, so that pistons can be replaced in their original locations.

3. Separate cylinder halves, using a wood block and mallet (figure 101). Make certain that discharge crossover tube does not contact axial plate when separating cylinder halves (a new service discharge crossover tube will be installed later).

> **CAUTION:** *Under no circumstances should shaft be struck at either end in an effort to separate upper and lower cylinder halves because the shaft and the axial plate could be damaged.*

4. Carefully remove the rear half of the cylinder from the pistons and set the front cylinder half, with the piston, shaft and axial plate, in compressing fixture J-9397.

5. Pull up on compressor shaft and remove piston previously identified as No. 1, with balls and shoe discs, from axial plate.

a. Inspect the Teflon piston rings for nicks, cuts or metal particles imbedded in exposed ring surface and replace the piston rings as required if either condition exists. See "Teflon Piston Ring" replacement procedure later in this section.

6. Remove and discard the piston shoe discs.

7. Remove and examine piston balls, and if satisfactory for reuse, place balls in No. 1 compartment of parts tray J-9402 (figure 99).

8. Place piston in No. 1 compartment of parts tray J-9402, with notch in casting web at front end of piston (figure 102) into the dimpled groove of parts tray compartment.

9. Repeat Steps 5 through 9 for pistons No. 2 and No. 3.

10. Remove rear combination of thrust races

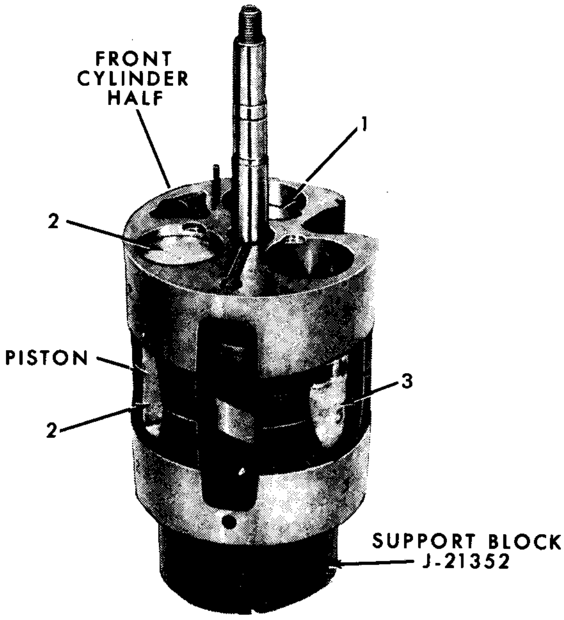


Figure 100—Numbering Piston and Cylinder Bores

and thrust bearing from shaft. Discard races and bearing.

11. Remove shaft assembly from front cylinder half. If the discharge crossover tube remained in the front cylinder half, it may be necessary to bend discharge cross-over tube slightly in order to remove shaft.

12. Remove front combination of thrust races and bearing from shaft. Discard races and bearing (figure 103).

13. Examine surface of axial plate and shaft. Replace as an assembly, if necessary.

A certain amount of shoe disc wear on axial plate is normal, as well as some markings indicating load of needle bearings on shaft.

14. Remove discharge crossover tube from cylinder half, using self-clamping pliers.

This is necessary only on original factory equipment, as ends of the tube are swedged into cylinder halves. The discharge crossover tube in internal mechanism assemblies that have been previously serviced have an O-ring

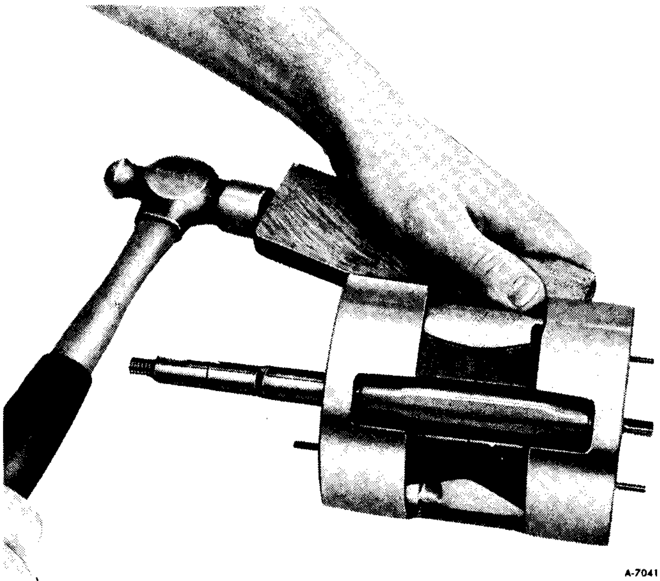


Figure 101—Separating Cylinder Halves

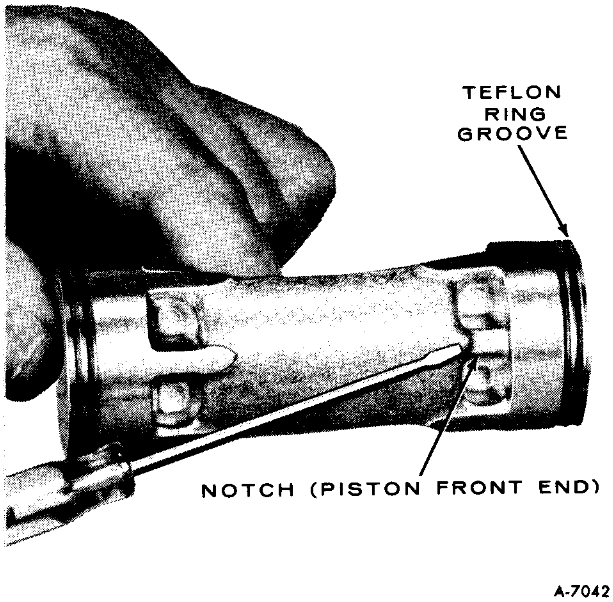


Figure 102—Notch Identifying Front End Of Piston

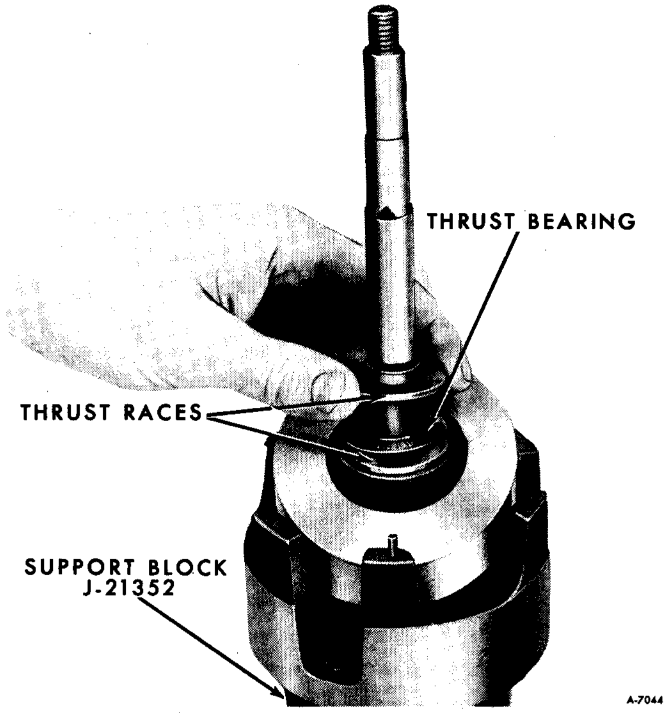


Figure 103—Removng Front Thrust Races And Bearings

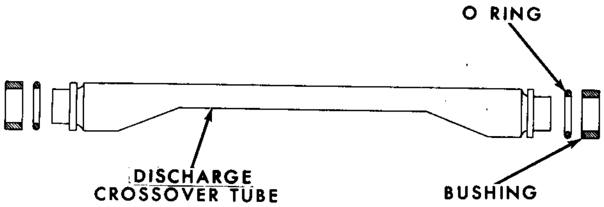


Figure 104—Service-Type Discharge Crossover Tube

and bushing at EACH END of the tube, and can be easily removed by hand (see figure 104).

15. Examine piston bores and needle bearings in front and rear cylinder halves. Replace front and rear cylinders if any cylinder bore is deeply scored or damaged.

16. Needle bearings may be removed if necessary by driving them out with special Thin-Wall Socket J-9399. Insert socket in hub end (inner side) of cylinder head and drive bearing out. To install needle bearing, place cylinder half on Support Block J-21352, and insert bearing in end of cylinder head with bearing identification marks UP. Use Needle Bearing Installer J-9432 and drive bearing into cylinder head (figure 105) until tool bottoms on the cylinder face.

Two different width needle bearings are used in production compressors - a 1/2" size and a 5/8" size. The bearings ARE interchangeable.

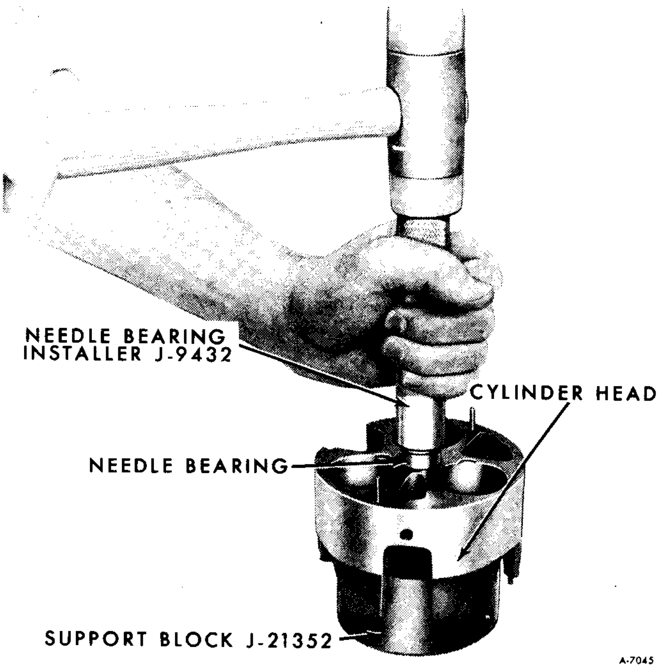


Figure 105—Installing Needle Bearing

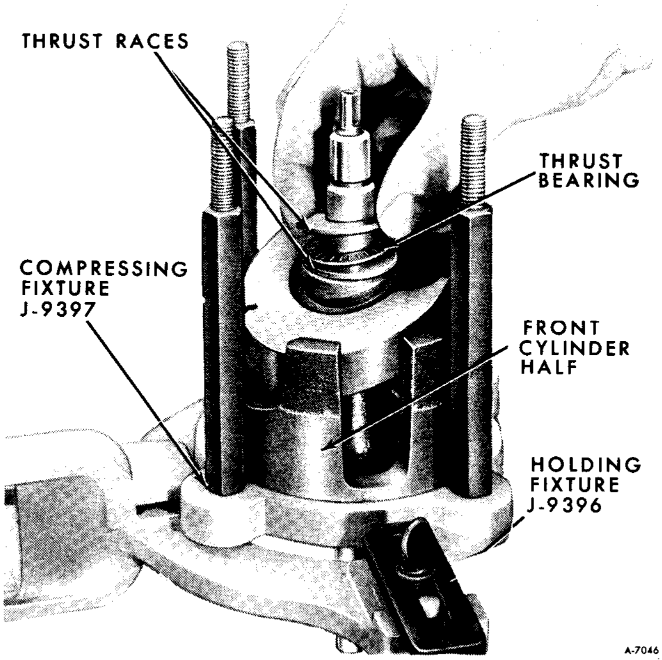


Figure 106—Installing Rear Thrust Races And Bearings

17. Wash all parts to be re-used with trichlorethylene, naptha, stoddard solvent, kerosene, or a similar solvent. Air-dry parts using a source of clean, dry air.

Compressor internal components may be identified by referring to figures 67 and 68.

GAUGING OPERATION

1. Install Compressing Fixture J-9397 on Holding Fixture J-9396 in vise. Place front cylinder half in Compressing Fixture, flat side

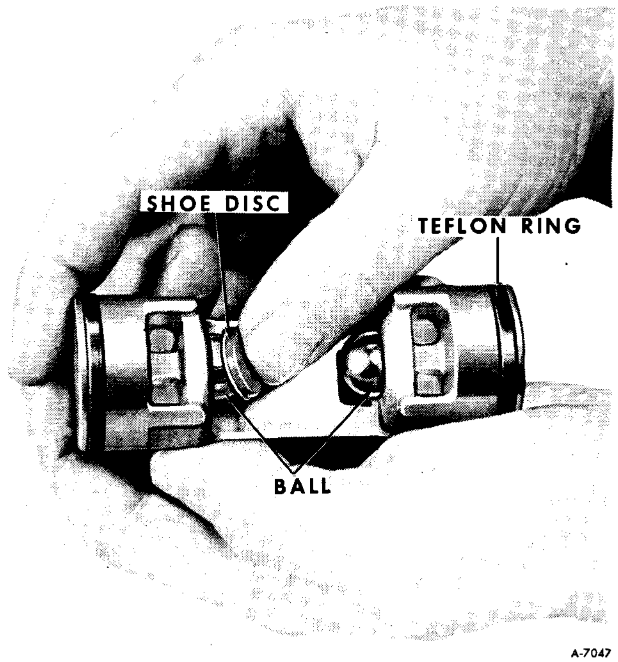


Figure 107—Installing Front Shoe Disc

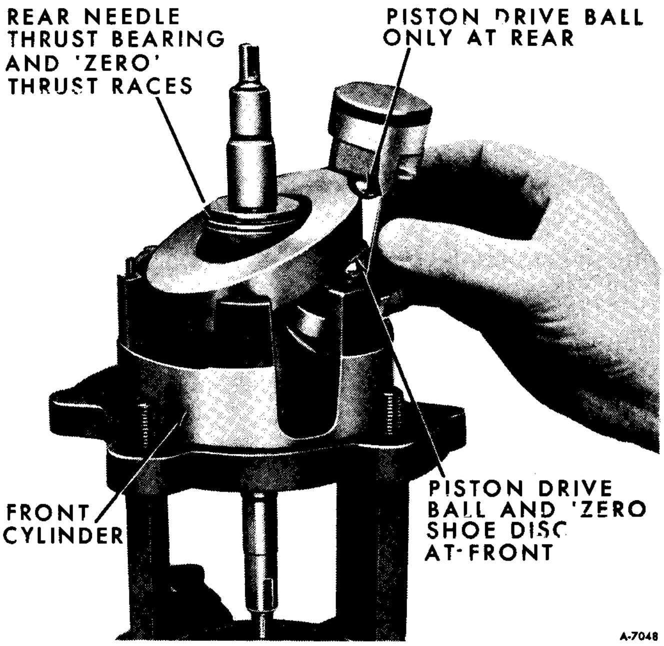


Figure 108—Installing Piston During Gauging Operation

down. Front cylinder half has long slot extending out from shaft hole.

2. Secure from service parts stock four zero thrust races and three zero shoe discs.

Install a zero thrust race, thrust bearing, and a second zero thrust race on front end of compressor shaft. Lubricate races and bearing with petrolatum.

4. Insert threaded end of shaft through needle bearing in front cylinder half, and allow thrust race and bearing assembly to rest on hub of cylinder.

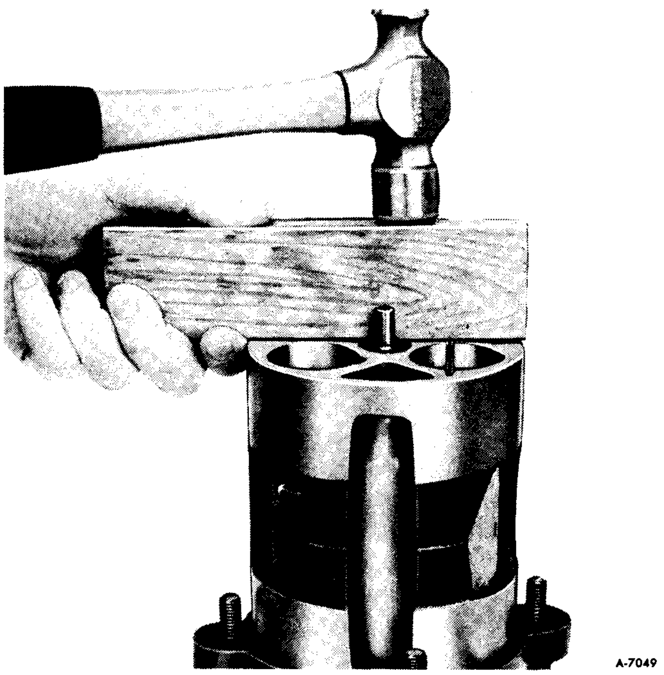


Figure 109—Assembling Cylinder Halves

5. Now install a zero thrust race on rear end of compressor shaft (figure 106), so that it rests on hub of axial plate. Then install thrust bearing and a second zero thrust race. Lubricate races and bearing with petrolatum.

6. Lubricate ball pockets of the No. 1 piston with 525 viscosity refrigerant oil and place a ball in each socket. Use balls previously removed if they are to be re-used.

7. Lubricate cavity of zero shoe disc with 525 viscosity refrigerant oil and place shoe disc over ball in front end of piston (figure 107).

Front end of piston has an identifying notch in casting web (figure 102).

> **CAUTION:** *Exercise care in handling the piston and ring assembly, particularly during assembly into and removal from the cylinder bores to prevent damage to the Teflon piston rings.*

Shoe discs should not be installed on rear of piston during following "Gauging" operation.

8. Rotate shaft and axial plate until high point of axial plate is over the No. 1 piston cylinder bore.

9. Lift shaft assembly up and hold front thrust race and bearing assembly against axial plate hub.

10. Position piston over No. 1 cylinder bore (notched end of piston on bottom and piston straddling axial plate) and lower the shaft to allow piston to drop into its bore (figure 108).

11. Repeat Steps 6 through 10 for pistons No. 2 and No. 3

12. Install rear cylinder half on pistons, aligning cylinder with discharge crossover tube hole in front cylinder.

Tap into place using a plastic mallet or piece of clean wood and hammer (figure 109).

13. Position discharge crossover tube opening between a pair of compressing fixture bolts to permit access for feeler gauge.

14. Install top plate on compressing fixture J-9397. Tighten nuts to 15 ft. lbs. torque using a 1-25 ft. lb. torque wrench.

GAUGING PROCEDURE
(STEPS 15 THRU 18)

The gauging operations which follow have been worked out on a simple basis to establish and provide necessary running tolerances. Two gaging procedures are necessary.

The first is made to choose the proper size shoe discs to provide, at each piston, a .0016"

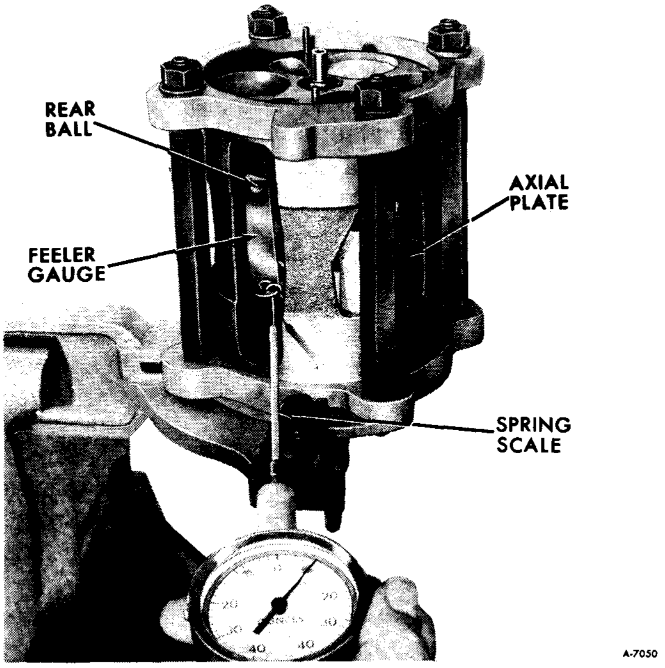


Figure 110—Gauging Rear Piston Ball

SHOE DISC			THRUST BEARING RACE		
Part No. Ending In	Identi-fication Stamp	Min. Feeler Gage Reading	Part No. Ending In	Identi-fication Stamp	Dial Indi-cator Reading
000	0	.0000	000	0	.0000
175	17-1/2	.0175	050	5	.0050
180	18	.0180	055	5-1/2	.0055
185	18-1/2	.0185	060	6	.0060
190	19	.0190	065	6-1/2	.0065
195	19-1/2	.0195	070	7	.0070
200	20	.0200	075	7-1/2	.0075
205	20-1/2	.0205	080	8	.0080
210	21	.0210	085	8-1/2	.0085
215	21-1/2	.0215	090	9	.0090
220	22	.0220	095	9-1/2	.0095
			100	10	.0100
			105	10-1/2	.0105
			110	11	.0110
			115	11-1/2	.0115
		A-7032	120	12	.0120

Figure 112—Available Service Shoes And Thrust Washers

to .0024" total preload between the seats and the axial plate at the tightest place through the 360-degree rotation of the axial plate at the tightest place. The bronze shoe discs are provided in .0005" variations, including a basic ZERO shoe.

The second, performed at the rear shaft thrust bearing and race pack, is designed to obtain .0025" to .0030" preload between the hub surfaces of the axial plate and the front and rear hubs of the cylinder. A total of 15 steel thrust races, including a basic ZERO race, are provided in increments of .0005" thickness to provide the required fit.

Feeler Gauge Set J-9564 or J-9661-01 may be used for gaging proper shoe disc size. Feeler Gauge Set J-9564-01 or Dial Indicator Set J-8001 may be used to determine proper thrust race size.

PROPER SELECTION OF THRUST RACES AND BALL SEATS IS OF EXTREME IMPORTANCE.

	POSITION 1	POSITION 2	POSITION 3	SELECT AND USE SHOE NO.
PISTON NO. 1	.019"	.0195"	.019"	19
PISTON NO. 2	.020"	.020"	.020"	20
PISTON NO. 3	.021"	.021"	.022"	21

A-7033

Figure 111—Selection of Proper Shoe Disc

15. Measure clearance between rear ball of No. 1 piston and axial plate, in following manner:

a. Select a suitable combination of well-oiled feeler gauge leaves to fit snugly between ball and axial plate.

b. Attach a spring scale, reading in 1-ounce increments, to the feeler gauge. A distributor point checking scale or Spring Scale J-544 may be used.

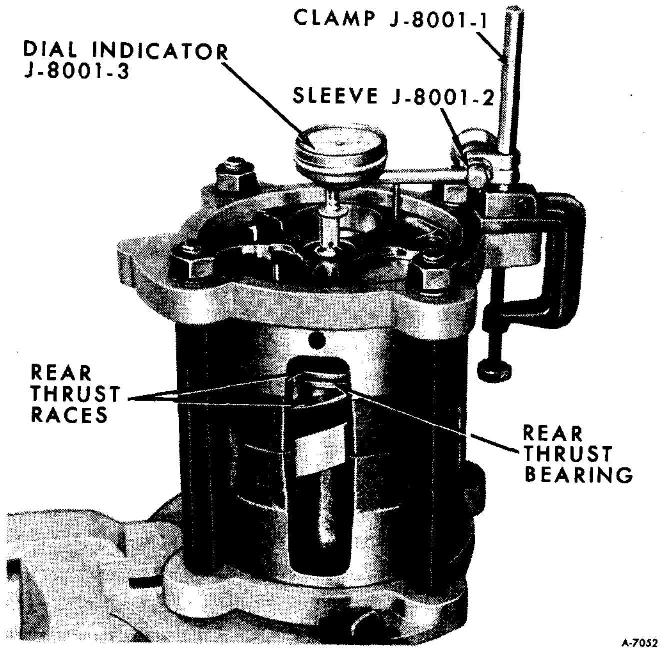


Figure 113—Gauging Rear Thrust Race

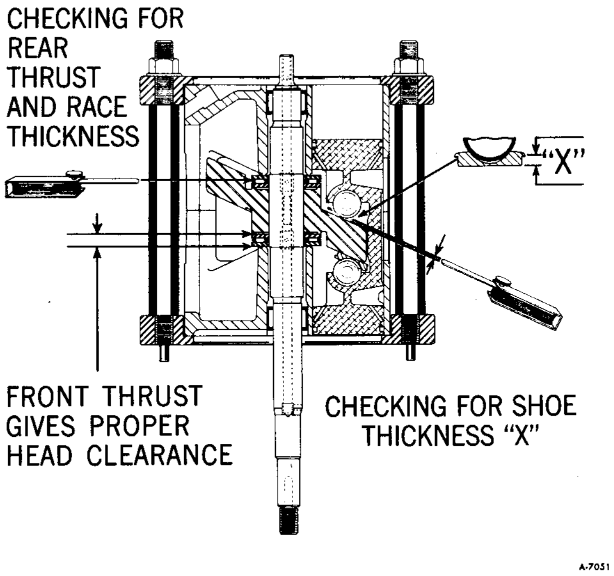


Figure 114—Checking Piston and Shaft End Play

c. Pull on spring scale to slide feeler gauge stock out from between ball and axial plate, and note reading on spring scale as feeler gauge is removed (figure 110). Reading should be between 4 and 8 ounces.

d. If reading in Step c. above is under 4 or over 8 ounces, reduce or increase thickness of feeler gauge leaves and repeat Steps 1 through c. above until a reading of 4 to 8 ounces is obtained. Record clearance between ball and axial plate that results in the 4 to 8-ounce pull on spring scale.

16. Now rotate shaft 120° and repeat step 15 between same ball and axial plate. Record this measurement. If shaft is hard to rotate, install shaft nut onto shaft and turn shaft with wrench.

17. Rotate shaft another 120° and again repeat Step 15 between these same parts and record measurements.

18. Select a "numbered" shoe disc corresponding to minimum feeler gauge reading recorded in the three checks above. (See example in figure 111). Place shoe discs in Parts Tray J-9402 compartment corresponding to piston No. 1 and rear ball pocket position.

Shoe discs are provided in .0005" (one-half thousandths) variations. There are a total of 11 sizes available for field servicing. All shoe discs are marked with the shoe size, which corresponds to the last three digits of the piece part number. (See Shoe Disc size chart in figure 112 above).

Once a proper selection of the shoe has been made, THE MATCHED COMBINATION OF SHOE DISC TO REAR BALL AND SPHERICAL CAVITY IN PISTON MUST BE KEPT IN PROPER RELATIONSHIP during disassembly after gauging operation, and during final assembly of internal mechanism.

19. Repeat in detail the same gauging procedure outlined in Steps 15 through 18 for piston no. 2 and no. 3.

20. Mount dial indicator J-8001-3 on edge of compressing fixture J-9397 with clamp J-8001-1 and sleeve J-8001-2 (figure 113). Position dial indicator on rear end of shaft and adjust to "zero".

Apply full hand force at end of mainshaft a few times before reading clearance. This will help squeeze the oil out from between mating parts. Push upward and record measurement. Dial indicator increments are .001"; therefore, reading must be estimated to nearest .0005".

An alternate method of selecting a proper race is to use gauge set J-9661-01 selecting a suitable feeler gauge leaf until the result is a 4 to 8 ounce pull on the scale between the rear thrust bearing and upper (or outer rear) thrust race (figure 114). If the pull is just less than 4 ounces, add .0005" to the thickness of the feeler stock used to measure the clearance. If the pull on the scale reads just over 8 ounces, then subtract .0005" from the thickness of the feeler stock. Select a race two (2) full sizes larger than feeler gauge thickness.

(If feeler gauge is .007", select a No. 9 or 090 race.)

21. Select a thrust race with a "number" corresponding to TWO (2) full sizes larger than dial indicator or feeler gauge measurement of the amount of end play shown. (If measurement is .007", select a No. 9 or 090 race.) Place thrust race in right-hand slot at bottom center of parts tray J-9402.

Fifteen (15) thrust races are provided in increments of .0005" (one-half thousandths) thickness and one zero gauge thickness, providing a total of 16 sizes available for field service.

The thrust race "number" also corresonds to the last three digits of the piece part number. See "Thrust Race Size Chart" in figure 112.

22. Remove nuts from top plate of compressing fixture J-9397, and remove top plate.

23. Separate cylinder halves while unit is in fixture. It may be necessary to use wood block and mallet.

24. Remove rear cylinder half and carefully remove one piston at a time from axial plate and front cylinder half. Do not lose the relationship of the front ball and shoe disc and rear ball. Transfer each piston, ball and shoe disc to its proper place in Parts Tray J-9402.

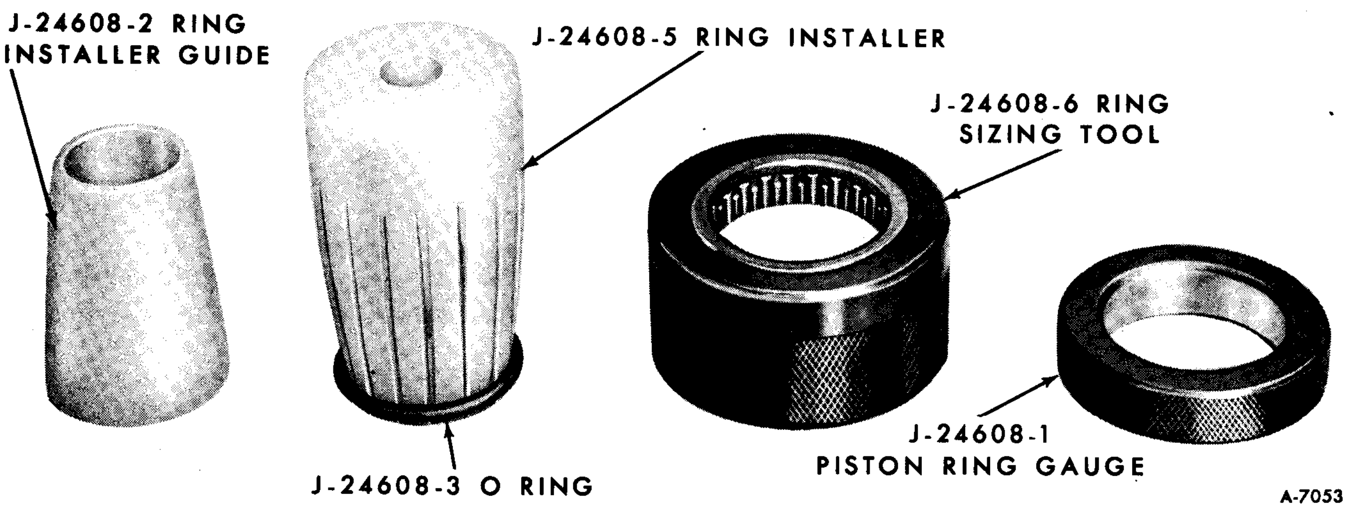


Figure 115—Teflon Piston Ring Installing, Sizing and Gauging Tools

25. Remove rear outer zero thrust race from shaft and install thrust race just selected.

The zero thrust race may be put aside for reuse in additional gauging or rebuilding operations.

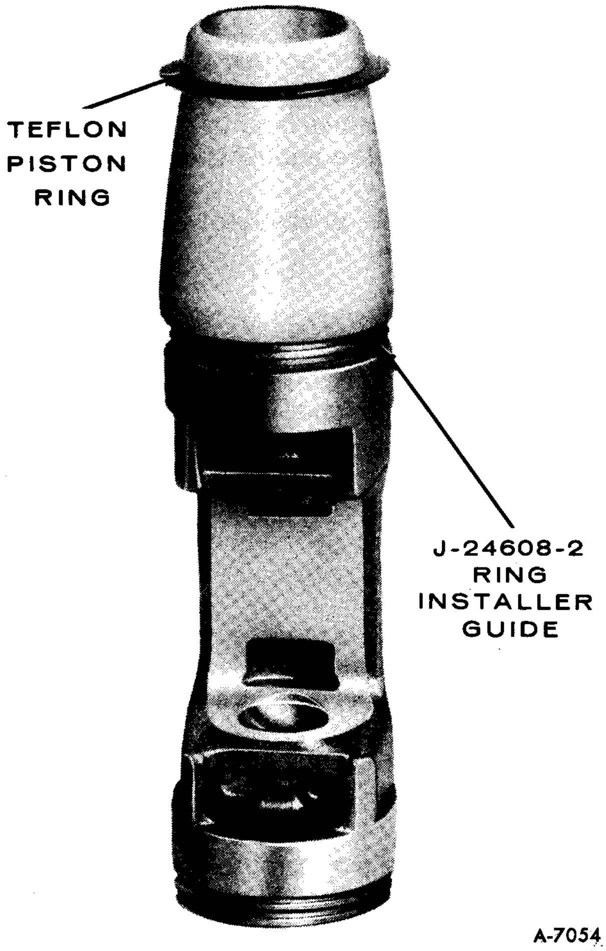


Figure 116—Teflon Piston Ring Positioned On Ring Installer Guide

TEFLON PISTON RING REPLACEMENT

The Teflon piston ring installing, sizing and gauging tools are shown in figure 115.

1. Remove the old piston rings by carefully slicing through the ring with a knife or sharp instrument, holding the blade almost flat with the piston surface. Be careful not to damage the aluminum piston or piston groove in cutting to remove the ring.

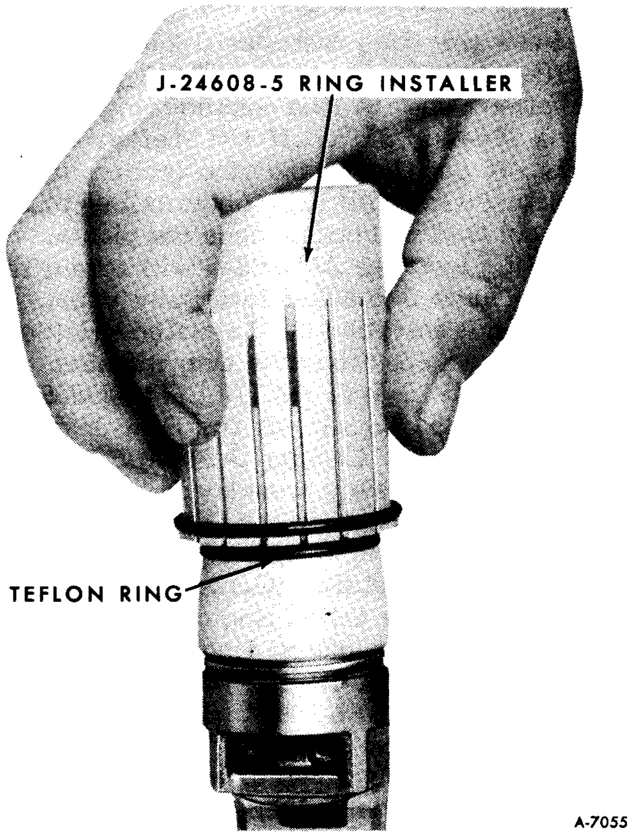


Figure 117—Installing Teflon Piston Ring

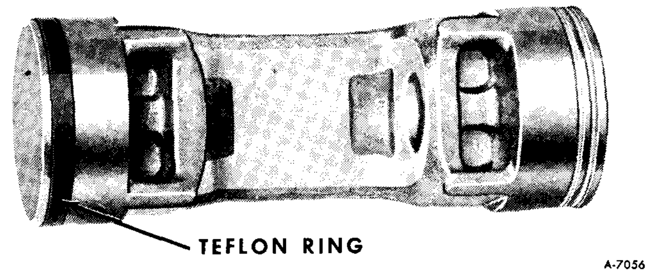


Figure 118—Teflon Piston Ring Installed On Piston Groove

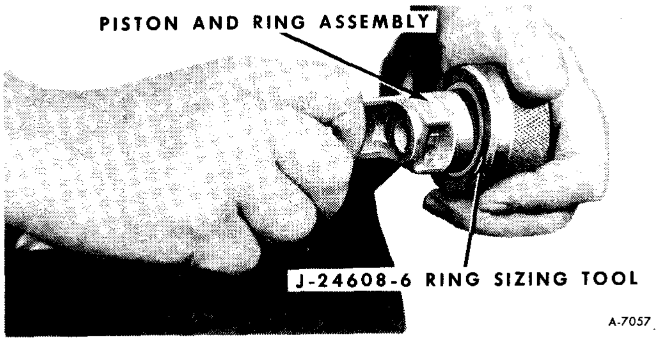


Figure 119—Turning Piston and Ring Assembly into Sizing Tool

WARNING: EXERCISE PERSONAL CARE IN CUTTING THE PISTON RING FOR REMOVAL.

2. Clean the piston and piston ring grooves with a recommended cleaning solvent and blow the piston dry with dry air (Trichlorethylene, naphtha, stoddard solvent, kerosene, or equivalent).
3. Set the piston on end on a clean, flat surface and install the Ring Installer Guide J-24608-2 on the end of the piston (figure 116).
4. Install a teflon ring on the Ring Installer Guide J-24605-2 as shown in figure 116, with the dished or dull-side down and glossy side up.
5. Push the Ring Installer J-24608-5 down over the Installer Guide J-24608-2 to install the Teflon ring in the piston ring groove (figures 117 and 118). If the Teflon ring is slightly off position in the ring groove, it can be positioned into place by fingernail or blunt-edged tool that will not damage the piston.

The Ring Installer J-24608-5 will retain the Installer Guide J-24608-2 internally when the Teflon ring is installed on the piston. Remove the installer guide from the ring installer and DO NOT STORE THE INSTALLER GUIDE IN THE RING INSTALLER, as the Ring Installer Segment Retainer O-Ring J-24608-3 will be stretched and possibly weakened during storage. This could result in the O-ring J-24608-3 not holding the ring installer segments tight enough to the Installer Guide J-24608-2 to properly install the teflon ring on the piston.

6. Lubricate the piston ring area with 525 viscosity refrigerant oil and rotate the piston and ring assembly into the Ring Sizer J-24608-6 at a slight angle (figure 119). Rotate the piston, while pushing inward, until the piston is inserted against the center stop of the Ring Sizer J-23608-6.
7. Rotate the piston and ring assembly in the ring sizer J-24608-6 several complete turns, until the assembly rotates relatively free in the ring sizer (figure 119).
8. Remove the piston and ring asembly, wipe the end of the piston and ring area with a clean cloth and then push the piston and ring assembly into the ring gauge J-24608-1 (figure 120). The piston should go through the ring gauge with a 6 lb. force or less without lubrication. If not, repeat Steps 6 and 7.

CAUTION: *Do not push the piston and ring assembly into the ring sizer J-24608-6 without proper positioning and rotating as described above, as the ends of the needle bearings of the ring sizer may damage the end of the piston.*

9. Repeat the procedure for the opposite end of the piston.

CAUTION: *Do not lay the piston down on a dirty surface where dirt or metal chips might become imbedded in the Teflon ring surface.*

10. Lubricate both ends of the piston with 525 viscosity refrigerant oil before inserting the piston into the cylinder bore.

CAUTION: *Reasonable care should be exercised in installing the piston into the cylinder bore to prevent damage to the teflon ring.*

ASSEMBLY

After properly performing the "Gauging Procedure", choosing the correct shoe discs and thrust races, and installing any needed teflon piston rings, the cylinder assembly may now be reassembled. Be sure to install all NEW seals and O-rings. All are included in the compressor O-Ring Service Kit.

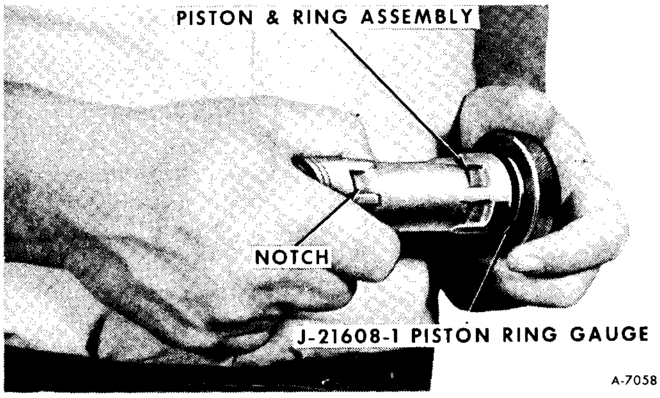


Figure 120—Gauging Piston Ring Size

Assembly procedure is as follows:

1. Support the FRONT half of the cylinder assembly on Compressing Fixture J-9397 Install the shaft and axial plate, threaded end down, with its front bearing race pack (zero race, bearing numbered race), if this was not already done at the end of the "Gauging Procedure".

2. Apply a light smear of petroleum jelly to the "numbered" shoe discs chosen in the gauging procedure and install all balls and shoe discs in their proper place in the piston assembly.

3. Rotate the axial plate so that the high point is above cylinder bore No. 1. Carefully assemble Piston No.1, complete with ball and zero shoe disc on the front and ball and numbered shoe disc on the rear, over the axial plate. Hold front thrust bearing pack tightly against axial plate hub while lifting hub. Insert the piston assembly into the front cylinder half (figure 121).

4. Repeat this operation for pistons No. 2 and No. 3 (figure 122).

5. Without installing any O-rings or bushings, assemble one end of the new service discharge crossover tube into the hole in the front cylinder half (figures 104 and 123).

Be sure the flattened portion of this tube

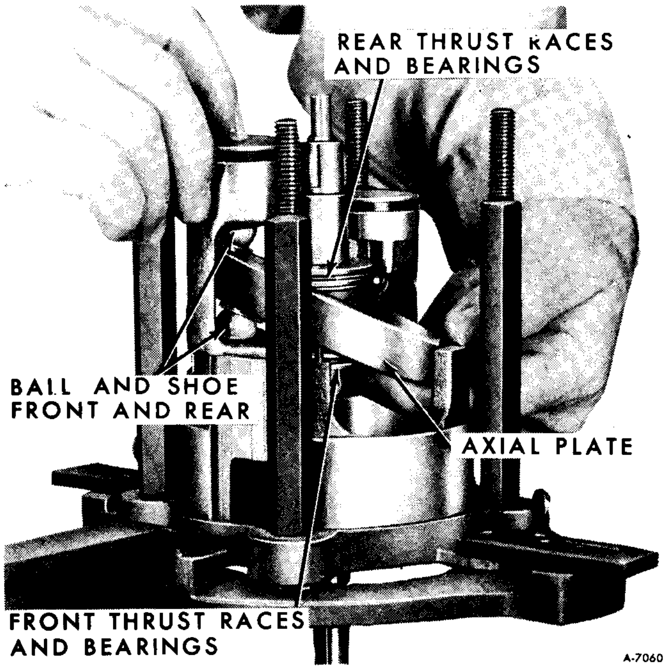


Figure 122—Installing 2nd Piston

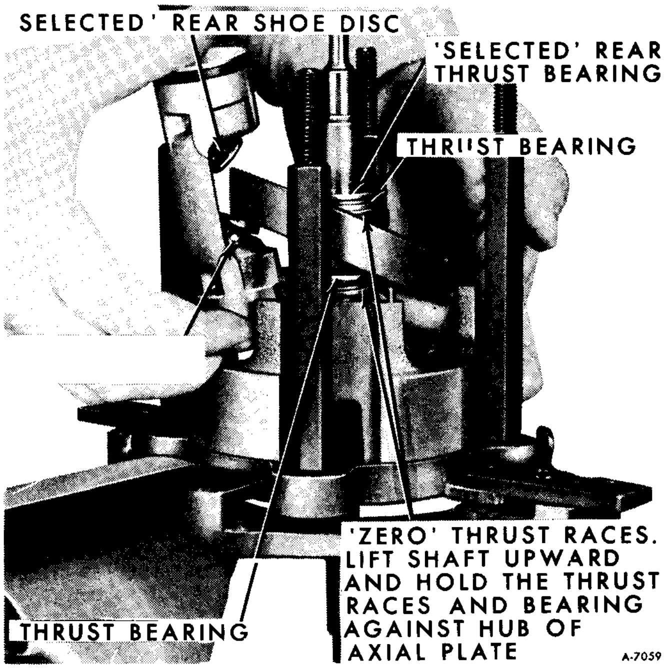


Figure 121—Installing 1st Piston Assembly Into Front Cylinder Half

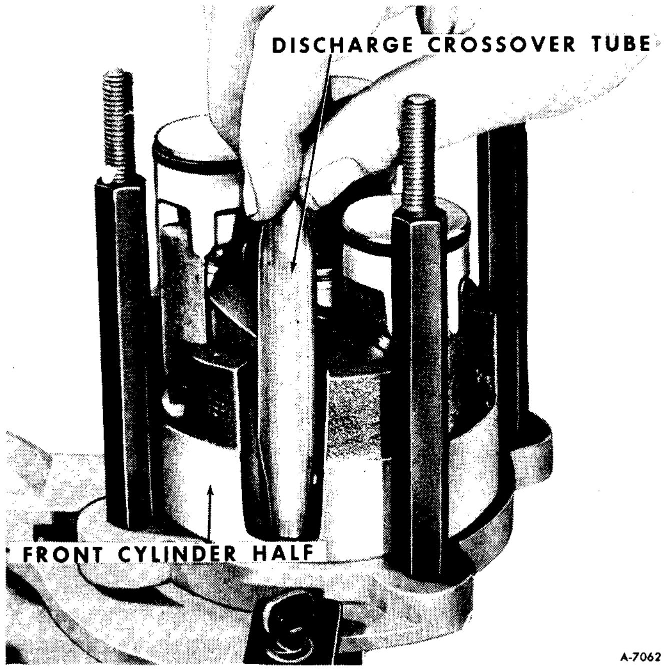


Figure 123—Installing Discharge Crossover Tube

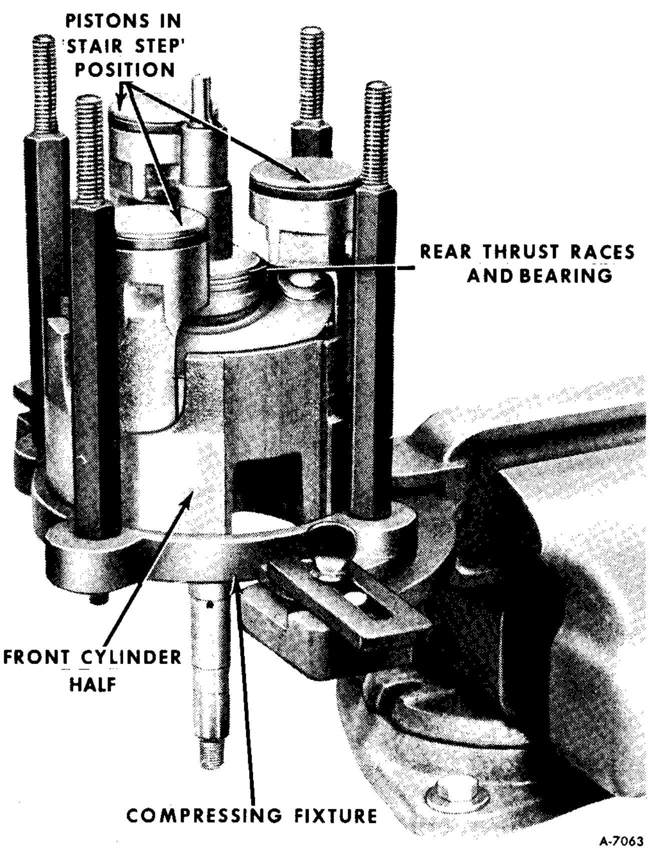


Figure 124—Pistons Positioned in Stair-Step Arrangement

faces the inside of the compressor to allow for axial plate clearance (figure 123).

6. Now rotate the shaft to position the pistons in a stair step arrangement; then carefully place the rear cylinder half over the shaft and start the pistons into the cylinder (figure 124).

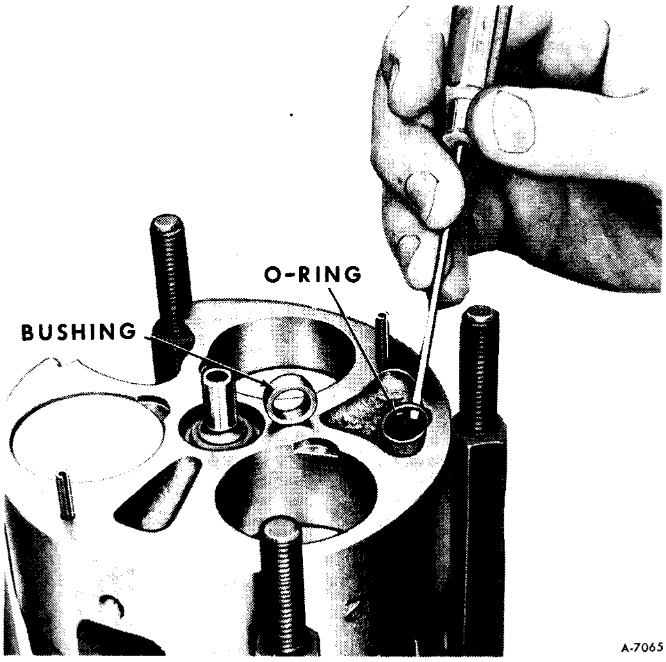


Figure 126—Installing O-Ring on Discharge Crossover Tube

7. When all three piston and ring assemblies are in their respective cylinders, align the end of the discharge crossover tube with the hole in the rear half of the cylinder.

8. When all parts are in proper alignment, tap with a clean wood block and mallet to seat the rear half of the cylinder over the locating dowel pins. If necessary, clamp the cylinder in compressing fixture J-9397, to complete drawing the cylinder halves together.

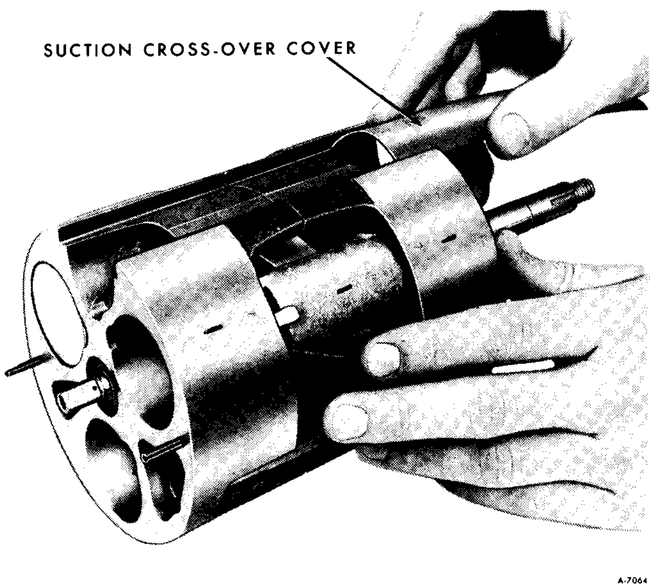


Figure 125—Installing Suction Crossover Cover

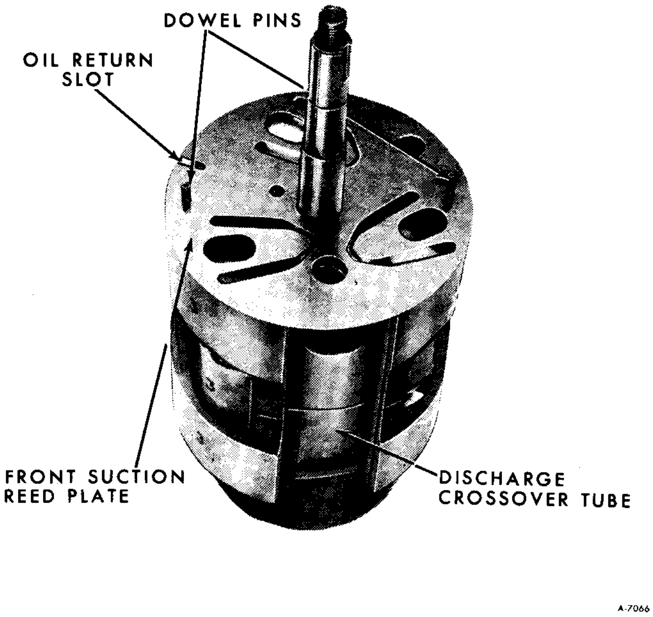


Figure 127—Installing Front Suction Reeds

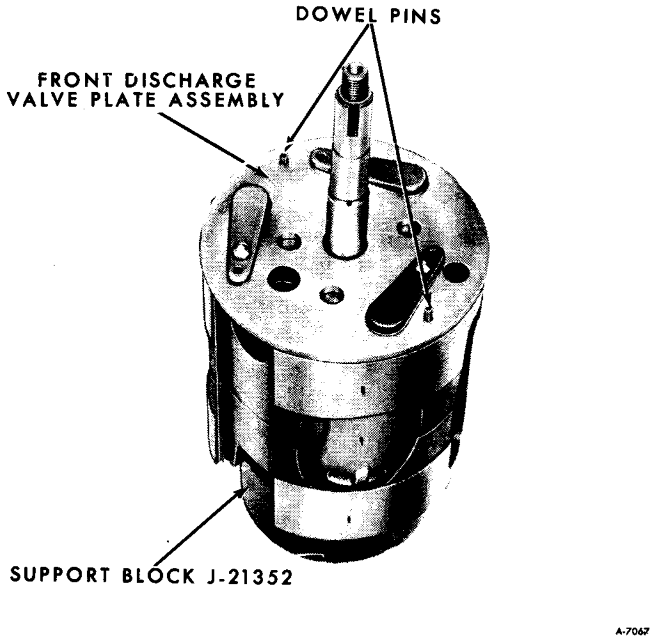


Figure 128—Installing Front Discharge Valve Plate

9. Generously lubricate all moving parts with clean 525 viscosity refrigerant oil and check for free rotation of the parts.

10. Replace the suction crossover cover (figure 125). Compress the cover as shown to start it into the slot, and then press or carefully tap it in until flush on both ends.

INSTALLATION

1. Place internal mechanism on internal

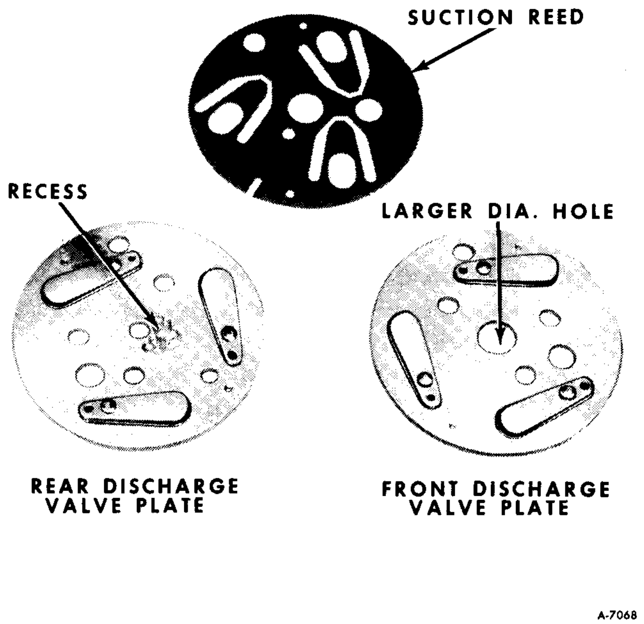


Figure 129—Front and Rear Discharge Valve Plate

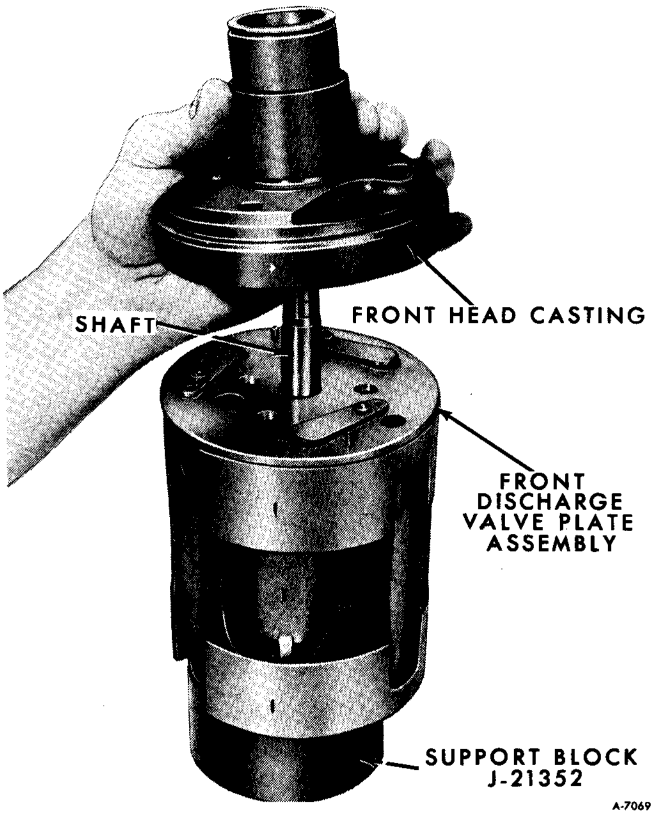


Figure 130—Installing Front Head Casting

assembly support block J-21352, with rear end of shaft in block hole.

2. Now install new O-ring bushing in front end of the discharge crossover tube (figure 126). The O-ring and bushing for internal mechanism are service parts only that have been disassembled in the field (refer to figure 104).

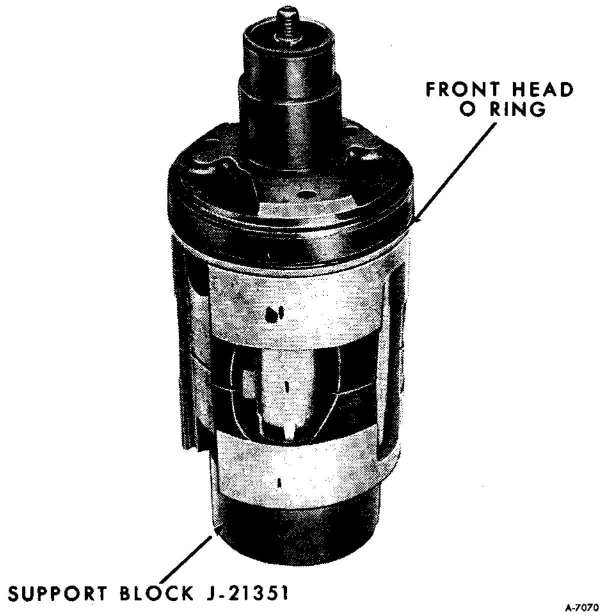


Figure 131—Front Head O-Ring Installed

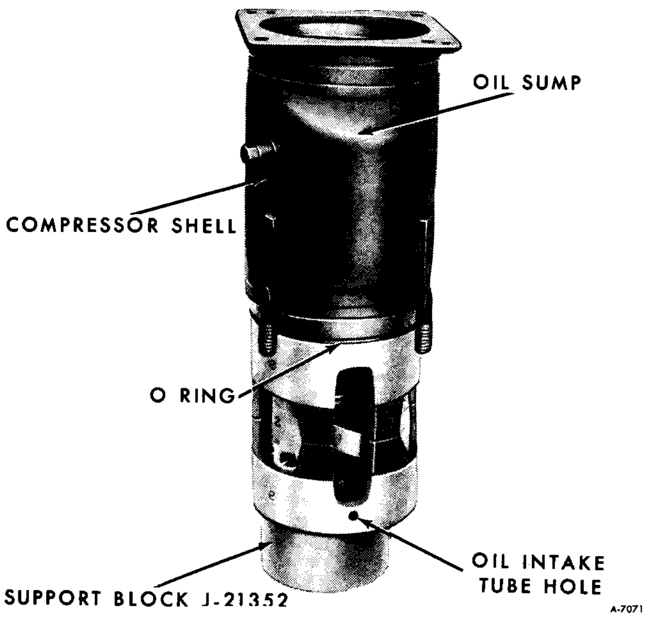


Figure 132—Installing Compressor Shell

3. Install new dowel pins in front cylinder half, if previously removed.

4. Install front suction reed plate on front cylinder half. Align with dowel pins, suction ports, oil return slot, and discharge crossover tube (figure 127).

5. Install front discharge valve plate assembly, aligning holes with dowel pins and proper openings in front suction reed plate (figure 128).

Figure 133—Installing Oil Pick-Up Tube

Front discharge plate has a large diameter hole in the center (figure 129).

6. Coat sealing surfaces on webs of compressor front head casting with 525 viscosity refrigerant oil.

7. Determine exact position of front head casting in relation to dowel pins on internal mechanism. Mark position of dowel pins on sides of front head assembly and on sides of internal mechanism with a grease pencil. Carefully lower front head casting into position (figure 130), making certain that sealing area around center bore of head assembly does not contact shaft as head assembly is lowered. Do not rotate head assembly to line up with dowel pins, as the sealing areas would contact reed retainers.

8. Generously lubricate new O-ring and angled groove at lower edge of front head casting with 525 viscosity refrigerant oil and install new O-ring into groove (figure 131).

9. Coat inside machined surfaces of compressor shell with 525 viscosity refrigerant oil and position shell on internal mechanism, resting on O-ring seal.

10. Using flat-side of a small screwdriver, gently position O-ring in a round circumference of internal mechanism until compressor shell slides down over internal mechanism. As shell slides down, line up oil sump with oil intake tube hole (figure 132).

11. Holding support block, invert assembly and place back into holding fixture with front end of shaft down. Remove support block.

12. Install new dowel pins in rear cylinder half, if previously removed.

13. Install new O-ring in oil pick-up tube cavity.

14. Lubricate oil pick-up tube with 525 viscosity refrigerant oil and install into cavity, rotating compressor mechanism to align tube with hole in shell baffle (figure 133).

15. Install new O-ring and bushing on rear end of discharge crossover tube (figure 104).

16. Install rear suction reed over dowel pins, with slot towards sump.

17. Install rear discharge valve plate assembly over dowel pins, with reed retainer up.

18. Position inner oil pump gear over shaft with previously applied identification mark up.

19. Position outer oil pump gear over inner gear with previously applied identification mark up and, when standing facing oil sump, position outer gear so that it meshes with inner gear at the 9 o'clock position, and resulting cavity between gear teeth is then a 3 o'clock position (figure 134).

20. Generously oil rear discharge valve plate assembly with 525 viscosity refrigerant oil

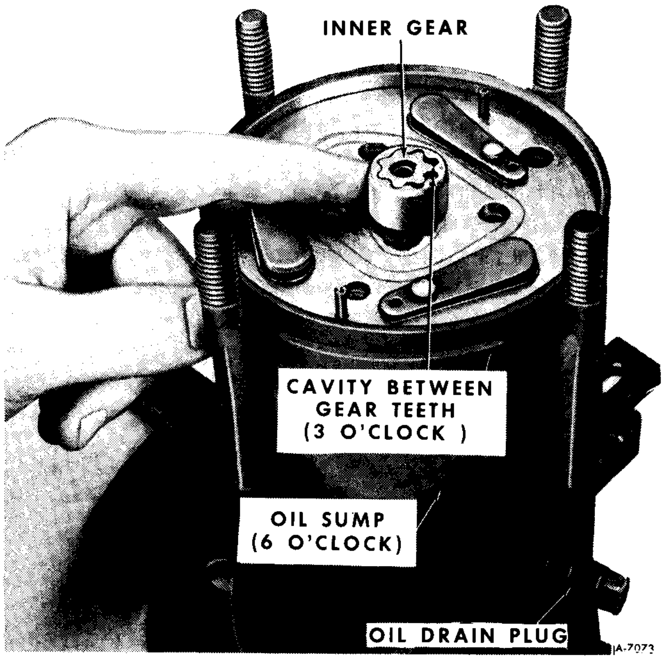


Figure 134—Positioning Oil Pump Gears

around outer edge where large diameter O-ring will be placed. Oil the valve reeds, pump gears, and area where sealing surface will contact rear discharge valve plate.

21. Using the 525 oil, lubricate new head-to-shell O-ring and install on rear discharge valve plate, in contact with shell (figure 135).

22. Install suction screen in rear head casting, using care not to damage screen.

23. Coat sealing surface on webs of compressor rear head casting, with 525 viscosity refrigerant oil.

24. Install rear head assembly over studs on compressor shell.

The two lower threaded compressor mounting holes should be in alignment with the compressor sump.

Make certain that suction screen does not drop out of place when lowering rear head into position (figure 136).

If rear head assembly will not slide down over dowels in internal mechanism, twist front head assembly back and forth very slightly by hand until rear head drops over dowel pins.

25. Install nuts on threaded shell studs and tighten evenly to 25 ft. lbs. torque using a 0-50 ft. lbs. torque wrench.

26. Invert compressor in holding fixture and install compressor shaft seal as described in "Compressor Shaft Seal" replacement procedure.

27. Install compressor clutch coil and housing assembly as described in "Compressor Clutch Coil and Housing Assembly" replacement procedure.

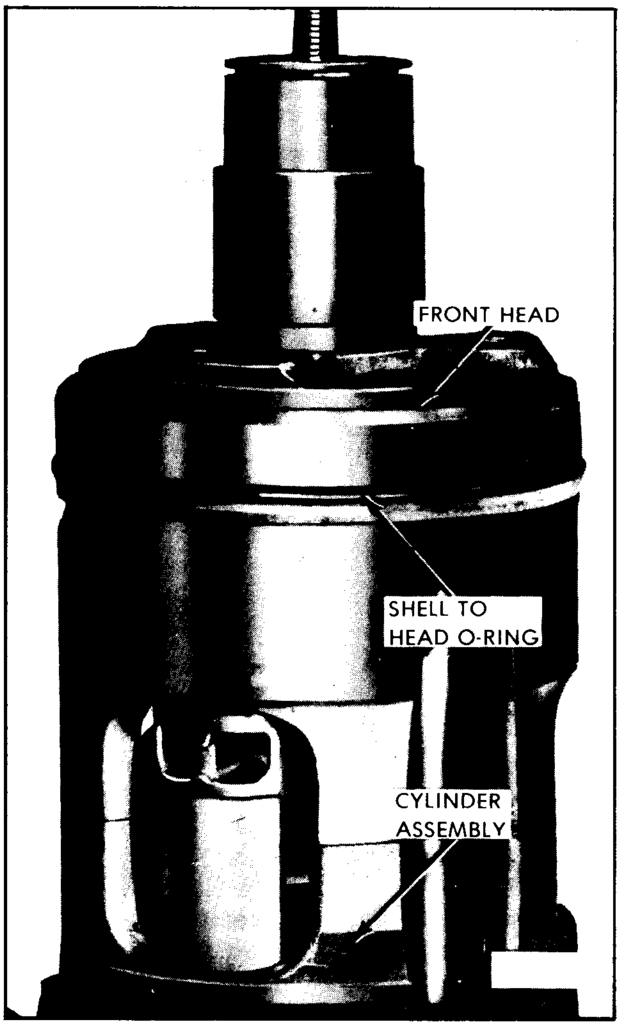


Figure 135—Shell-to-Front Head Installations

28. Install compressor pulley and bearing assembly as described in "Compressor Pulley and Bearing" replacement procedure.

29. Install compressor clutch plate and hub assembly as described in "Compressor Clutch Plate and Hub Assembly" replacement procedure.

30. Add required amount of 525 viscosity refrigerant oil.

31. Check for external and internal leaks as described in the following "Compressor Leak Testing" procedure.

COMPRESSOR LEAK TESTING— EXTERNAL AND INTERNAL

BENCH-CHECK PROCEDURE

1. Install test plate J-9625 on rear head of compressor.

2. Attach center hose of gauge manifold set on charging station to a refrigerant drum standing in an upright position and open valve on drum.

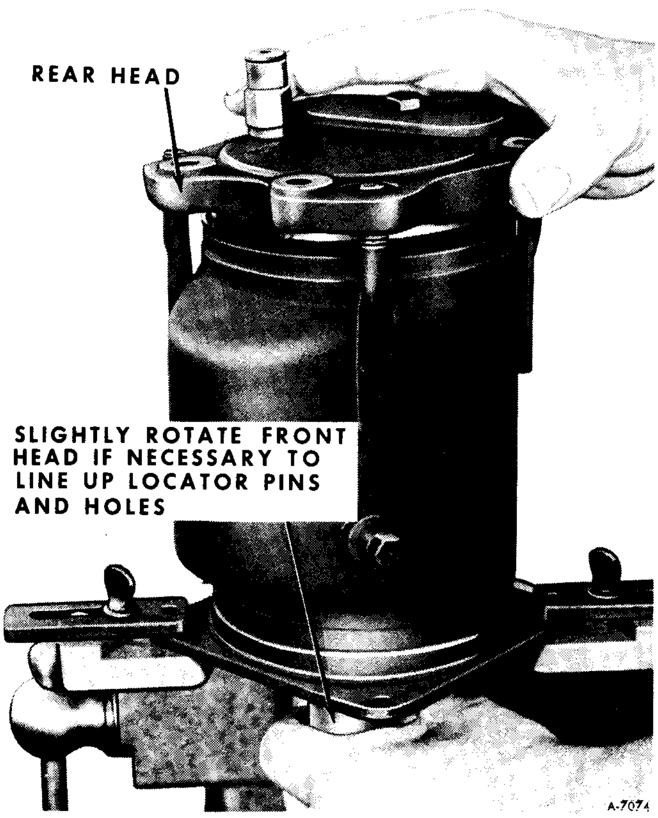


Figure 136—Installing Rear Head

3. Connect charging station "high" and "low" pressure lines to corresponding fittings on test plate J-9625, using J-5420 (7/16") gauge adapters, or J-25498 (3/8") gauge adapters.
4. Open "low" pressure control, "high" pressure control and refrigerant control on charging station to allow refrigerant vapor to flow into compressor.
5. Using leak detector, check for leaks at pressure relief valve, compressor shell to cylinder, compressor front head seal, rear head seal, oil charge port, and compressor shaft seal. After checking, shut off "low" pressure control and "high" pressure control on charging station.
6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.
7. Loosen the manifold gauge hose connections to the gauge adapters connected to the "low" and "high" sides and allow the vapor pressure to release from the compressor.
8. Disconnect both gauge adapters from the test plate J-9625.
9. Rotate the complete compressor assembly (not the crankshaft or drive plate hub) slowly several turns to distribute oil to all cylinder and piston areas.
10. Install a shaft nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.
11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to ensure piston assembly to cylinder wall lubrication.
12. Connect the charging station "high" pressure line or a "high" pressure gauge and gauge adapter J-5420 or J-25498 to the test plate J-9625 high side connector.
13. Attach adapter J-5420 or J-25498 to the suction or "low" pressure port of the test plate J-9625 to open the schrader-type valve.

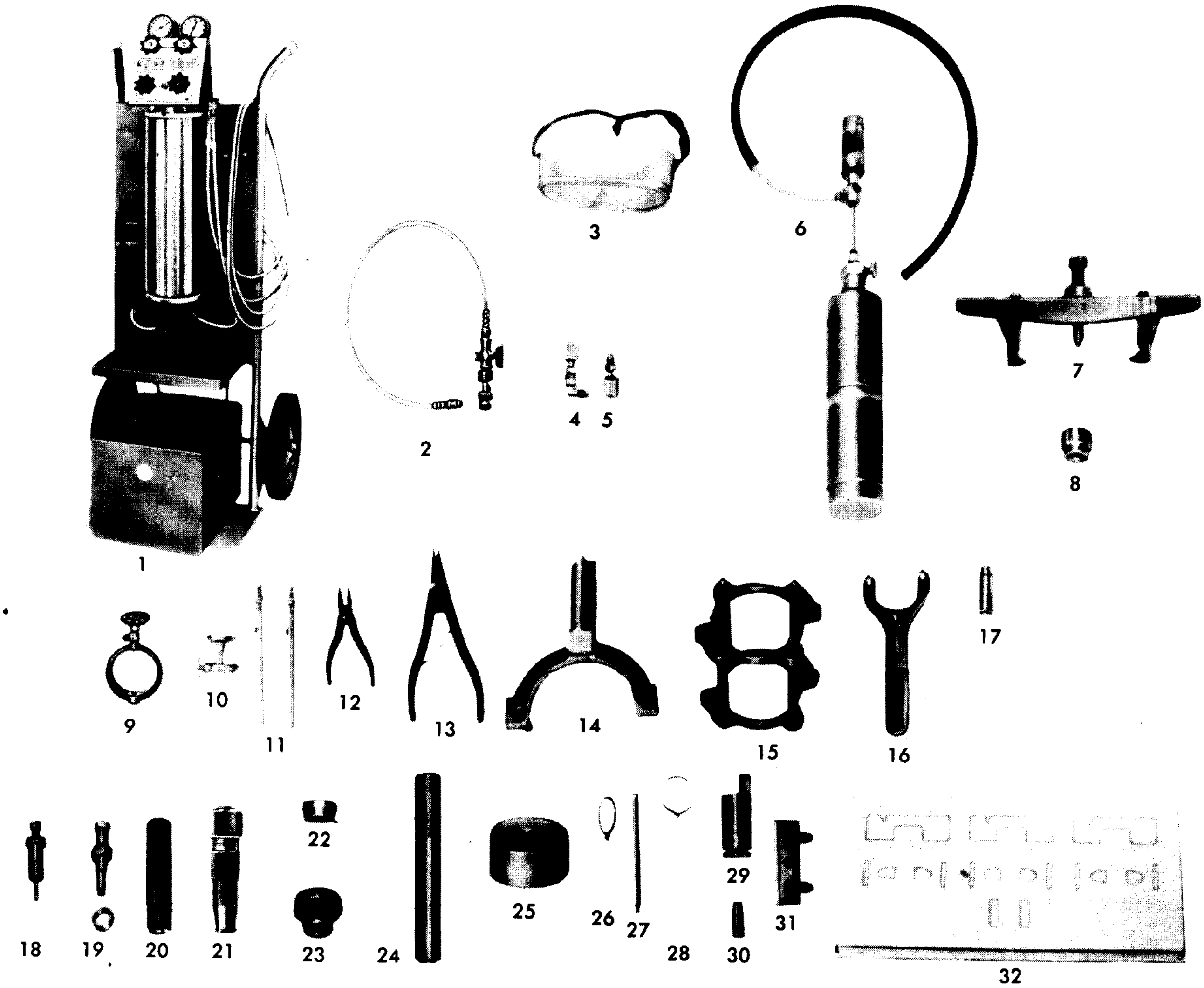
NOTE: Oil will drain out of the compressor suction port adapter if the compressor is positioned with the suction port down.

14. Attach the compressor to the holding fixture J-9396 and clamp the fixture in a vise so that the compressor can be manually turned with a wrench.
15. Using a wrench, rotate the compressor crankshaft to drive plate hub 10 complete revolutions at a speed of approximately one revolution per second.

NOTE: Turning the compressor at less than one revolution per second can result in a lower pump up pressure and disqualify a good pumping compressor.

16. Observe the reading on the "high" pressure gauge at the completion of the tenth revolution of the compressor. The pressure reading for a good pumping compressor should be 60 psi or above. A pressure reading of less than 50 psi would indicate one or more suction and/or discharge valves leaking, an internal leak, or an inoperative valve and the compressor should be disassembled and checked for cause of leak. Repair as needed, reassemble and repeat the pump up test. Externally leak test.
17. When the pressure pump up test is completed, release the air pressure from the "high" side and remove the gauge adapters J-5420 or J-25498 and test plate J-9625.
18. Remove oil charge screw and drain the oil sump.
19. Allow the compressor to drain for 10 minutes, then charge with the proper amount of 525 viscosity oil. The oil may be poured into the suction port.

NOTE: If further assembly or processing is required, a shipping plate or test plate J-9625 should be installed to keep out air, dirt and moisture until the compressor is installed.



1. J-23500	Charging Station
2. J-24095	Oil Inducer
3. J-5453	Goggles
4. J-9459	7/16"-20 90° Gauge Line
J-25499	3/8"-24 Adapter
5. J-5420	7/16"-20 Straight Gauge Line
J-25498	3/8" Adapter
6. J-6084	Leak Detector
7. J-8433	Puller
8. J-9395	Puller Pilot
9. J-23595	Refrigerant Can Valve (Side-Tap)
10. J-6271-01	Refrigerant Can Valve (Top-Tap)
11. J-5421-02	Pocket Thermometers (2)
12. J-5403	No. 21 Snap Ring Pliers
13. J-6435	No. 26 Snap Ring Pliers
14. J-9396	Compressor Holding Fixture
15. J-9397	Compressing Fixture
16. J-9403 &	Clutch Hub Holding Tool
J-25030	Clutch Hub Holding Tool
17. J-9399	9/16" Thin Wall Socket
18. J-9401	Hub and Drive Plate Assembly Remover
19. J-9480-01	Hub and Drive Plate Assembly Installer
20. J-9392	Seal Remover
21. J-23128	Seal Seat Remover
22. J-9398	Pulley Bearing Remover
23. J-9481	Pulley and Bearing Installer
24. J-8092	Handle
25. J-21352	Internal Assembly Support Block
26. J-5139	Oil Pickup Tube Remover
27. J-9432	Needle Bearing Installer
28. J-9553-01	Seal Seat "O" Ring Remover
29. J-21508	Seal Seat "O" Ring Installer
30. J-22974	Shaft Seal Protector
31. J-9625	Pressure Test Connector
32. J-9402	Parts Tray

Not Illustrated J-24092 Pulley Puller (Polly V Pulley)

A-7500

Figure 137—Special Tools

SPECIFICATIONS

COMPRESSOR

Type	6 Cylinder Axial
Displacement	12.6 Cu. In.
Rotation	Clockwise

COMPRESSOR CLUTCH COIL

Ohms (at 80°F, 27°C)	3.85
Amps (at 80°F, 27°C)	3.2 (max.) @ 12 volts
Clutch	.022" to .057"

SYSTEM CAPACITIES (REFER TO COMPRESSOR OIL CHART)

TORQUE SPECIFICATIONS

Compressor Suction & Discharge Connector Bolt	10-25 (max.) ft. lbs.
Rear Head to Shell Stud Nuts	25 ft. lbs.
Shaft Mounting Nut	25 ft. lbs.
Pressure Relief Valve	10-14 (max.) ft. lbs.
Oil Drain Screw	10-15 (max.) ft. lbs.
Rear Bracket to Compressor	25-35 ft. lbs.
Front Bracket to Compressor	25-35 ft. lbs.
Rear Compressor Bracket to Engine Mounting Bracket	25-35 ft. lbs.
Front Compressor Bracket to Engine Mounting Bracket	25-35 ft. lbs.
Compressor Brace Adjustment	
Link Upper Bolt	20-25 ft. lbs.
Link Lower Bolt	25-35 ft. lbs.
Hose Assembly Mounting Bolt	10-25 ft. lbs.
Heater Hose Clamps	20-24 in. lbs.
Water Valve Clamps	20-24 in. lbs.
Compressor Hose O-ring Nuts	
High Pressure Line Nut	11-13 ft. lbs.
Low Pressure Line Nut	21-27 ft. lbs.
Receiver-Dehydrator Bracket Mounting Screws	25-35 in. lbs.

SPECIAL TOOLS

(Not Illustrated on Page 1B-109)

J-24364	Vacuum Pump (3 c.f.m displacement)
J-23575-01	Manifold Gauge Set
J-24410	Charging Station
J-26933	Electronic Leak Detector
J-24095	Compressor Oil Injector
J-24612-01	A/C Register Remover and Installer
J-8001-3	Dial Indicator Set
J-9564-01	Feeler Gauge Set (5/1000 through 22/1000)
J-9661-01	Feeler Gauge Set (17/1000 through 22/1000)
J-24608	Teflon Piston Ring Service Set

SECTION 2
FRAME

The information described in Maintenance Manual X-7525 under the heading FRAME (SEC. 2) is applicable to models covered by this supplement with exception of the following illustration of revised front body mountings and body insulators (figure 1).

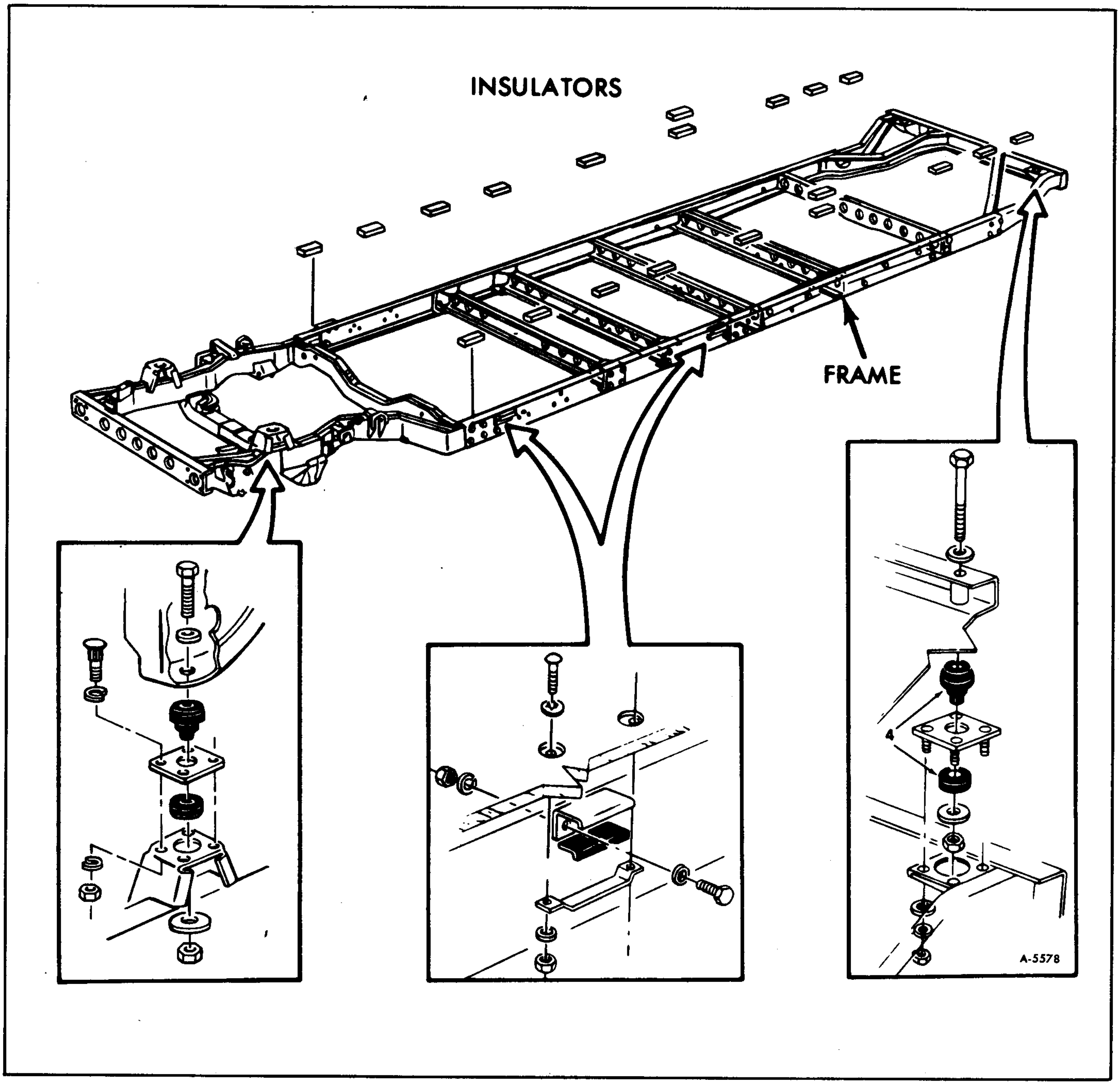


Figure 1—Body Mountings

SECTION 3A
FRONT SUSPENSION

CAUTION: *Front suspension fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of 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. Torque values must be used as specified during reassembly to assure proper retention of this part.*

NOTE: Never attempt to heat, quench or straighten any front suspension component. Replace it with a new part.

The information described in Maintenance Manual X-7525 under the heading FRONT SUSPENSION (SEC. 3A) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

DIAGNOSIS OF FRONT SUSPENSION AND STEERING

Before making any adjustment to a vehicle because of suspension, steering and tire wear problems, it is necessary to make a preliminary inspection of all moving parts from the steering wheel to the road wheels.

Wear, looseness or binding of any of the moving parts of the steering system and suspension system will affect vehicle alignment. Vehicle misalignment cannot be corrected as long as conditions of bind or looseness exist. A complete inspection should be made, even if the cause of the problem is suspected.

INSPECTION PROCEDURE

1. Inflate tires to proper pressure (when cold):

- Bias belted nylon or steel belted bias ply tires —— 60 psi.
- Steel belted radial tires —— 65 psi.

2. Check ride height for sag and uneveness. Before adjusting front ride height, park the vehicle on a known level surface and adjust the rear ride height. (Refer to "RIDE HEIGHT" in Section 4 of this supplement.)

3. Adjust front ride height. (Refer to "RIDE HEIGHT" discussed later in this section.)

If you are unable to adjust the front ride height to 13-1/8" plus or minus 1/4", it will be necessary to change the torsion bar anchor arm. Use the following guide to select the proper anchor arm:

Condition	Use Part Number	Anchor Arm Angularity
Vehicle too high	413683	23°
Vehicle too low	418352	$25\ 1/2^\circ$
Vehicle extremely low	416373	28°

If changing the anchor arm does not correct the ride height, inspect the lower control arm for galling, bulging or splitting, and inspect the control arm end of the torsion bar for wear. Replace as necessary.

4. Check shock absorber control. (Refer to "Front Suspension and Steering Trouble Diagnosis Chart" later in this section.)
5. Check wheels and tires for runout and wobble. (Refer to Sec. 10, Maintenance Manual X-7525.)
6. Check tires for side wear, misalignment wear, cornering wear or uneven wear. (Refer to Sec. 10, Maintenance Manual X-7525.)

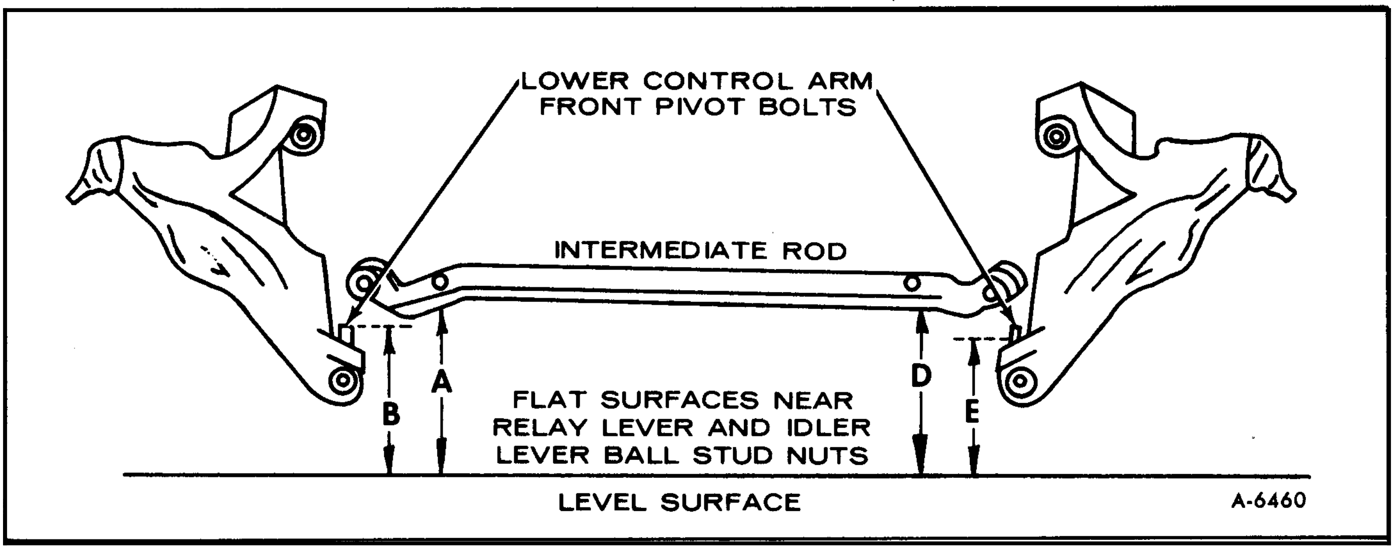


Figure 1—Measuring Intermediate Rod Parallelism

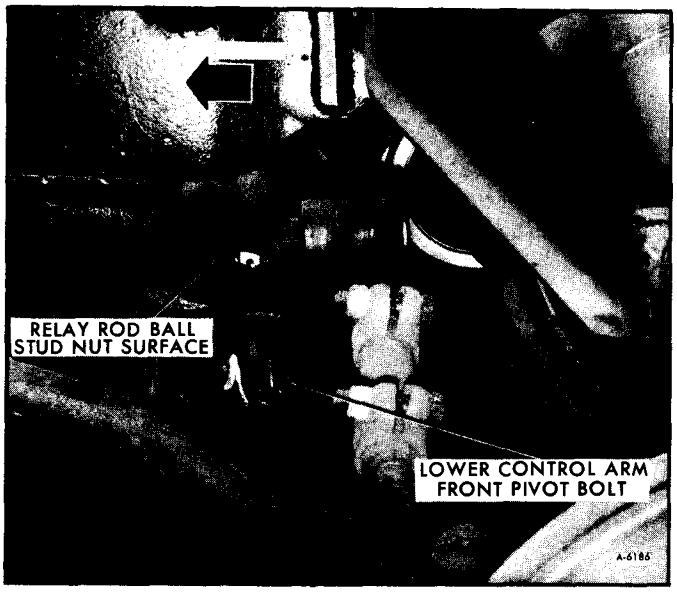


Figure 2—Measuring Relay Rod Levelness

7. Check brakes for dragging. (Refer to "Brake System Trouble Diagnosis," Sec. 5, Maintenance Manual X-7525.)

8. Check front hub bearings for wear or adjustment. (Refer to "Hub Bearing" later in this section.)

9. Check ball joints for looseness. (Refer to "Ball Joint Checks" later in this section.)

10. Check all steering connections for looseness or binding. (Refer to "Front Suspension and Steering Trouble Diagnosis Chart" later in this section.)

11. Inspect the intermediate rod for parallelism with the front axle to eliminate the possiblity of front tires wearing unevenly. The parallelism can be measured and corrected as follows (see figure 1):

a. Position vehicle on a level surface.

b. Record the following measurements: (Refer to figure 2)

		Col 1	Col 2
Entry D	Distance from the flat surface surrounding the relay lever ball stud nut to level surface.		—
Entry E	Distance from lower left hand control arm front pivot bolt to level surface.		—
Entry F	Subtract entry "E" from entry "D" and record in column 2.	—	
Entry A	Distance from the flat surface surrounding the idler lever ball stud nuts to level surface.		—

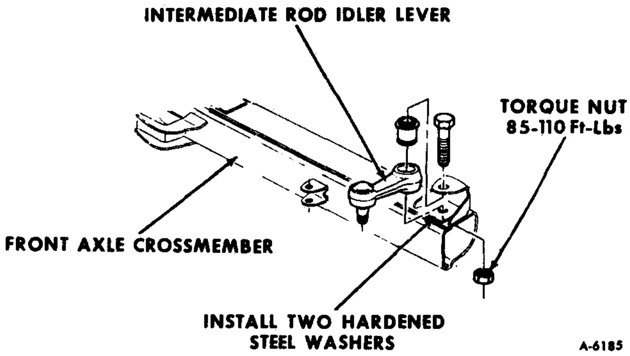


Figure 3—Installing Washer Under Idler Pivot

Entry B	Distance from lower right hand control arm front pivot bolt to level surface.		—
Entry C	Subtract entry "B" from entry "A" and record in column 2.	—	
Entry G *	Subtract entry "C" from entry "F" and record in Column. 2.	—	

*If entry "G" is .125" or greater, add two hardened steel washers under the idler lever pivot as shown in figure 3. Otherwise, the intermediate rod parallelism is acceptable.

12. Check rear suspension for alignment and correct toe-in (see figure 4). (Refer also to Section 4A of this supplement.

13. Check steering gear for adjustment, binding and centering. (Refer to "Trouble Diagnosis," Section 9, Maintenance Manual X-7525.)

14. Check rear suspension bushings for wear. (Refer to bulletins 75-TM-23, 75-TM-4.)

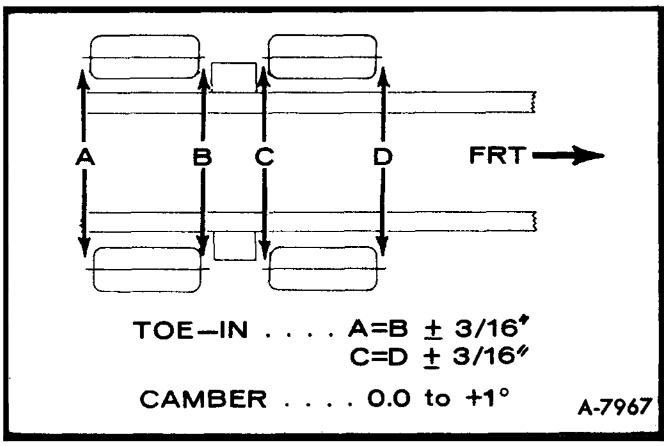


Figure 4—Measuring Toe on Rear Suspension

DIAGNOSIS OF FRONT SUSPENSION AND STEERING

PROBLEM	POSSIBLE CAUSE	CORRECTION
HARD STEERING, EXCESSIVE EFFORT REQUIRED AT STEERING WHEEL	1. Low or uneven tire pressure.	1. Inflate tires to recommended pressure.
	2. Suspension ball joints or steering linkage need lubrication.	2. Lubricate ball joints and linkage with specified lubricant.
	3. Tight or frozen relay lever pivot or idler lever pivot.	3. Lubricate or replace as necessary.
	4. Steering gear to column misalignment.	4. Align column.
	5. Steering gear adjusted too tightly.	5. Adjust preload to specification.
	6. Front wheel alignment incorrect.	6. Check alignment and ride height and correct as necessary.
	7. Relay arm or idler arm pivot over-torqued.	7. Torque to specification.
	8. Power steering partially or not operative.	8. Check power steering components for proper operation.
FRONT WHEEL SHIMMY (SMOOTH ROAD SHAKE)	1. Tire and wheel out of balance, or out of round.	1. Balance tires, check runout.
	2. Worn tie rod ends.	2. Replace tie rod ends.
	3. Worn lower suspension ball joints.	3. Replace entire lower control arm assembly.
	4. Worn upper suspension ball joints.	4. Replace upper ball joints.
	5. Malfunctioning shock absorber.	5. Replace shock absorbers.
	6. Worn or loose wheel bearings.	6. Replace or adjust wheel bearings.
VEHICLE PULLS TO ONE SIDE (NO BRAKING ACTION)	1. Low or uneven tire pressure.	1. Inflate tires to recommended pressure.
	2. Broken or sagging torsion bar.	2. Replace torsion bar.
	3. Incorrect front wheel alignment (camber).	3. Check ride height and align front suspension.
	4. Wheel bearings worn out.	4. Replace wheel bearings.
	5. Brakes dragging.	5. Inspect and adjust brakes.
POOR DIRECTIONAL STABILITY	1. Suspension ball joints and steering linkage need lubrication.	1. Lubricate at proper intervals.
	2. Low or uneven front or rear tire pressure.	2. Inflate tires to recommended pressure.
	3. Steering gear not on high point.	3. Adjust steering gear. See Maintenance Manual X-7525, Sec. 9.
	4. Incorrect front wheel alignment (caster).	4. Check ride height and align front suspension.
	5. Broken torsion bar.	5. Replace torsion bar.
	6. Malfunctioning shock absorber.	6. Replace shock absorbers.
	7. Broken stabilizer bar or missing link.	7. Replace stabilizer or link.

DIAGNOSIS OF FRONT SUSPENSION AND STEERING (CONT'D)

PROBLEM	POSSIBLE CAUSE	CORRECTION
	8. Intermediate rod not parallel.	8. Correct to specification.
EXCESSIVE PLAY IN STEERING	1. Front wheel bearings loosely adjusted.	1. Adjust bearings or replace with new parts as necessary.
	2. Worn couplings or steering shaft U-joints.	2. Replace.
	3. Worn upper ball joints.	3. Replace.
	4. Steering wheel loose on shaft.	4. Tighten to specified torque.
	5. Incorrect steering gear adjustment.	5. Adjust steering gear. See Maintenance Manual X-7525, Sec. 9.
	6. Loose pitman arm, tie rods, steering arms or steering linkage ball studs. Worn intermediate rod or tie rod sockets.	6. Replace loose or worn parts.
	7. Loose relay arm pivot.	7. Replace.
	8. Loose idler arm pivot.	8. Replace.
POOR RETURNABILITY	1. Steering linkage or suspension ball joints need lubrication.	1. Lubricate with specified lubricant.
	2. Steering gear adjusted too tightly.	2. Adjust to specification.
	3. Steering gear to column misalignment.	3. Align column.
	4. Front wheel alignment incorrect.	4. Check ride height alignment and correct as necessary.
NOISE IN FRONT END	1. Suspension ball joints and steering linkage need lubrication.	1. Lubricate at recommended intervals.
	2. Shock absorbers loose or bushings worn.	2. Tighten bolts and/or replace shock absorber.
	3. Worn upper control arm bushings.	3. Replace bushings.
	4. Worn lower control arm bushings.	4. Replace entire lower control arm assembly.
	5. Worn tie rod ends.	5. Replace tie rod ends.
	6. Loose stabilizer bar.	6. Tighten all stabilizer bar attachments.
	7. Loose wheel nuts.	7. Tighten wheel nuts to proper torque.
	8. Loose suspension bolts.	8. Torque to specifications or replace.
TIRE THUMP	1. Tire and wheel out of balance.	1. Balance wheels.
	2. Tire and wheel out of round.	2. Replace tire.
	3. Blister or bump on tire.	3. Replace tire.
	4. Improper shock absorber action.	4. Replace shock absorber.

DIAGNOSIS OF FRONT SUSPENSION AND STEERING (CONT'D)

PROBLEM	POSSIBLE CAUSE	CORRECTION
EXCESSIVE OR UNEVEN TIRE WEAR	1. Underinflated or over-inflated tires. 2. Improper toe-in. 3. Wheels out of balance. 4. Hard driving. 5. Overloaded vehicle. 6. Improper camber. 7. Unparallel intermediate rod.	1. Inflate tire to recommended pressure. 2. Realign front end. 3. Balance wheels. 4. Instruct driver 5. Instruct driver. 6. Realign front end. 7. Correct as necessary.
SCUFFED TIRES	1. Toe-in incorrect. 2. Excessive speed on turns. 3. Tires improperly inflated. 4. Rear suspension arm bent or twisted. 5. Intermediate rod not parallel. 6. Incorrect ride height.	1. Adjust toe-in to specifications. 2. Advise driver. 3. Inflate tires to recommended pressure. 4. Replace arm. 5. Correct to specifications. 6. Adjust ride height.
CUPPED TIRES	1. Shock absorbers defective. 2. Worn upper suspension ball joint. 3. Worn lower suspension ball joint. 4. Wheel and tire out of balance. 5. Excessive tire or wheel runout.	1. Replace shock absorbers. 2. Replace upper ball joint. 3. Replace entire lower control arm assembly. 4. Balance wheel and tire. 5. Compensate for runout.
WEAR IN THE SECOND TREAD ROW ON EACH SIDE OF TIRE	1. Underinflation or inherent problem of bias belted tires.	1. Inflate tire to recommended pressure and rotate tires.
EXCESSIVE LOOSENESS IN TIE ROD OR INTERMEDIATE ROD PIVOTS, OR EXCESSIVE VERTICAL LASH IN IDLER PIVOT OR RELAY ARM PIVOT.	1. Seal damage and leakage resulting in loss of lubricant, corrosion and excessive wear or improper torque.	1. Replace damaged parts as necessary and check torque.
SHOCK ABSORBER—WEAK.	1. Low or uneven tire pressure. 2. Excessive or incorrect vehicle loading. 3. Worn out shock absorber. Front.	1. Inflate tires to recommended pressure. 2. Instruct driver. 3. Perform on-vehicle test. Push down and lift up at end of bumper nearest front shock in question. Right and left shocks must be comparable in rebound resistance to compression ratio (usually 2 to 1). If in doubt compare with vehicle having acceptable ride quality.

DIAGNOSIS OF FRONT SUSPENSION AND STEERING (CONT'D)

PROBLEM	POSSIBLE CAUSE	CORRECTION
SHOCK ABSORBER— WEAK (CONT'D)	4. Worn out shock absorber. Rear.	4. Disconnect the lower shock mountings. Stroke shocks at various rates of speed through maximum travel in both directions. Compare side to side for rebound and compression resistance. Rebound resistance is normally stronger than compression (approximately 2 to 1. It is manadatory that right and left shocks feel comparable. If in doubt about condition, compare with a known good shock.
SHOCK ABSORBER— NOISY.	1. Loose mounting.	1. Check all shock mounting torques (bolt and/or nut).
	2. Faulty shock absorber.	2. Observe hoisting instructions and instructions for removal of front shock absorbers. Clamp shock upside down. Clamp vise on top mount with shock vertical in vise (do not clamp on reservoir tube). Rear shocks may be tested on the vehicle by disconnecting the lower mount. Completely extend to full rebound then exert an extra pull. If a "give" is felt, a loose piston is indicated and the shock should be replaced. A hissing noise (orifice swish) is normal; however, replace shock absorber for any of the following: 1. A skip or lag at reversal near mid-stroke. 2. A seize (except at either extreme end of travel). 3. A noise such as a grunt or squeal after completing one full stroke in both directions. 4. A clicking noise at fast reversal.
SHOCK ABSORBER— LEAKS.	1. Faulty shock absorber.	1. A slight trace of shock fluid is NOT cause for replacement as the seal permits some seepage for lubrication of the piston rod. The shock contains a fluid reverse to compensate for seepage. A shock that is truly leaking is easily detected as there will be evidence of shock fluid around the seal cover and on down the reservoir tube; any leaking shock should be replaced.

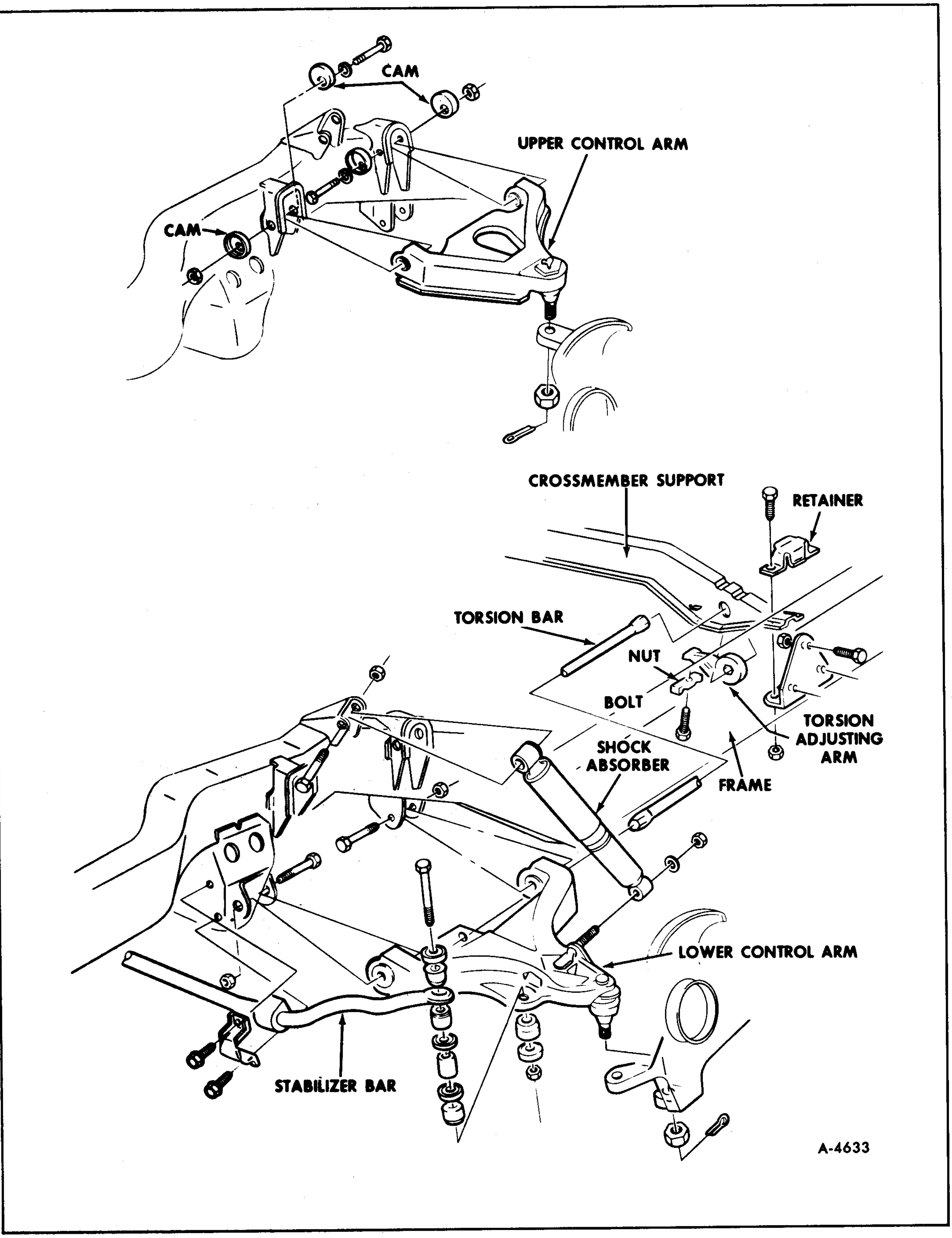


Figure 5—Front Suspension

GENERAL DESCRIPTION

The front suspension consists of control arms, stabilizer bar, shock absorbers and a right and left side torsion bar. Torsion bars are used instead of the conventional coil springs. The front end of the torsion bar is attached to the lower control arm. The rear of the torsion bar is mounted into an adjustable arm at the torsion bar crossmember support. The front ride height of the vehicle is controlled by this adjustment (figure 5).

COMPONENT REPLACEMENT

DISC AND HUB
(FIGURE 6)

REMOVAL

1. Siphon approximately two-thirds of the brake fluid from the front reservoir of the master cylinder. Discard fluid.

NOTE: Do not empty front reservoir or it will be necessary to bleed the brake system.

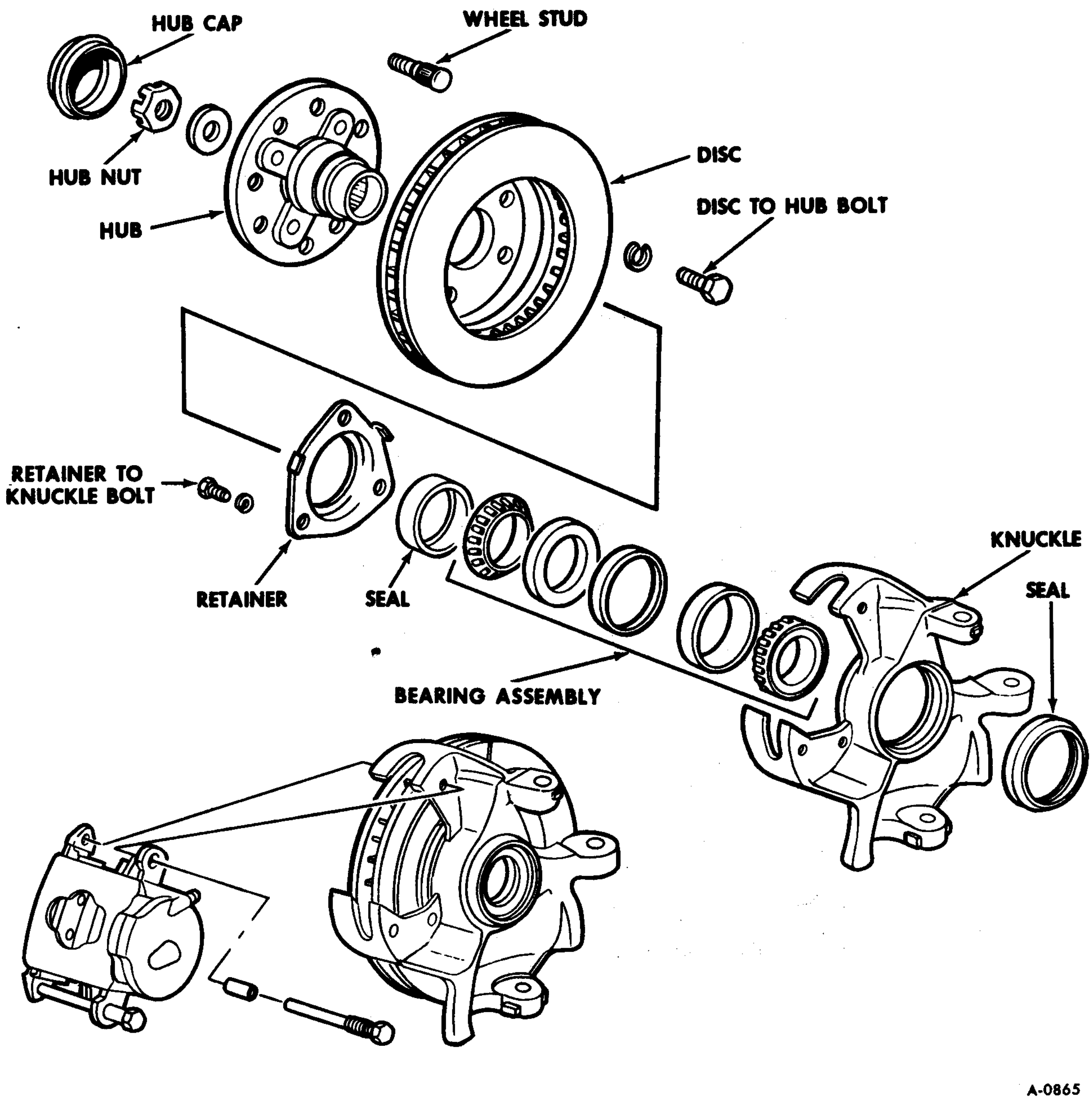


Figure 6—Disc and Hub Assembly

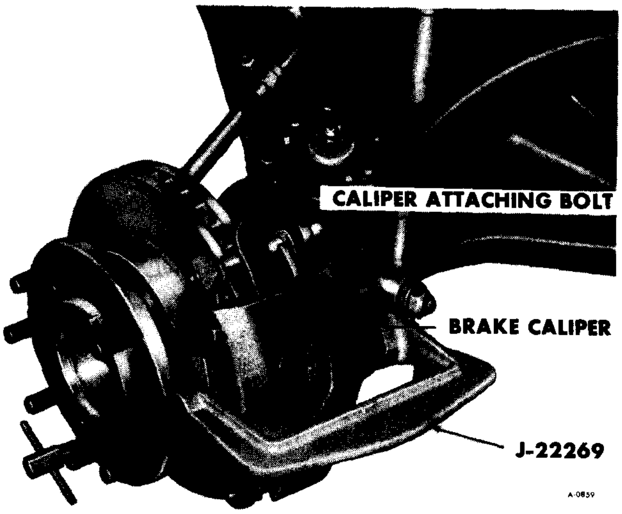


Figure 7—Caliper Removal

2. Hoist vehicle. Remove eight hub nuts from wheel studs and remove wheel. Support vehicle with floor stands.

NOTE: Wheel studs and nuts should be checked after every wheel removal and replaced if necessary. If wheel studs require replacement, removal of studs from hub may be accomplished by the use of Wheel Stud Remover Tool J-5504-01.

3. Remove cotter pin, drive axle nut and washer.
4. Position Tool J-22269 on caliper as shown in figure 7.
5. Tighten screw of tool until caliper moves outboard far enough to push piston to bottom of piston bore. This will allow shoes to back off from the disc surface. Remove Tool J-22269.

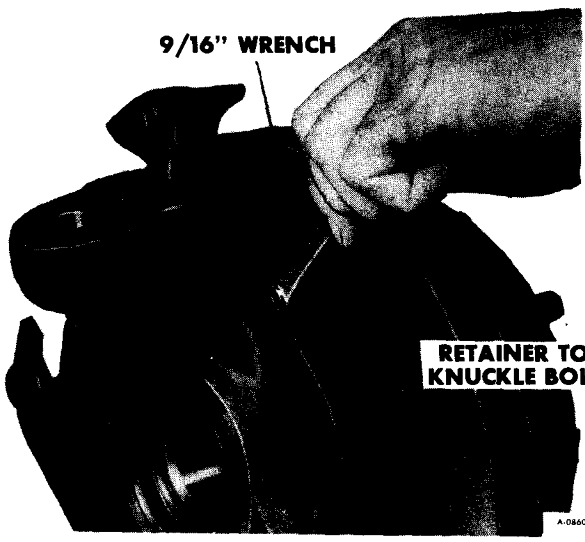


Figure 8—Retainer Bolt Removal

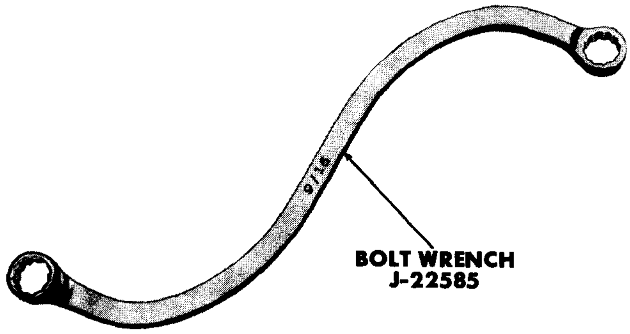


Figure 9—Front Hub Retainer Bolt Wrench J-22585

6. Remove the two caliper-to-knuckle attaching bolts (figure 7).
7. Carefully lift caliper assembly from disc and reposition so that brake hose is not kinked or stretched.
8. Loosen uniformly and remove the three bolts securing the retainer to the knuckle (figure 8). Removal of these bolts may be expedited by the use of special Bolt Wrench J-22585 (figure 9).
9. Position Tool No. J-24717 on hub as shown in figure 10.
10. Operate slide hammer Tool No. J-2619, until assembly is free of knuckle. See figure 10.
11. Remove slide hammer and Tool No. J-24717.

INSTALLATION

See CAUTION on Page 3A-1 of this section.

1. Lubricate O.D. of bearing with chassis grease. Clean bearing seat of knuckle where rust or dirt may fall during removal.
2. The outer race of the bearing is a snug fit into the knuckle. Light tapping on the hub's outer surface (not the disc) will aid assembly.

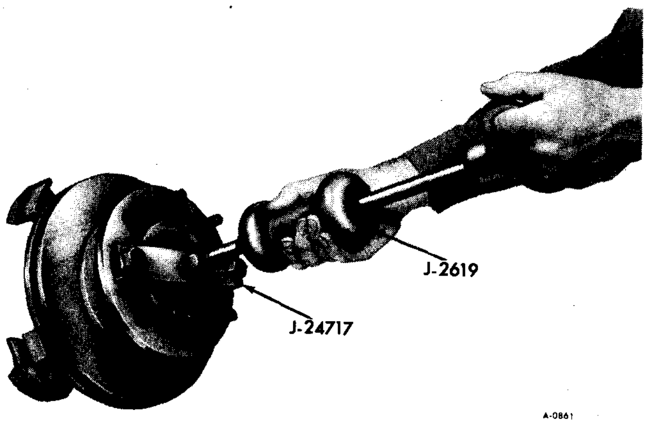


Figure 10—Hub and Disc Removal

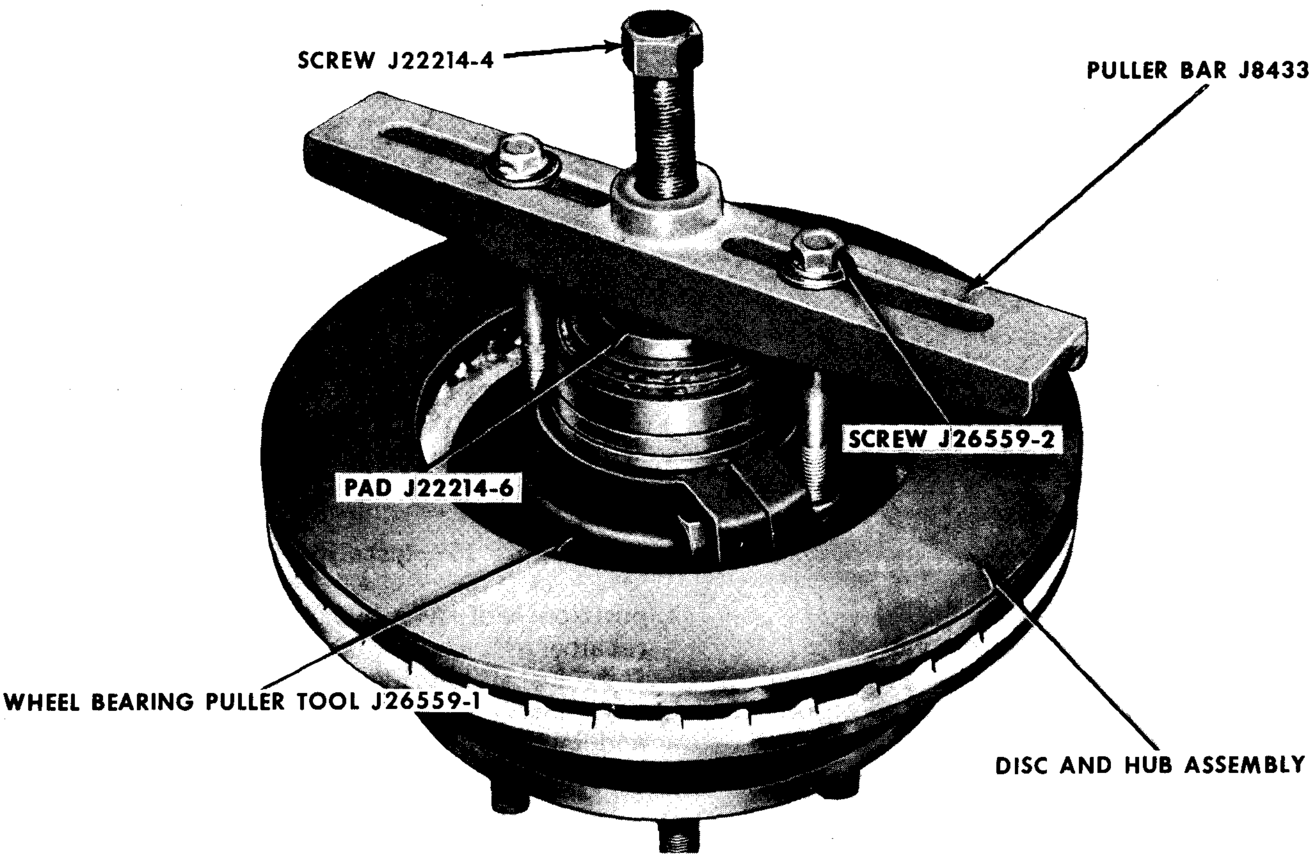


Figure 11—Wheel Bearing Puller Tool J-26559

Care must be used when installing hub assembly over drive axle splines so that splines are in correct alignment.

3. Install three bolts attaching bearing retainer to knuckle. Torque bolts. See Specifications at the end of this section for torque value and procedure.

4. Install drive axle washer and nut. Torque nut. See Specifications at the end of this section for torque value and procedure. If necessary to align cotter pin slot, tighten nut and install NEW cotter pin and crimp.

5. Replace wheel and secure with eight nuts on studs. Refer to Maintenance Manual X-7525, Sec. 10 for torque values and tightening sequence. Refill master cylinder with new brake fluid.

6. Remove floor stands. Lower vehicle.

HUB BEARING

NOTE: Front wheel bearings on 1978 model vehicles must be cleaned and repacked at specific intervals. Refer to 1978 Motorhome and TransMode Maintenance Schedule (X-7822A) for interval listing and lubricant recommendation.

There is a new Bearing Puller Ring, Tool J-26559, used to facilitate the removal of front wheel bearings from the front hub/ rotor

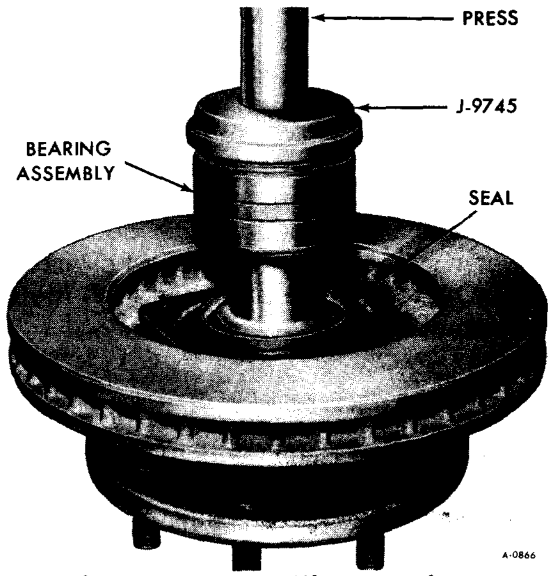


Figure 12—Installing Bearing

Figure 13—Disc Removal

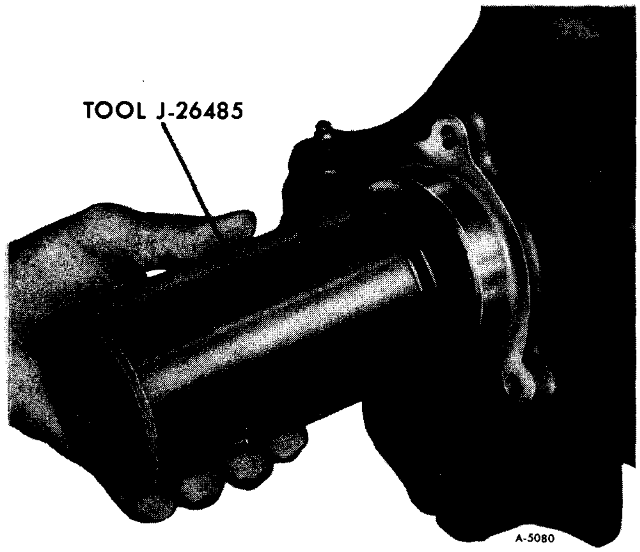


Figure 14—Installing Knuckle Seal

assembly (figure 11). This tool is to be used in conjunction with Puller Bar J-8433.

REMOVAL

1. Remove disc and hub assembly. Refer to "Disc and Hub Removal" covered earlier in this section.
2. Assemble Tool No. J-26559-1 to Tool No. J-8433.
3. Position tool assembly as shown in figure 11.

CAUTION: *The gripping or pulling edge of the tool must be under the inner race. If the tool slips up to the bearing cage, the bearing will be seriously damaged and need to be replaced.*

4. With Tool No. J-22214-6 in place, and a clamp in position, tighten center screw (J-22214-4) until bearing is free of hub.
5. Remove seal and retainer.
6. Clean bearing and inspect for wear or damage. If bearing condition is good repack with bearing grease. Use GM Part No. 1051344 or equivalent, a premium high melting point lubricant.

INSTALLATION

See CAUTION on Page 3A-1 of this section.

1. Postion retainer over hub.
2. Lubricate seal lips with Special Seal Lubricant No. 1050169 or equivalent, then position seal over hub with metal end toward retainer.
3. Install bearing as shown in figure 12.
4. Install disc hub assembly. Refer to "Disc and Hub Installation" covered earlier in this section.

DISC

REMOVAL (FIGURE 13)

1. Remove disc and hub assembly. Refer to "Disc and Hub -Removal"
2. Remove hub bearing. Refer to "Hub Bearing Removal".
3. Remove four bolts and separate disc from hub as shown in figure 13.

INSTALLATION

1. Install four attaching bolts. See Specifications at the end of this section for torque value.
2. Install hub bearing. Refer to "Hub Bearing - Installation".
3. Install disc and hub assembly. Refer to "Disc and Hub Installation".

KNUCKLE SEAL

REMOVAL

1. Remove disc and hub. Refer to "Disc and Hub - Removal".
2. Pry seal from knuckle.

INSTALLATION

1. Lubricate seal inner lips with Special Seal Lubricant No. 1050169 or equivalent.

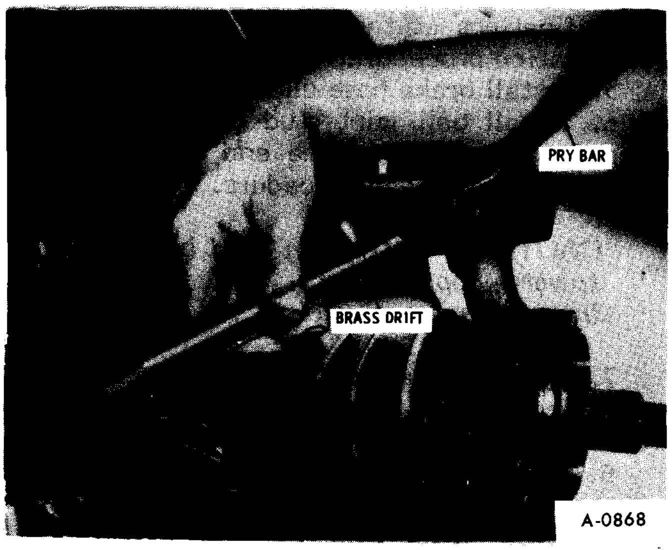


Figure 15—Removing Upper Ball Joint

Place knuckle seal on Tool J-26485. Insert tool as far as possible into knuckle and then drive it in with a hammer until it bottoms (figure 14). Remove tool.

2. Install disc and hub. (See "Disc and Hub - Installation").

KNUCKLE

REMOVAL

1. Remove disc and hub assembly (refer to "Disc Hub -Removal").
2. Remove upper ball joint cotter pin and nut.
3. Remove brake line hose clip from ball joint stud.

NOTE: Do not loosen ball joint in upper control arm.

4. Using a brass drift and hammer, and a pry bar, placed as in figure 15, loosen upper ball joint stud from knuckle. Remove upper ball joint from knuckle.
5. Remove cotter pin and nut from tie rod end.
6. Using Tool J-21319, remove tie rod end as shown in figure 16.
7. Remove cotter pin and nut from lower (suspension) ball joint.
8. Using Tool J-24319 remove lower (suspension) ball joint from knuckle (figure 17).
9. Remove knuckle. Pry seal from knuckle.

INSTALLATION

See CAUTION on Page 3A-1 of this section.

1. Lubricate seal inner lips with Special

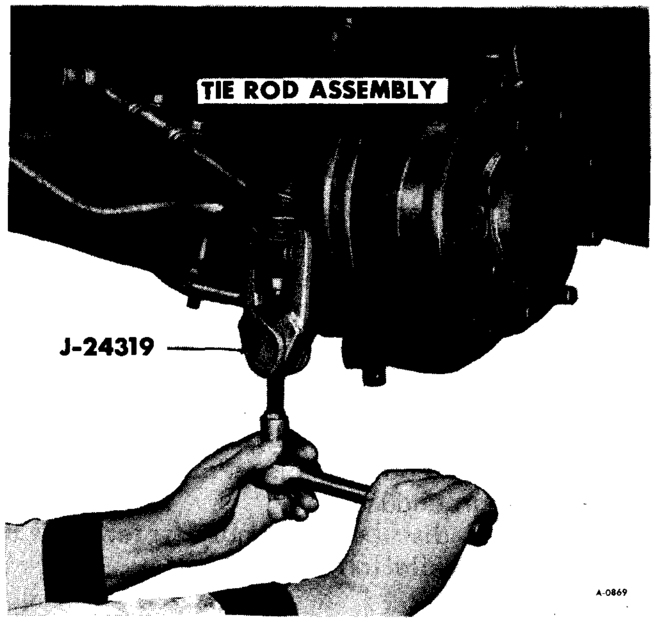


Figure 16—Removing Tie Rod End

Seal Lubricant No. 1050169 or equivalent. Then, using Tool J-26485 install seal into knuckle until it bottoms.

2. Install lower ball joint stud into knuckle and attach nut. Do not torque. See Specifications at the end of this section for installation procedure.
3. Install tie rod end stud into knuckle and attach nut. Do not torque. See Specifications at the end of this section for installation procedure.

Figure 17—Removing Lower Ball Joint

4. Install upper ball joint stud into knuckle. Attach nut. See Specifications at the end of the section for installation procedure. Attach brake line hose clip.
5. Torque ball joint stud nut. See Specifications at the end of this section for torque value and procedure. Tighten to install NEW cotter pins.

CAUTION: *Cotter pin on upper ball joint must be bent up only to prevent interference with C. V. joint seal.*

6. Torque tie rod end nut. See Specifications at the end of this section for torque value and procedure.
7. Install disc hub assembly (refer to "Disc and Hub -Installation").

UPPER CONTROL ARM

REMOVAL

1. Hoist vehicle and remove wheel. Place floor stand on each side, under and firmly against the lower control arm.
2. Remove upper shock absorber attaching bolt.
3. Remove cotter pin and nut from upper ball joint.
4. Disconnect brake hose clip from ball joint stud.
5. Using hammer and a drift (figure 15), drive on spindle until upper ball joint stud is disengaged from knuckle.
6. Remove upper control arm cams, washers and nuts. Remove control arm from vehicle by guiding shock absorber through access hole.

NOTE: While cam is removed check cam adjustment surface of brackets for weld splatter. Weld splatter in this area will affect front end alignment. Remove weld splatter before reassembly.

INSTALLATION

See CAUTION on Page 3A-1 of this section.

1. Guide upper control arm over shock absorber and install bushing end of control arm into frame bracket.
2. Install cams as shown in figure 5.
3. Install washers and nuts. Torque nuts. See Specifications at the end of this section for torque values.
4. Install ball joint stud into knuckle. See Specifications at the end of this section for installation procedure.
5. Install brake hose clip on ball joint stud.
6. Install ball joint stud nut. Torque nut. See Specifications at the end of this section for torque value and procedure.

CAUTION: *Cotter pin must be crimped toward upper control arm to prevent interference with outer C. V. joint seal.*

7. Install upper shock attaching bolt and nut. Torque nut. See Specifications at the end of this section for torque value.
8. Replace wheel and secure with eight nuts on studs. Refer to Maintenance Manual X-7525, Sec. 10, for torque values and tightening sequence.
9. Remove floor stands and lower hoist.
10. Check camber, caster and toe-in and adjust if necessary. Refer to FRONT END ALIGNMENT later in this section.

UPPER CONTROL ARM BUSHING

Upper control arm bushings can be removed and installed while control arm is installed on vehicle.

REMOVAL

1. Hoist vehicle, place floor stands under and firmly against the lower control arm, and remove wheel.
2. Disconnect upper shock absorber attaching bolt (figure 18).
3. Remove cams, bolts, washers and nuts from control arm.
4. Move control arm out of frame brackets and attach bushing removal tools as shown in figure 19. Remove bushings.

INSTALLATION

See CAUTION on Page 3A-1 of this section.

1. Install tools and press bushings into control arm (figure 20).
2. Move control arm into frame brackets and install cams, bolts, washers and nuts. The cams are installed with the bolts in the lower position. Torque cam nuts. See Specifications at the end of this section for torque value and procedure.
3. Connect upper shock attaching bolt. Torque nut. See Specifications at the end of this section for torque value and procedure.
4. Install wheel and secure with eight nuts on studs. Refer to Maintenance Manual X-

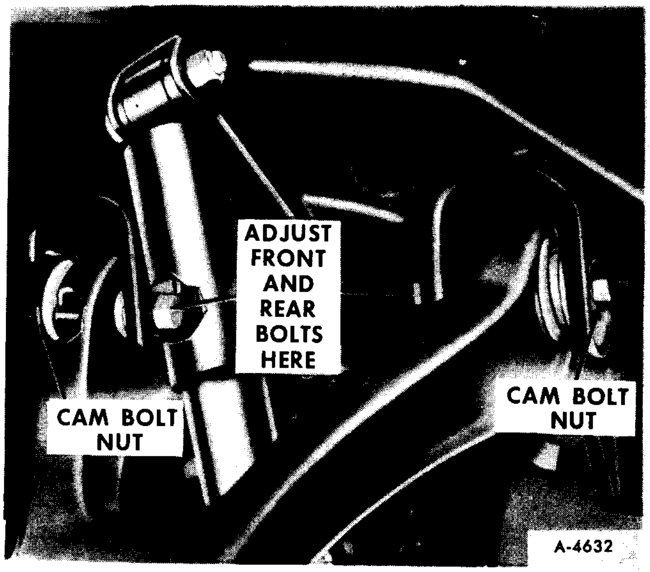


Figure 18—Upper Control Arm Attachment

7525, Sec. 10 for torque values and tightening sequence.

5. Remove floor stands and lower hoist.

6. Align front wheels. Refer to FRONT END ALIGNMENT later in this section.

LOWER CONTROL ARM

NOTE: Service parts for lower control arm ball joints and bushings are no longer available. If lower control arm ball joints or bushings require replacement, entire new lower control arm assembly must be installed.

REMOVAL

1. Hoist vehicle and remove wheel assembly.

2. Before using Tool J-22517-02, remove two nuts and center screw, then place tool over crossmember support. Align pin of tool into hole in crossmember. Install two nuts on tool and center screw. Turn center screw until seated in dimple of torsion adjusting arm.

3. Using a socket on the torsion bar adjusting bolt, turn counterclockwise, counting the number of turns necessary to remove.

NOTE: The number of turns to remove the adjusting bolt will be used when installing, to obtain the original ride height.

4. Remove adjusting bolt and nut.

5. Turn center screw of Tool J-22517-02 until torsion bar is completely relaxed and remove torsion bar, noting which end is front.

6. Disconnect shock absorber and stabilizer link from lower control arm.

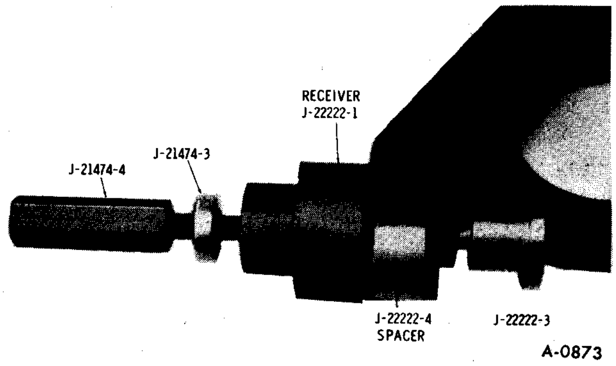


Figure 19—Removing Upper Control Arm Bushing

7. Remove drive axle nut.

8. Remove cotter pin and nut from lower ball joint stud.

9. Install Tool J-24319 and remove ball joint stud from knuckle (figure 17).

10. Remove bolts from lower control arm to frame and remove torsion bar.

11. Push inboard on drive axle and pull outward on knuckle to gain clearance, then remove lower control arm from knuckle.

INSTALLATION

See CAUTION on Page 3A-1 of this section.

1. Install lower control arm. Make sure that shock absorber is guided onto lower control arm shock absorber mount and drive axle is positioned in knuckle. Guide ball joint stud into knuckle. Install but do not torque stud nut. See Specifications at the end of this section for installation procedure.

2. Install lower control arm to frame bracket bolts. Install nuts and torque. See Specifications at the end of this section for torque values.

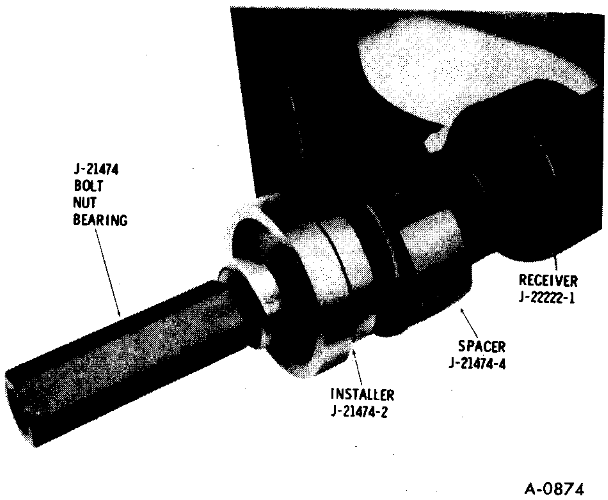


Figure 20—Installing Upper Control Arm Bushing

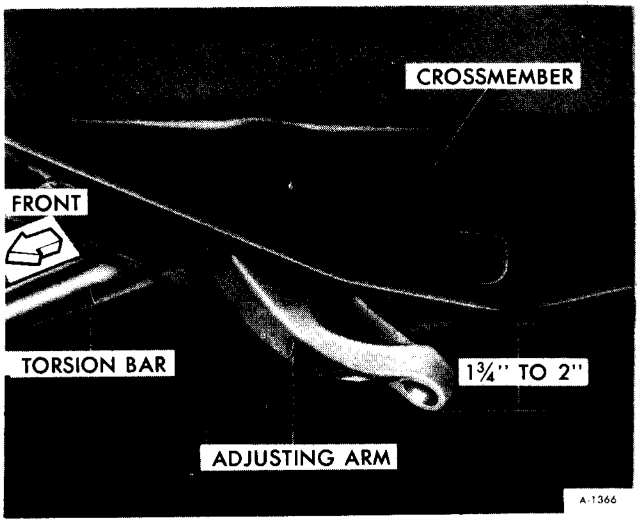


Figure 21—Positioning of Adjusting Arm

3. Torque lower ball joint stud nut. See Specifications at the end of the section for torque value and procedure.

4. Install shock absorber nut, and torque. Install stabilizer link and torque nut. Install drive axle nut and torque. See Specifications at the end of this section for torque values.

5. Apply a liberal amount of chassis grease to both ends and place front end of torsion bar into control arm. Push torsion bar all the way forward into the control arm.

6. Insert adjusting arm into the crossmember and position approximately 1 3/4" below the centerline of the crossmember (see figure 21). Slide torsion bar rearward until it is flush with the rear face of the adjusting arm.

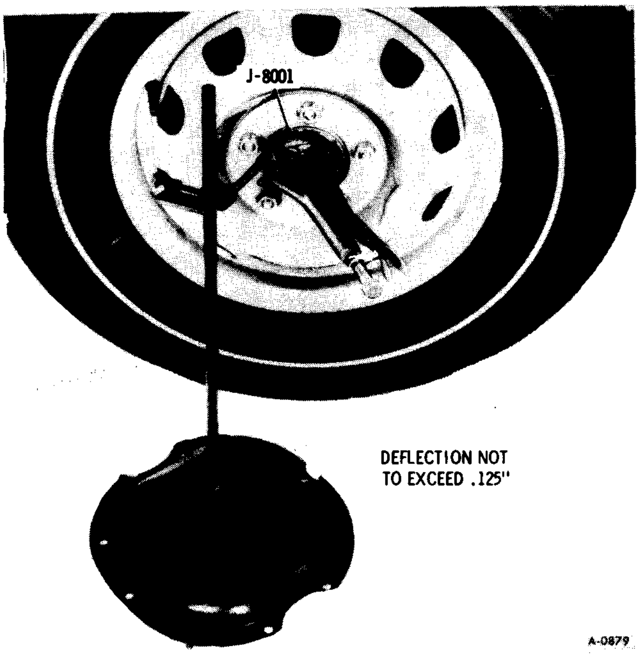


Figure 22—Ball Joint Vertical Check

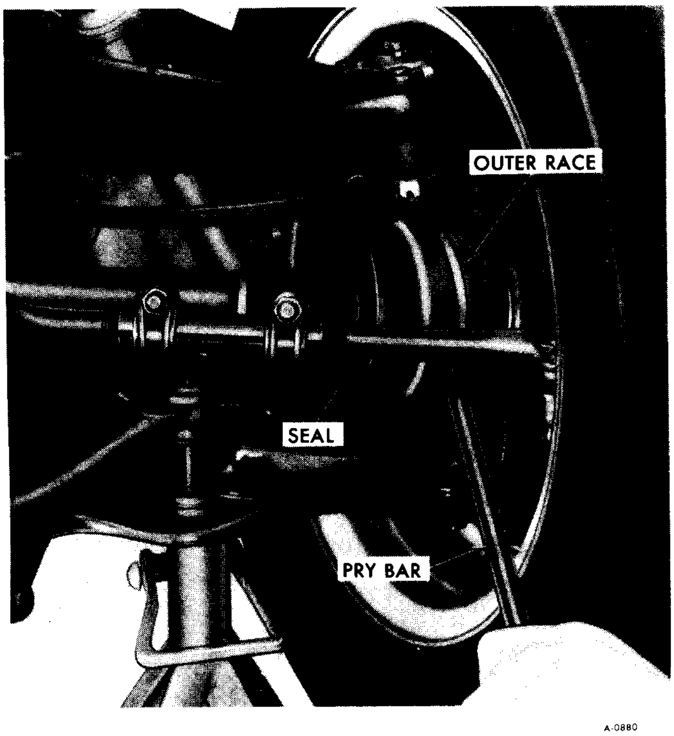


Figure 23—Pry Bar Installation

NOTE: There must be 3/16" to 1/4" clearance between the rear end of the torsion bar and the rear inside face of support crossmember.

7. Reposition Tool J-22517-02 making sure pin of tool is in hole in crossmember. Turn center screw of Tool J-22517-02 until adjusting arm is in position to allow installation of the adjusting nut.

8. Apply a liberal amount of chassis grease and install adjusting bolt. Tighten as necessary to obtain original ride height. (Check number of turns previously recorded).

9. Turn center screw until torsion is relaxed and remove tool.

10. Install wheel and secure with eight stud nuts. Refer to Maintenance Manual X-7525, Sec. 10 for torque values and tightening sequence. Lower vehicle.

11. Check ride height and adjust if necessary. Refer to "RIDE HEIGHT" later in this section.

LOWER CONTROL ARM BUSHING

NOTE: Lower control arm bushings are no longer serviced separately. If bushings are worn and need replacement, it is now necessary to install entire right or left hand lower control arm assembly as needed.

BALL JOINT

Ball joint lubrication and seal inspection is important. Refer to Section 0, Maintenance Manual X-7525 for maintenance intervals.

BALL JOINT CHECKS

VERTICAL CHECKS

1. Raise the vehicle and position floor stands under the left and right lower control arms as near as possible to each lower ball joint. Vehicle must be stable and should not rock on the floor stands. Lower front hoist.
2. Position dial indicator as shown in figure 22.
3. Place pry bar as shown in figure 23 and pry down on bar. Care must be used so that drive axle seal is not damaged. Reading must not exceed .125".

LOWER CONTROL ARM BALL JOINT

NOTE: Lower control arm ball joints are no longer serviced separately. If ball joints are worn, it is now necessary to install entire right or left hand lower control arm.

UPPER CONTROL ARM BALL JOINT

REMOVAL

1. Hoist vehicle under lower control arms and remove wheel.
2. Remove cotter pin and nut from upper ball joint stud.
3. Disconnect brake hose clip from upper ball joint stud.
4. Using hammer and a brass drift similar to figure 15, drive on spindle until upper ball joint stud is disengaged from spindle.
5. Raise control arm up and drill rivets with a 1/8" drill bit 3/8" deep.

NOTE: It may be necessary to use a block of wood between frame and control arm for support.

6. Drill off rivets using a 1/2" drill bit. Do not drill into control arm.
7. Using a punch, drive out rivets and remove ball joint.

INSTALLATION

See CAUTION on Page 3A-1 of this section.

1. Install service ball joint into control arm (bolts must be installed from top side). Torque four nuts. See Specifications at the end of this section for torque value.
2. Install service ball joint into knuckle. See Specifications at the end of this section for procedure. Do not torque at this time. Position brake hose clip over stud.
3. Install ball joint stud nut. Torque nut. See Specifications at the end of this section for torque value and procedure.

CAUTION: *Cotter pin must be bent up to prevent interference with outer C. V. Joint Seal.*

4. Install wheel and lower hoist.

STABILIZER BAR

REMOVAL

1. Remove link bolts, nuts, grommets, spacers and retainers from lower control arm. Discard bolts.
2. Remove bracket-to-frame attaching bolts and remove stabilizer bar from front of vehicle.

INSTALLATION

See CAUTION on Page 3A-1 of this section.

To install, reverse removal procedure.

NOTE: New link nuts must be torqued, then bolt cut off 1/4" below nut. See Specifications at the end of this section for torque value.

SHOCK ABSORBER

(Refer to Figure 5)

REMOVAL

1. Raise vehicle. Place a safety stand under and firmly against the lower control arm.

CAUTION: *This must be done to prevent the lower control arm from shifting and damaging the tie rod.*

2. Remove wheel.
3. Remove upper shock attaching bolt.

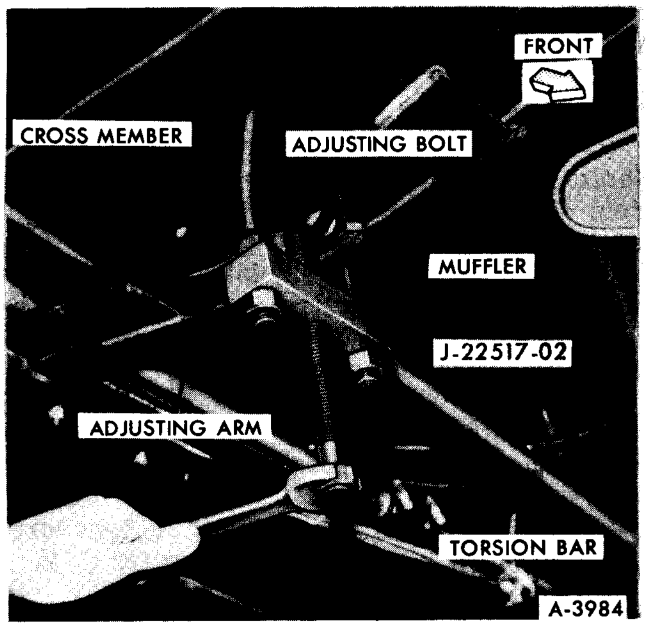


Figure 24—Removing Torsion Bar

4. Remove lower shock attaching nut and carefully guide shock through upper control arm.

INSTALLATION

1. Guide shock absorber through upper control arm and onto lower shock mounting stud.
2. Extend shock towards upper mount as necessary and install bolt and nut. Torque upper mounting nut. See Specifications at the end of this section for torque value.
3. Install lower shock mounting nut and torque. See Specifications at the end of this section for torque value.
4. Install wheel and wheel stud nuts finger tight.
5. Remove safety stands and lower vehicle. Torque wheel nuts. See Sec. 10, Maintenance Manual X-7525 for torque value and tightening sequence.

TORSION BAR AND/OR CROSSMEMBER SUPPORT

REMOVAL

1. Raise vehicle on a two-post hoist.
2. Remove two nuts and center screw from Tool J-22517-02. Position tool over crossmember, installing pin of tool into hole in crossmember. Install two nuts on tool, install center screw. Grease center screw threads and the rounded end of the screw with chassis grease.
3. Turn center screw until seated in dimple of torsion bar adjusting arm. See figure 24.
4. Remove torsion bar adjusting bolt and nut. Count the number of turns necessary to remove and record.

NOTE: The number of turns necessary to remove the adjusting bolt will be used when installing to obtain the original ride height.

5. Turn center screw of Tool J-22517-02 until torsion bar is completely relaxed.
6. Remove Tool J-22517-02.
7. Repeat steps 2, 3, 4, 5 and 6 on opposite torsion bar.
8. Remove bolts and retainer from torsion bar crossmember at frame (figure 5).
9. Disconnect exhaust pipe hanger from crossmember and loosen pipe saddle and "U" clamp. Slide hanger backward.
10. Move crossmember rearward until torsion bars are free and adjusting arms are removed.
11. Move torsion bar crossmember sideways to the extreme left. Move crossmember upward and outward until opposite end clears exhaust pipe.
12. Remove torsion bars. Mark accordingly to insure proper installation.

INSTALLATION

1. Install torsion bars. New torsion bars are stamped on one end with an "R" for right or an "L" for left side. Apply a liberal amount of chassis grease to both ends.
2. Install crossmember insulators on the crossmembers.
3. Install crossmember and position approximately two inches rearward of its normal position.
4. Raise torsion bars and align with hole in crossmember. Move crossmember forward so torsion bars rest on edge of hole.
5. Insert torsion bar adjusting arm into crossmember. Position so the arm will engage the torsion bar and the end of the arm will be approximately 1 3/4" below the centerline of the crossmember. (Refer to figure 21.) Tap crossmember forward enough to engage bar into arm.
6. Repeat step 5 for the other side of the vehicle.
7. Position crossmember to its normal position. Torsion bar should be through and flush with rear face of the adjusting arm. If torsion bar is not flush with rear face of adjusting arm, repeat steps 5 and 6 after pulling torsion bar slightly out from the lower control arm.

NOTE: There must always be 3/16" to 1/4" clearance between the rear end of the torsion bar and the rear inside face of support crossmember.

8. Install torsion bar retainer over each insulator on crossmember support. Torque nuts (torsion bar retainer bolt nuts). (See figure 5.) See Specifications at the end of this section for torque value.

9. Reposition and connect exhaust pipe hanger to crossmember and tighten saddle and "U" clamp. Torque U-clamp bolt nuts. See Specifications at the end of this section for torque value.

10. Position Tool J-22517-02 over crossmember, installing pin of tool into hole in crossmember. Install two nuts on tool, install center screw.

11. Turn center screw until adjusting arm is in a position to allow installation of adjusting nut. See figure 24.

12. Install nut and turn adjusting bolt the recorded number of turns to obtain previous ride height.

13. Turn center screw until torsion is completely relaxed. Remove tool and repeat steps 10, 11, 12, 13 on the opposite side.

14. Lower hoist.

15. If ride height requires adjustment, refer to "RIDE HEIGHT" immediately following.

ALIGNMENT AND RIDE HEIGHT

RIDE HEIGHT

When checking front ride height, have the vehicle parked on a known level surface, and tire pressure at specified psi.

NOTE: For details on adjusting rear ride height refer to Section 4, REAR SUSPENSION. Vehicles equipped with the Electro-Level Rear Air Suspension System must have power level control switches for right and left hand side of vehicle in "OFF" position. Set center control switch to "TRAVEL AUTO" position prior to adjusting front ride height.

Measurements must be taken from the top of oval hole in the frame rail to ground level (figure 25).

NOTE: Never attempt to increase the ride height of the vehicle using the adjusting bolt only (figure 26). The bolt will turn but will strip threads and will necessitate replacement of the bolt. Always use special tool.

RIDE HEIGHT ADJUSTMENT (FIGURE 25)

NOTE: Tool J-22517-02 (shown in figure 24) must be used the reset ride height. This tool will raise or lower the torsion bar rear anchor arm so that the adjusting bolt is not loaded.

1. Install Tool J-22517-02 with pin of tool aligned into hole in crossmember. Seat center screw in dimple of torsion bar adjusting arm.

2. If vehicle must be raised, turn tool until proper adjustment level is reached, then turn the adjusting bolt until it makes contact with the adjusting arm. Remove tool.

3. If vehicle is to be lowered, raise adjusting arm from contact with adjusting bolt. Lower bolt, then lower arm with tool until proper ride height level is reached. Raise bolt to contact adjustment arm. Remove tool.

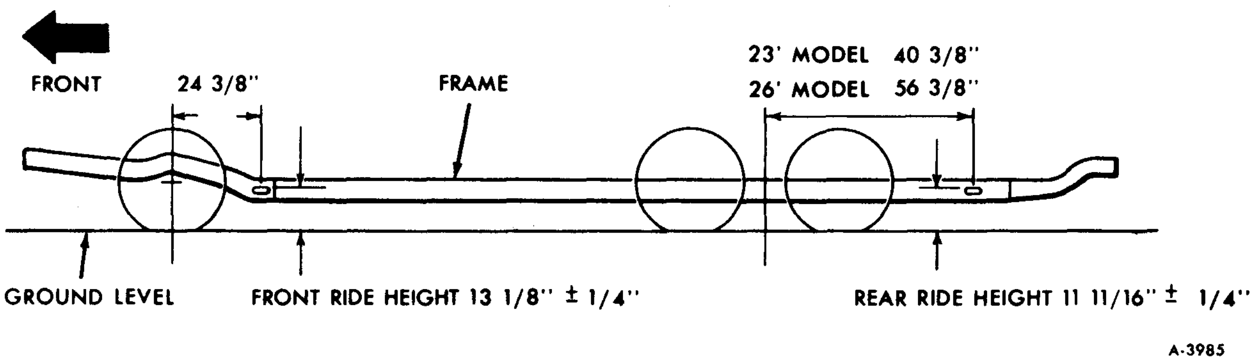


Figure 25—Vehicle Ride Height

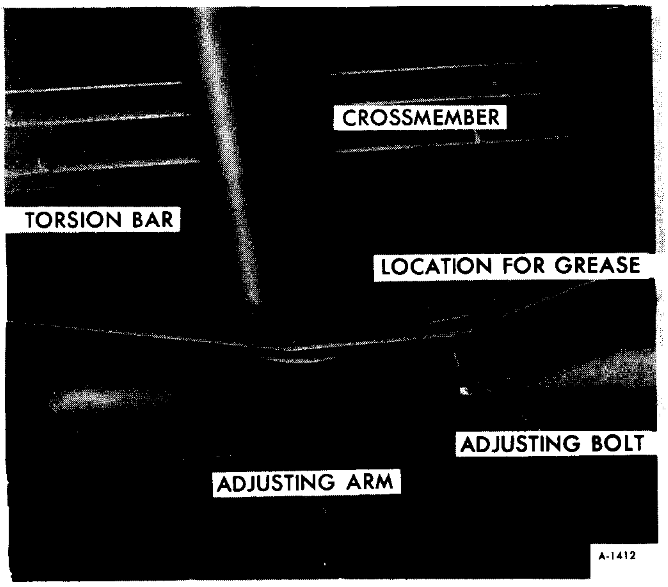


Figure 26—Location for Front Ride Height Adjustment

FRONT END ALIGNMENT

	Check	Set
Caster	$+1\text{-}1/2^{\circ}$ to $+2\text{-}1/2^{\circ}$	$+2^{\circ}$
Camber—L.H.. .	$+1/2^{\circ}$ to 1°	$+3/4^{\circ}$
Camber—R.H.. .	$+1/4^{\circ}$ to $3/4^{\circ}$	$+1/2^{\circ}$
Toe	-1/16" to -3/16" (toe out)	-1/8" (toe out)

Make adjustments as required. Refer to "ALIGNMENT ADJUSTMENT" below.

ALIGNMENT ADJUSTMENT

Camber

1. Loosen nuts on inboard side of upper control arm cam bolts. (figure 5).

2. Turn front cam bolt (inboard or outboard) to correct for 1/2 of incorrect setting found in checking.

3. Turn rear cam bolt (same way front bolt was turned) to correct for remaining 1/2 of incorrect setting found in checking.

Example:

Camber Reading (Checking)............ $+1\text{-}1/4^{\circ}$
Amount To Be Corrected................ $1/2^{\circ}$

$1/2$ of $1/2^{\circ} = 1/4^{\circ}$ Front Cam Bolt
Remaining $1/4^{\circ}$ Rear Cam Bolt

4. Tighten upper control arm cam nuts (front and rear). Torque to Specifications while holding bolts with back-up wrench so that camber is not changed. Check caster; do not reset unless caster exceeds specifications.

NOTE: Check cam adjustment surface for weld splatter. Weld splatter in this area will affect front end alignment. Remove weld splatter if found.

Caster

1. Loosen front and rear cam nuts while holding bolts with back-up wrench so that camber is not changed.

2. Turn front cam bolt so that camber changes 1/4 of the desired amount of caster to be corrected.

Example:

Caster Reading (Checking).................... $+5^{\circ}$
Amount To Be Corrected........................ 3°
$1/4$ of $3^{\circ} = 3/4^{\circ}$ Front Cam Bolt

3. Turn rear cam bolt so that camber now returns to corrected setting.

4. Recheck caster setting.

This is a location to start from and a correct setting can be obtained with the above procedure.

NOTE: Torque upper control arm cam nuts to Specifications. Hold head of bolt securely; any movement of the cam will affect the final setting and caster-camber adjustment must be rechecked.

Toe-In Adjustment

NOTE: Effective with Vehicle Identification Numbers TZE167V101401 (Motorhome), TZE337V101429 (23' TransMode) and TZE367V101393 (26' TransMode), Motorhome and TransMode vehicles are equipped with METRIC TIE ROD CLAMPS. The new torque for these clamps is 16-22 N•m (12-16 ft. lb.). Replacement clamps and fasteners must be correct part number and must be tightened to proper torque specifications.

1. Loosen the clamp bolts at each end of the steering tie rod adjustable sleeves. Tie rod assembly must be decreased in length in order to increase toe-in.

NOTE: Tie rod adjuster components often become rusted in service. In such cases, it is recommended that if the torque required to remove the nut from the bolt (after breakaway) exceeds 7 ft. lbs., discard the nuts and bolts. Apply penetrating oil between the clamp and tube and rotate the clamps until they move freely on the adjuster tube. Install new metric bolts and nuts to assure proper clamping at the specified nut torque. (Refer to figure 27.)

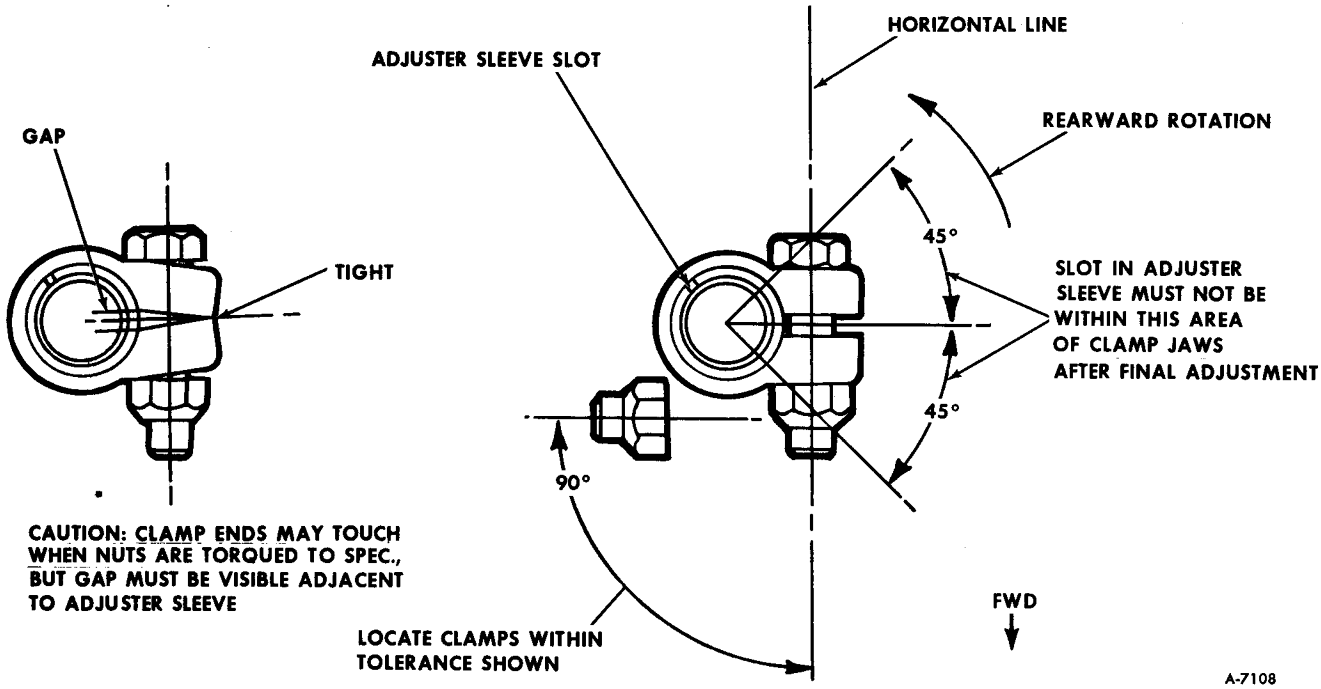


Figure 27—Positioning Tie Rod Clamp

2. With steering wheel set in straight ahead position, turn tie rod adjusting sleeves to obtain proper toe adjustment at curb load.

3. When adjustment has been completed according to the recommended specifications, check to see that the number of threads showing on each end of sleeve are equal and that the tie rod end housings are at right angles to steering arm.

With this same rearward rotation, all bolt centerlines must be between angles shown.

Rotate toward forward, and leave tightened tie rod assembly in its centered position (outer socket square with its stud).

TORQUE SPECIFICATIONS

APPLICATION	IN. LBS.
Exhaust "U" Clamp Bolts (2) (nut torque)	95-150 In. Lbs.
Exhaust Mounting Bracket to Crossmember Bolts (4) (nut torque)	95 - 120 In. Lbs.

APPLICATION	FT. LBS.
Bearing Retainer to Knuckle Bolts (3)	35 Ft. Lbs.
Drive Axle Nut*	110-140 Ft. Lbs. (Do not exceed 280 ft. lbs.)
Disc to Hub Bolts (4)	35 Ft. Lbs.
Stabilizer Link Nut	10 - 15 Ft. Lbs.
Stabilizer Bracket to Frame Screw	20 - 28 Ft. Lbs.
Torsion Bar	
Retainer Bolts (2) (nut torque)	8 - 12 Ft. Lbs.
Crossmember Support Bracket to Frame Bolts (3) (nut torque)	25 - 30 Ft. Lbs.
Tie Rod to Knucke Nut *	40 - 50 Ft. Lbs.
Tie Rod Clamp Nuts (2) (16-22 N.m)	12 - 16 Ft. Lbs.

TORQUE SPECIFICATIONS (CONT'D)

APPLICATION	FT. LBS.
Shock Absorber	
Upper Attaching Bolt (nut torque)	80 - 95 Ft. Lbs.
Lower Attaching Bolt (nut torque)	80 - 95 Ft. Lbs.
Upper Control Arm Ball Joint to Control Arm Bolts (4) (nut torque)	20 Ft. Lbs.
Upper Control Arm to Frame Bracket Bolts (2) (cam nut torque)	80 - 95 Ft. Lbs.
Lower Control Arm to Frame Bracket Bolts (2) (nut torque)	75 - 85 Ft. Lbs.
Ball Joint Stud Nut - Lower *	40 - 60 Ft. Lbs.
Ball Joint Stud Nut - Upper *	100 - 125 Ft. Lbs.

NOTE: All stud tapers on all ball joints must be kept sufficiently free of lubricant to prevent excessive pull in mating tapered holes.

***NOTE:** After reaching minimum torque required, nut must always be tightened to insert cotter pin. Never back nut off.

SPECIAL TOOLS

J-2619-01	Slide Hammer
J-8433-1	Puller Bar
J-9745	Front Hub Bearing Installer
J-21474-3-4-5	Control Arm Bushing Remover and Installer
J-22214-4-6	Front Hub Bearing Screw and Adapter
J-26559	Front Wheel Bearing Puller Ring
J-22269	Brake Caliper Collapser
J-22517-02	Torsion Bar Unloader
J-24319-01	Ball Joint, Pitman Arm and Idler Arm Puller
J-24717	Front Hub Puller
J-26485	Knuckle Seal Installer
J-22585	Front Hub Retainer Bolt Wrench
J-5504-01	Wheel Stud Remover

SECTION 3C
FINAL DRIVE

The information described in Maintenance Manual X-7525 under the heading FINAL DRIVE (SEC. 3C) is applicable to models covered by this supplement with the addition of the following illustration, showing new final drive attachment to engine (figure 1). Note that final drive bracket shown in Maintenance Manual X-7525 is no longer used.

Figure 1—Disconnecting Final Drive From Engine

SECTION 4

REAR SUSPENSION

CONTENTS

SECTION 4A

1977 REAR SUSPENSION

The information described in Maintenance Manual X-7525 under the heading REAR SUSPENSION (SEC. 4) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

GENERAL DESCRIPTION

There are two types of rear air suspension systems available in the 1977 Motorhome and TransMode vehicles — the standard air system and the Electro-Level I System (optional). The standard suspension system operates automatically as vehicle load varies to retain frame at proper ride height. The optional Electro-Level system provides the ability to raise or lower the rear of the vehicle approximately four inches from normal ride height.

The rear suspension system (either type) on the vehicle exterior consists of air bellows, shock absorbers, control arms and height control valves. Suspension control components — air compressor, wet tank, solenoid valves and

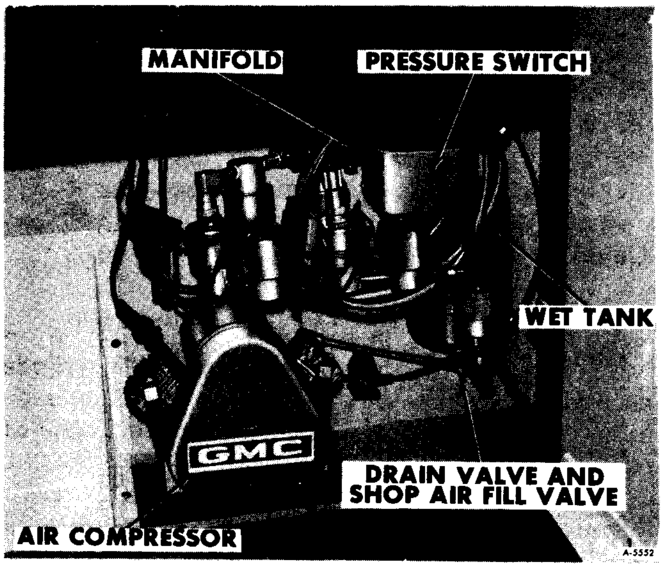


Figure 1—Air Suspension Control Components (Typical) (Model ZE06581)

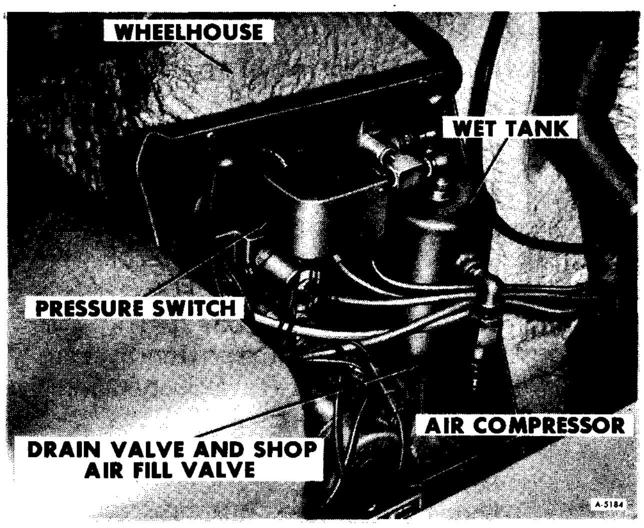


Figure 2—"TWIN BED" Air Suspension Control Components (Typical) (Model ZE06584)

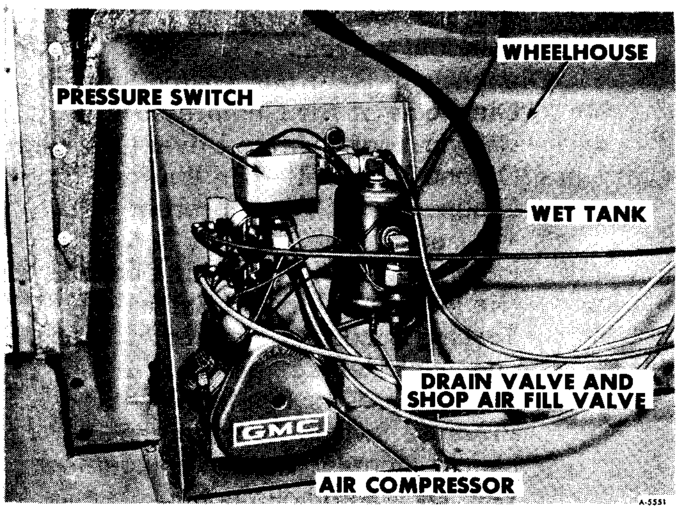


Figure 3—TRANSMODE Air Suspension Control Components (Typical) (Models ZE06083, ZE06583)

pressure switch — are positioned in a control module inside the vehicle. This module is located in the closet of Motorhome model ZEO6581 (figure 1), beneath the left rear twin bed in Motorhome model ZEO6584 (figure 2), and in front of the left rear wheelhousing in TransMode models ZEO6083 and ZEO6583 (figure 3). Control components vary slightly from standard to Electro-Level I suspension (as discussed following).

SYSTEM OPERATION

STANDARD REAR SUSPENSION SYSTEM

As stated, the standard suspension system operates automatically as vehicle load varies to retain frame at proper ride height. Compressed air flows to and from the air bellows as determined by the height control valves.

AIR FLOW (REFER TO FIGURE 4)

The air flow in the standard suspension system is controlled by two components: the height control valves (bolted to the wheel well and linked to the control arm) and two 2-way normally closed solenoid valves (located in the air suspension control module inside the vehicle). These electrically actuated air valves, when closed or de-energized, block air flow either to or from the bellows. This helps to maintain proper ride height with a minimum possibility of leak down.

When the ignition key is turned to the "ON" or "ACCESSORY" position, these valves are electrically energized, allowing positive air flow in either direction (ie., into or out of the bellows). The demand for air is "read" by the height control valves, which move up and down with the frame as ride height varies.

However, these valves will allow air into or out of the bellows only when a change in vehicle load causes actuation of the valve inlet or exhaust cores. Road bumps and irregularities move the HC valves within a free travel range, without adding or releasing compressed air to the system.

ELECTRO-LEVEL I REAR SUSPENSION SYSTEM

The optional Electro-Level I system operates automatically or manually. In automatic mode, the suspension is adjusted as vehicle load varies, to retain frame at proper ride height. Compressed air flows to and from the air bellows as determined by the height control valves. In addition, however, the Electro-Level I system provides the ability to raise or lower the rear of the vehicle approximately four inches from normal ride height. The control components and the physical system on the vehicle are the same as those on the standard system, with the addition of four 3-way solenoid valves.

The Electro-Level driver control switches are mounted on the lower dash panel to the right of the steering wheel (figure 5). The controls consist of three rocker switches that automatically or manually level the vehicle. Figure 6 is a schematic of the Electro-Level controls.

SWITCHES

The two RAISE-LOWER switches are used as necessary to raise or lower the rear of the vehicle (as when parked on surface that is not level). Engine need not be running to operate the system in either of these modes. However, the ignition switch must be in the "ON" or "ACCESSORY" Position.

The center TRAVEL switch has two positions — TRAVEL HOLD and TRAVEL AUTO.

TRAVEL HOLD is the switch position to be used for normal highway driving. This mode allows the vehicle to maintain a designed ride height and eliminates unnecessary operation of the air compressor. TRAVEL AUTO is the position to be used to "ready" the vehicle for highway driving after it has been parked in a raised or lowered position. This leveling of the vehicle will take place in the first five minutes with the rocker switch in TRAVEL AUTO position.

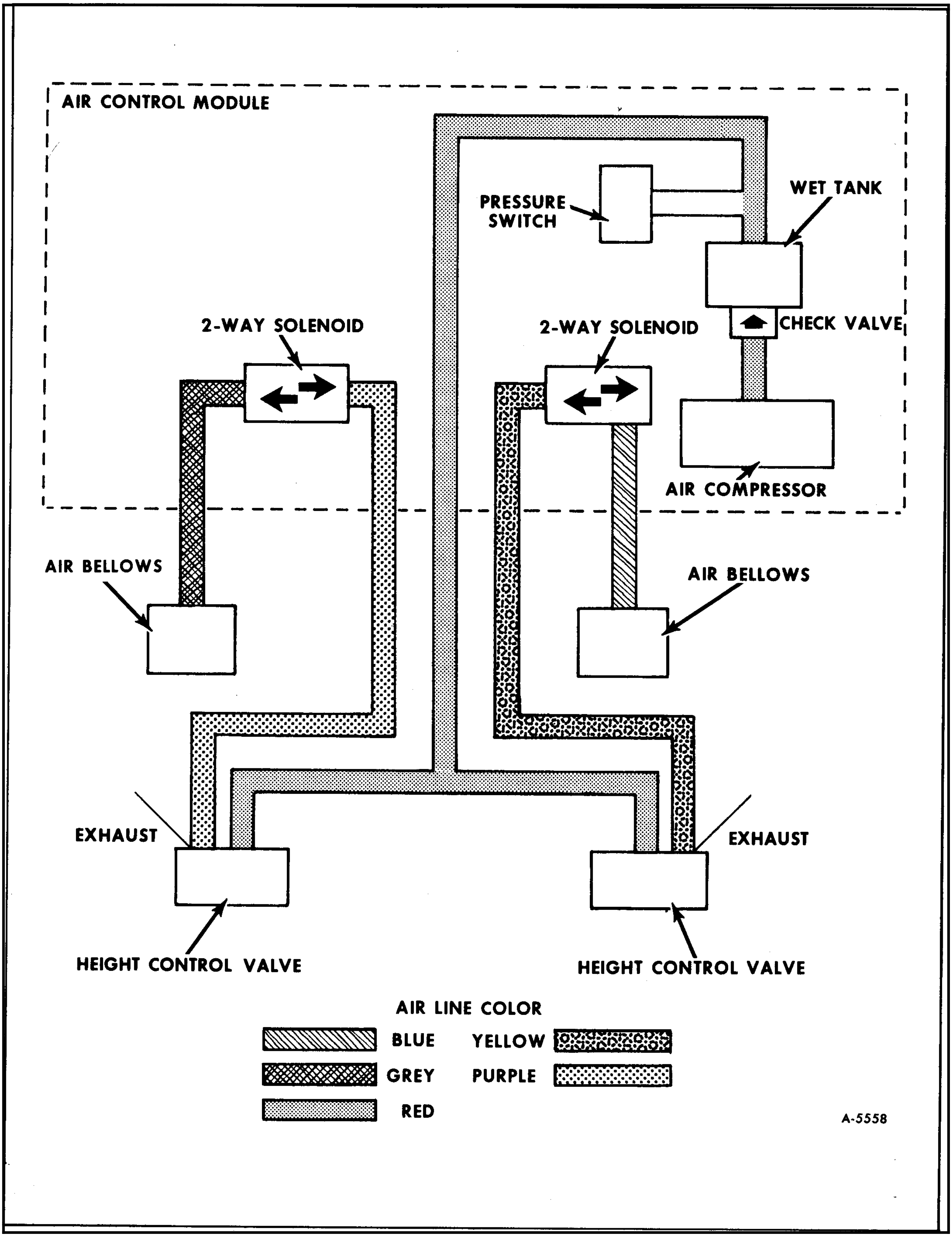


Figure 4—Standard Air Suspension System Schematic

A-6051

Figure 5—Electro-Level Controls

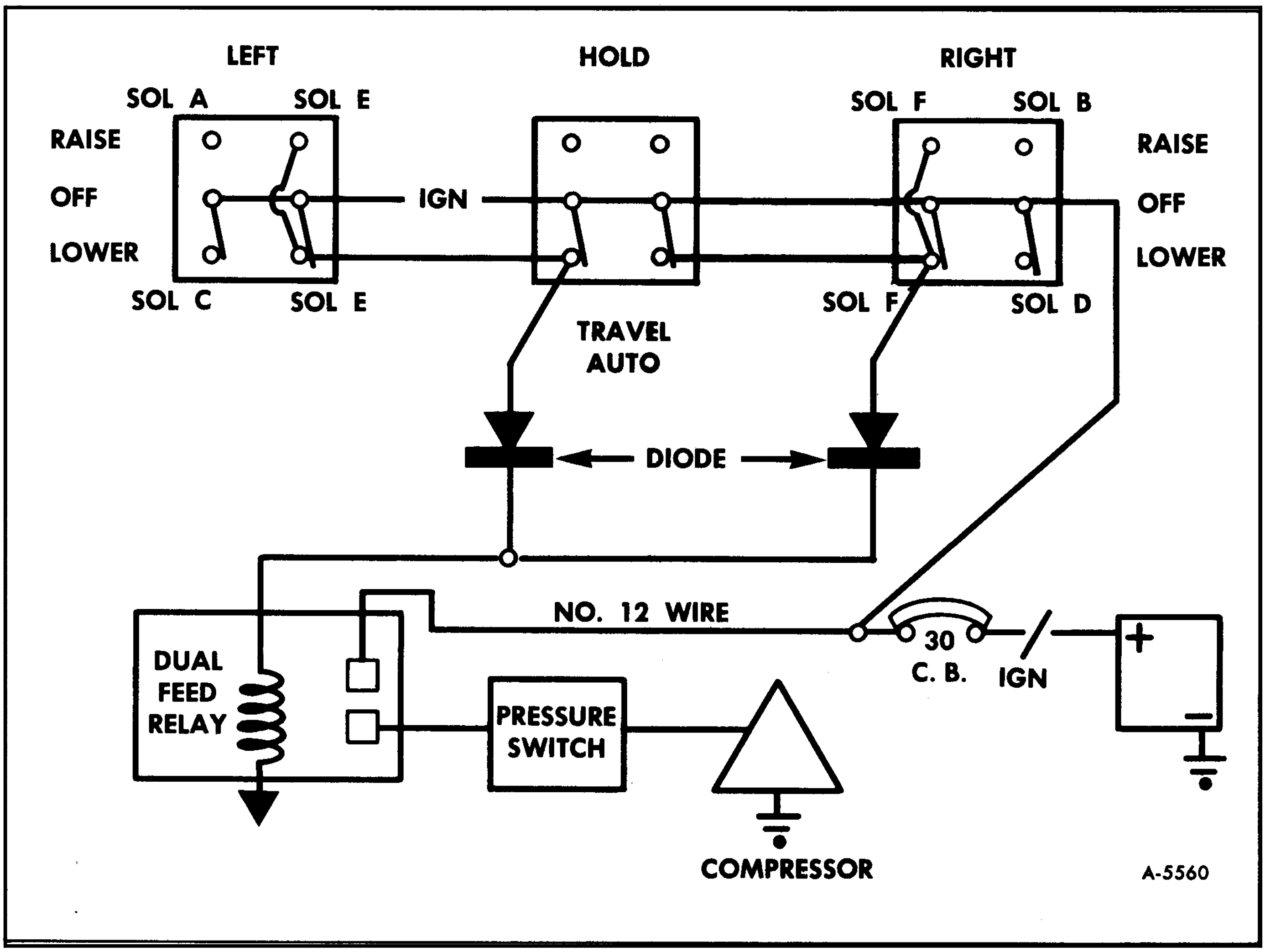


Figure 6—Electro-Level Controls Schematic

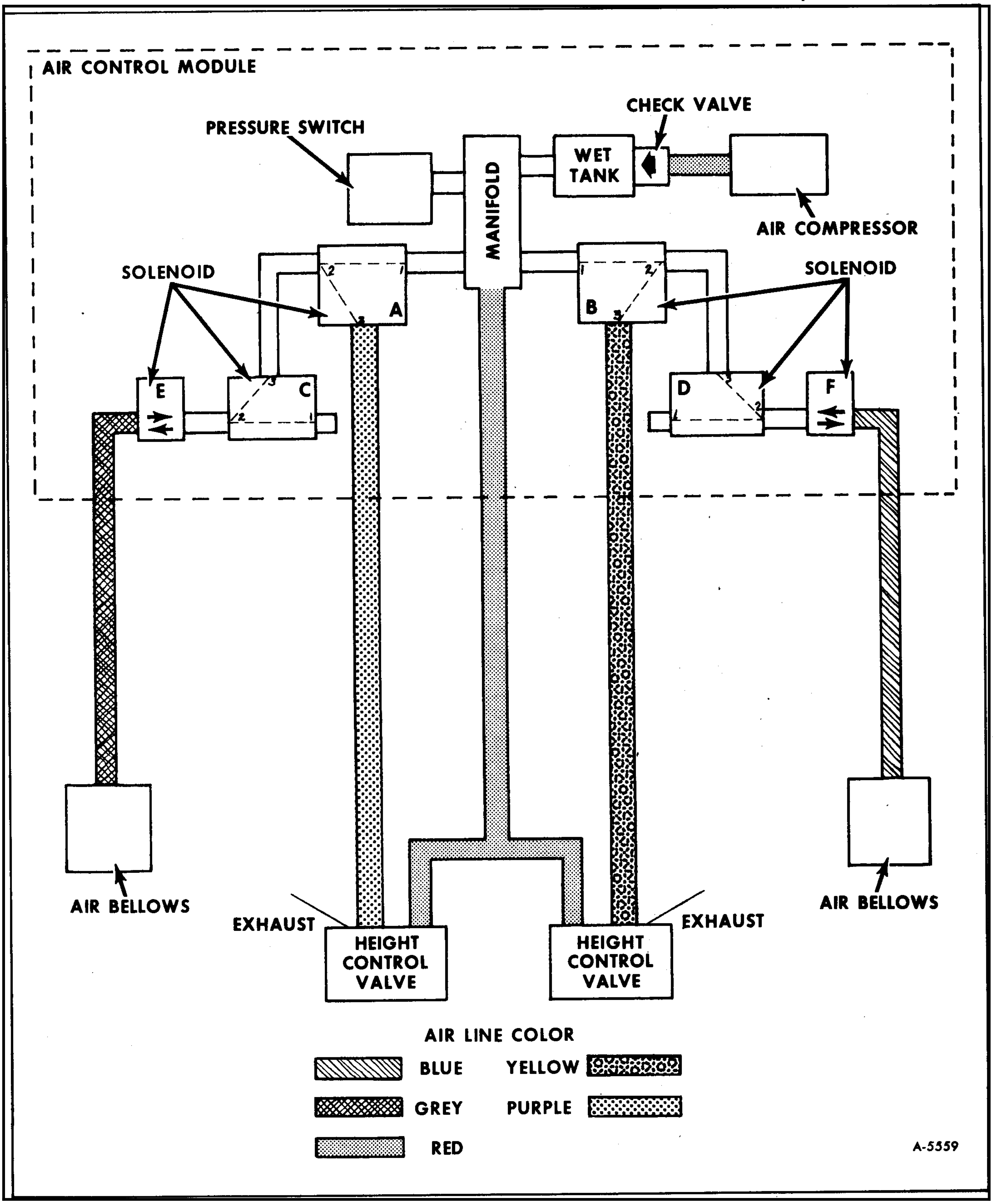


Figure 7—Electro-Level Air Suspension System Schematic

AIR FLOW (REFER TO FIGURE 7)

The air flow in the system (to or from the air bellows) is controlled by switch position on the Electro-Level control panel.

When the center switch is placed in TRAVEL AUTO, only the two-way solenoids "E" and "F" are open, i.e., energized. If air is needed in the system, this mode will allow air to flow from the compressor through the height control valve and further through solenoids "A", "C" and "E" on the left side to the bellows. On the right side, air will flow through solenoids "B", "D" and "F" to the bellows. The air flow can occur because the 3-way solenoids ("A", "B", "C", "D") will allow air to pass from the No. 3 port to the No. 2 port even though they are not electrically actuated. This is the normal air flow of these valves when they are de-energized.

When leveling requires pressure to be released from the system, TRAVEL AUTO position allows the necessary air flow from the bellows through the appropriate solenoids to the exhaust fiting at the height control valve. Two-way solenoids "E" and "F" are energized for this demand. Three-way solenoids "A", "B", "C" and "D" are de-energized yet will allow air to pass from the No. 2 to the No. 3 port.

When the vehicle is moving, the center switch should be in TRAVEL HOLD position, (with the RAISE-LOWER switches in "OFF"). In this mode the 2-way solenoids "E" and "F" are closed (i.e., de-energized), trapping air in the bellows and isolating the bellows from the rest of the system. This means the only possible areas of leakage will be the bellows themselves, the fittings at the solenoids, or the air line running between. The same air flow situation exists when the vehicle is parked and the key is in "OFF".

When the vehicle is in RAISE position, air flow is different. Solenoids "A" and/or "B" are electrically actuated. System pressure no longer goes through these valves from the No. 3 port to the No. 2 port. Instead, this passage within each valve is blocked and air must flow from the No. 1 to the No. 2 port. This means that the height control valve is now taken "OUT" of the system. Air moving through solenoids"A" or "B" is regulated only by the rocker switch on the dash panel. Air flow will continue through solenoids"C" and "E" to the left side bellows or "D" and "F" to the right side bellows. In this mode, the two-way solenoids "E" and "F" are energized also.

To lower the system, the RAISE-LOWER switch on the dash will be set in the LOWER position (right- or left-hand side, or both). With both RAISE-LOWER switches in LOWER, solenoids "C" and "D" are energized. This causes the normal passage of air between the No. 3 port and the No. 2 port to be blocked. Air flows instead from the bellows through open solenoids "E" and "F", and then from the No. 2 to the No. 1 (exhaust) ports in solenoids "C" and "D". Thus the vehicle ride height lowers by the release of air to the atmosphere through the exhaust ports of the "LOWER" solenoids.

SYSTEM COMPONENTS

CONTROL ARMS

The rear suspension control arms (one on either side of air bellows) attach to a control arm mounting bracket which in turn mounts to the vehicle frame rail. The control arms support the air bellows and the tandem rear wheels.

AIR BELLOWS

The air bellows for the tandem rear wheels are mounted between the control arms. On each side of the air bellows is a piston which is connected directly to the control arm.

The air bellows serve as a flexible connection between the two control arms on each side of suspension bracket. The flexing of the air bellows allows the control arms to move up and down in relation to the frame. This action absorbs road shocks in the same manner as an inflated rubber tire cushions shock caused by road roughness.

SHOCK ABSORBERS

A double acting shock absorber is used at each wheel on the rear suspension. The shocks are mounted to the top of the control arms and to the frame at the bottom.

The shock absorbers are gas filled cell-type shocks. They are filled with a calibrated amount of fluid and sealed during production. They are nonadjustable, nonrefillable and cannot be disassembled. The only service they require is replacement if they have lost their resistance, are damaged or leaking fluid.

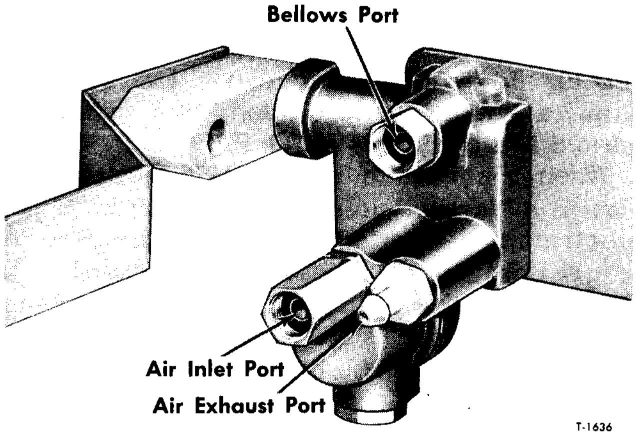


Figure 8—Height Control Valve (Port Identification)

HEIGHT CONTROL VALVE

(REFER TO FIGURE 8)

Height control valve automatically maintains a constant vehicle height by controlling the flow of compressed air into or out of suspension system air bellows. A delay piston in each valve provides a momentary delay in intake and exhaust valve action. Therefore, air in bellows is exhausted only during load changes and not during intermittent road bumps.

The height control valve contains an intake valve, air bellows outlet, exhaust valve, delay piston, and overtravel control body. The overtravel control body contains a spring-loaded nylon piston which protects valve part if overtravel lever is moved beyond normal operating range.

HEIGHT CONTROL VALVE OPERATION – (FIGURE 9)

Loading

When vehicle is being loaded, frame tends to settle. Since valve is linked to control arm, and valve is bolted to wheel well, valve moves downward with frame as vehicle is loaded. As valve arm and control shaft turns, a force is applied to the delay piston which moves slowly and allows the intake valve lever to move against the intake valve core. As pin is pushed in, air pressure flows through height control valve into bellows. Increased air pressure expands the bellows and raises frame.

Inlet valve is "PROTECTED" by check valve in inlet adapter. Light spring in core freely admits reservoir air, but return flow of air is blocked.

Neutral Position

As increased air pressure expands bellows and lifts frame, the height control valve moves upward with frame. As frame is returning to normal ride height, valve arm and shaft return to a neutral position. Inlet valve lever also moves away from inlet valve core and inlet valve closes. This stops the flow of air into bellows. The exhaust valve remains closed. Since the exhaust valve is closed, and the check valve in the inlet adapter prevents compressed air from returning to air reservoir, air is trapped in bellows and in valve. No

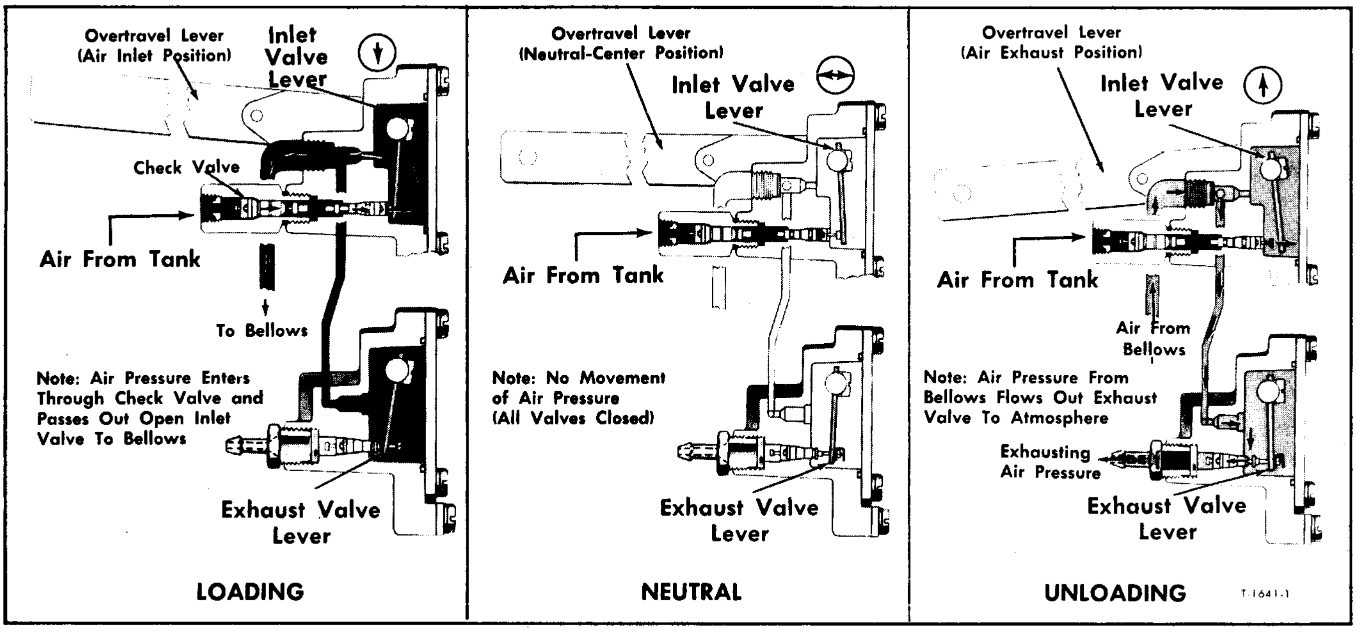


Figure 9—Operation of Height Control Valve

further valve action or air pressure change takes place until load is increased or decreased, moving valve arm out of neutral positon for four seconds or more to actuate intake valve or exhaust valve.

Unloading

When part of load is removed, air pressure in bellows lifts frame. Valve arm, linked to axle, is pulled downward from neutral position. This applies a force on the delay piston, which moves it slowly. The exhaust valve lever moves with the delay piston. The outer end of exhaust valve lever fits around stem of exhaust valve core.

As soon as lever moves beyond free-travel range, lever pulls on stem and opens exhaust valve. Inlet valve remains closed.

Compressed air from bellows then flows through the open exhaust valve and out exhaust fitting to atmosphere. As the compressed air is exhausted from bellows, the frame lowers until overtravel lever and shaft are again in normal (neutral) position.

Valve Arm Free Travel

With vehicle in motion and frame at normal ride height, control valve arm and shaft are in neutral position. Small irregularities in the road cause slight up and down movement of valve arm.

Clearances are provided between operating levers and cores of inlet and exhaust valves, to permit 1/4-inch up or down movement of valve arm from neutral position without causing valve action.

This compensates for small road bumps. The bumps are absorbed by tires and bellows without causing movement of compressed air either into or out of suspension system.

Hydraulic Delaying Action

Operation of delay piston in height control valve prevents change of bellows air pressure as a result of momentary road shocks, conserves air supply, and adds life to valve.

The nylon piston moves inside cylinder containing a silicone type fluid. A flapper valve on either end of piston allows displacement of fluid or acts as a check valve, depending on direction piston moves.

Delay piston is moved by piston pin that is threaded into overtravel shaft. A 4 to 18 second delay exists from the closing of one valve to the opening of other valve.

Overtravel piston is held against flat side of overtravel shaft by two springs inside piston. Piston keeps overtravel shaft in proper position relative to valve arm.

Piston also allows valve arm to rotate through a complete circle, if necessary, without damaging parts inside valve.

AIR COMPRESSOR

Compressed air for the system is supplied by an electric compressor which operates when the ignition key is in the "ON" or "ACCESSORY" position.

It is a demand-type compressor which will start compressing air when the pressure in the

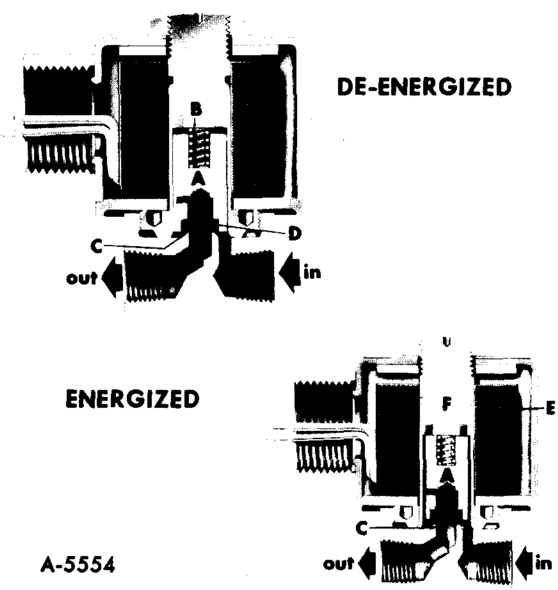


Figure 10—Two-Way Normally Closed Solenoid Valve

system drops below 100 psi, and will shut off when the pressure reaches 120 psi.

normal air compressor operation is encountered.

WET TANK

The purpose of the wet tank (or air tank) is to provide a place where the air, heated during compression, can cool and water vapor can condense. A drain and shop air fill valve is located at the bottom of the tank.

The wet tank should be drained at 3-month or 3,000-mile intervals, or more often if above

PRESSURE SWITCH

The air pressure switch is designed to maintain air pressure in the wet tank between 100 and 120 psi. Switch activates at 100 psi and opens at 120 psi.

SOLENOID VALVES

Air flow in the rear suspension system is electrically controlled by two solenoid air valves on the standard system and four additional solenoid air valves on the optional Electro-Level I System.

The two valves on the standard system are two-way, normally closed valves.

The four additional solenoid valves on the optional Electro-Level I system are three-way multipurpose valves plumbed to function either as three-way normally closed valves or three-way directional control valves.

TWO-WAY NORMALLY CLOSED SOLENOID VALVE —

This is a valve in which the single orifice is closed in the de-energized position and no flow can exist between the inlet and the outlet ports (figure 10).

THREE-WAY VALVE —

This is a valve that has 2 orifices and three ports. One orifice is always open when the other is closed and one port is always open to one of the other two ports.

Flow is controlled by electrically opening or closing either of the two orifices (figure 11).

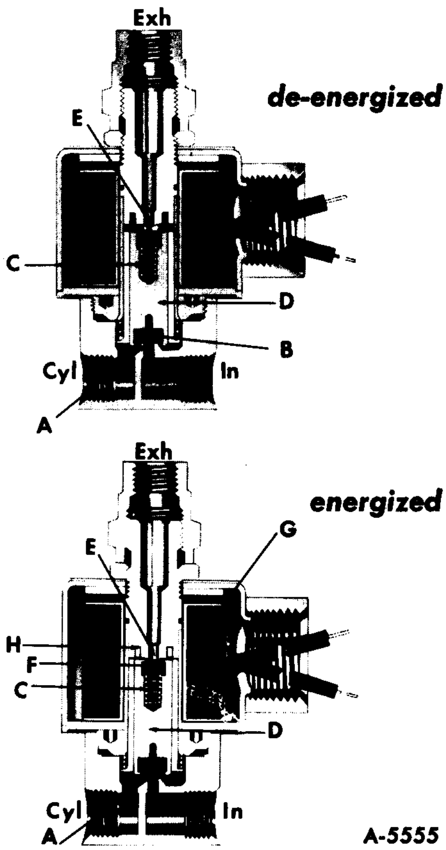


Figure 11—"Three-Way Solenoid Valve

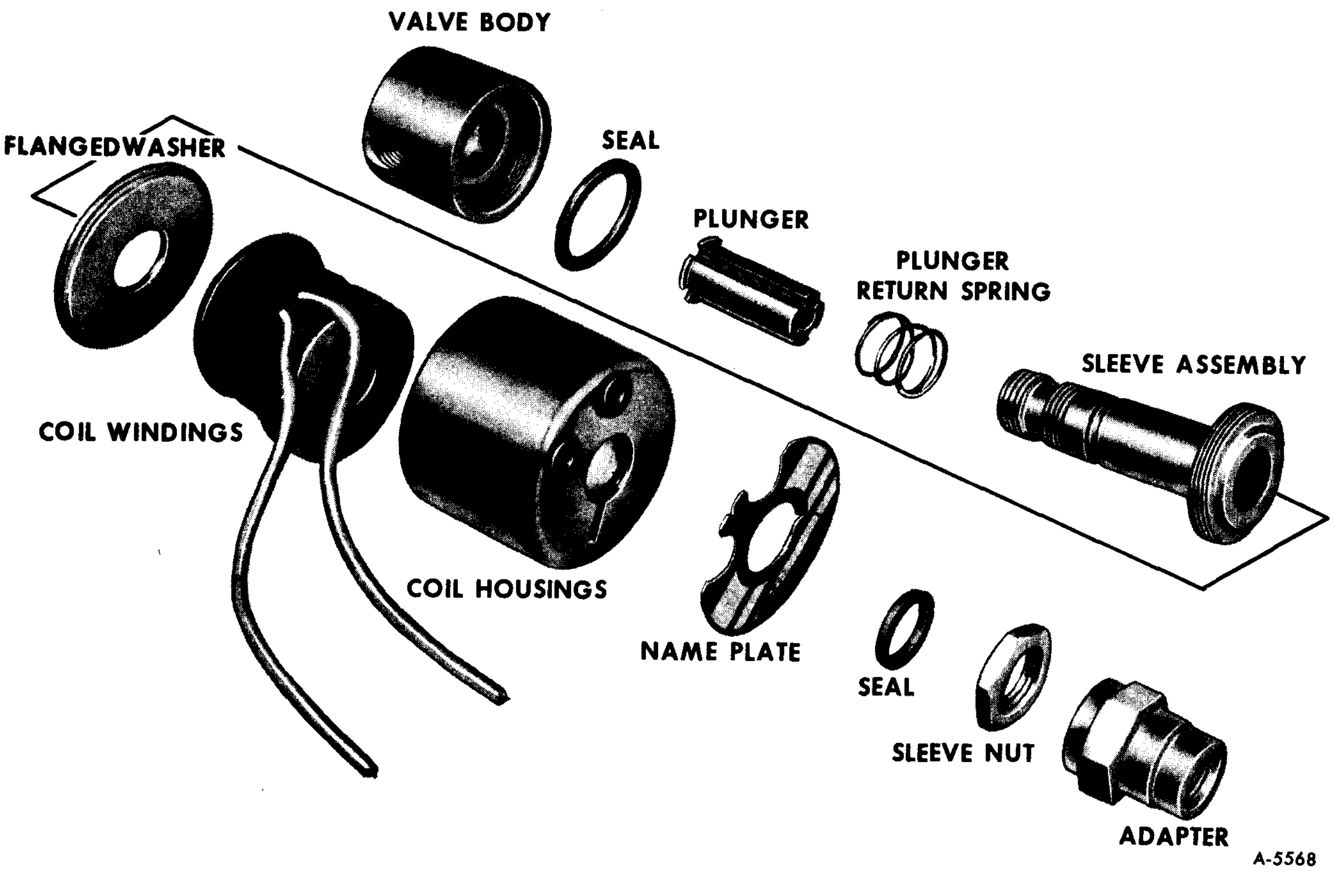


Figure 12—Solenoid Valve Components

PRINCIPLES OF OPERATION

The solenoid valve is an electromagnet so arranged that when current is applied to the coil (when the valve is "energized") the plunger either opens or seals an orifice, thereby controlling the flow of air. Typical solenoid valve components are shown in figure 12.

The solenoid valve has two basic functional parts: a solenoid coil and a plunger or armature. The coil surrounds the plunger which has a soft synthetic seal at one end. The valve body has an orifice which is sealed by the insert in the plunger. The orifice is opened or closed by the movement of the plunger. The coil causes the plunger to move when the coil is energized. When the coil is de-energized the plunger is returned to its original position by means of a spring.

The only moving parts of the valve are the plunger and the spring which are enclosed in the sleeve assembly. This arrangement within the sleeve is referred to as an internal solenoid. The plunger closes the negative circuit of the coil by coming into "face to face" contact with the stop. The stop, magnetic steel, is welded to a nonmagnetic steel tube which is welded to a magnetic stainless steel flange to make up the sleeve assembly. The "face to face" design permits the plunger to be spring loaded for positive operation regardless of valve mounting position.

DIAGNOSIS OF REAR SUSPENSION SYSTEM (1977)

DIAGNOSIS OF AIR COMPRESSOR

(REFER TO FIGURES 4 AND 7)

PROBLEM	POSSIBLE CAUSE	CORRECTION
COMPRESSOR NOT OPERATING. NO AIR PRESSURE.	1. Open circuit breaker. (Circuit breaker is located behind glove box door.)	1. Find cause of circuit breaker being open and correct it.

DIAGNOSIS OF AIR COMPRESSOR (CONT'D) (REFER TO FIGURES 4 AND 7)

PROBLEM	POSSIBLE CAUSE	CORRECTION
	2. Faulty wiring. (Compressor feed at ground wire not connected.)	2. Check to see that wiring is intact.
	3. Low battery.	3. The compressor runs off the automotive battery. Check battery condition and correct as necessary.
	4. Faulty pressure switch.	4. Replace pressure switch.
	5. Compressor motor has developed an open circuit.	5. Motor brushes or commutator worn out. Replace motor.
	6. Defective diode. (Electro-Level option only.)	6. Replace diode assembly in wiring harness. (See figure 17).
	7. Defective relay.	7. Replace relay.
COMPRESSOR OPERATES. NO AIR PRESSURE	1. Leak in air system.	1. Eliminate air leaks in system as described later in this sectior
	2. Compressor valve seat or valve spring worn or broken.	2. Replace valve seat and/or valve spring.
	3. Piston rings are worn—air leaks heavily at rings.	3. Replace piston rings.
	4. Pressure switch not properly adjusted.	4. Adjust pressure switch settings to operate at the 100-120 psi range.
AIR PRESSURE IN SYSTEM. COMPRESSOR OPERATES ERRATICALLY—TAKES TOO LONG TO PRESSURIZE SYSTEM.	1. Air leak in system.	1. Eliminate air leaks in system as described later in this section.
	2. Compressor valve seat or valve spring broken or worn.	2. Replace valve seat and/or valve spring.
	3. Piston rings are worn—air leaks heavily by rings.	3. Replace piston rings.
	4. Pressure switch contacts are pitted causing improper compressor action.	4. Replace pressure switch.
	5. Battery voltage too low to operate motor.	5. Charge battery.
	6. Bearing failure which causes unit to seize occasionally and break loose if galling occurs.	6. Replace bearings or parts with bearings.
AIR LINES FROZEN UP.	1. Water in lines	1. Drain wet tank.

DIAGNOSIS OF ELECTRO-LEVEL CONTROLS

(REFER TO FIGURE 6)

PROBLEM	POSSIBLE CAUSE	CORRECTION
COMPLETE OR PARTIAL LOSS OF AIR WITH TRAVEL SWITCH IN "HOLD".	1. Leak in air bellows. 2. Leak at air lines between bellows and solenoid. 3. Leak in 2-way solenoid.	1. Eliminate air leak. 2. Eliminate air leak. 3. Service or replace solenoid.
COMPLETE OR GRADUAL LOSS OF AIR OVER-NIGHT AT CAMP-SIGHT WITH IGNITION OFF.	1. Leak at air bellow. 2. Leak in air line between sole-noid and bellows. 3. Leak at fitting between sole-noid and air line or bellows and air line. 4. Defective 2-way solenoid valve.	1. Eliminate air leak. 2. Eliminate air leak. 3. Eliminate air leak. 4. Service or replace solenoid
COMPLETE OR PARTIAL LOSS OF AIR WITH TRAVEL SWITCH IN "AUTO", IGNITION ON. (COMPRESSOR RUNS TOO FRE-QUENTLY).	1. Air leak in system. 2. Defective height control valve.	1. Eliminate air leak. Note: Vehicle should be operated with travel switch in "HOLD" position. Do not operate vehicle with travel switch in "AUTO". 2. Service or replace valve.
TRAVEL SWITCH IN "AUTO". NOTHING HAPPENS.	1. Compressor not operating. 2. Defective control switch. 3. Defective pressure switch. 4. Defective diode. 5. Defective wiring. 6. Check relay. 7. Defective solenoid valves. 8. Leak at air bellows. 9. Leak in air lines.	1. Check feed at ground wire. 2. Replace switch. 3. Replace switch. 4. Check diode. Replace as re-quired. 5. Check wiring and electrical connections. 6. Replace relay. 7. Service or replace solenoid valves. 8. Eliminate air leak. 9. Eliminate leak.
LEFT OR RIGHT SWITCH IN "RAISE" POSITION. VEHICLE DOESN"T RAISE. COM-PRESSOR RUNS.	1. Leak in air lines. 2. Solenoid valves plumbed incorrectly. (RAISE solenoids.) 3. Faulty HOLD solenoid valves. 4. Faulty RAISE solenoid. 5. Faulty control switch. 6. Defective wiring between control switch and solenoid.	1. Eliminate air leak. 2. Properly install solenoid valve. 3. Service or replace valves. 4. Follow bench check of solenoid. Service or replace as necessary. 5. Replace switch. 6. Check wiring and electrical connections.
LEFT OR RIGHT SWITCH IN "RAISE" POSITION. VEHICLE DOESN'T RAISE. COMPRES-SOR NOT OPERATING.	1. Open circuit in compressor motor. 2. Defective relay. 3. Open in pressure switch. 4. Battery undercharged.	1. Motor brushes or commutator worn out. Replace motor. 2. Clean contacts or replace relay. 3. Pitted contacts. Replace pres-sure switch. 4. Charge or replace automotive battery.

DIAGNOSIS OF ELECTRO-LEVEL CONTROLS (CONT'D)

(REFER TO FIGURE 6)

PROBLEM	POSSIBLE CAUSE	CORRECTION
	5. Defective diode.	5. Replace diode.
	6. Defective wiring. (Compressor feed at ground wire not connected.)	6. Check wiring and electrical connections.
	7. Open circuit breaker.	7. Check for cause of open circuit breaker. Reset.
	8. Faulty control switch.	8. Replace switch.
LEFT OR RIGHT SWITCH IN "LOWER" POSITION. VEHICLE DOESN'T LOWER.	1. LOWER solenoid valves incorrectly plumbed.	1. Correctly install solenoid valves.
	2. Undercharged battery.	2. Charge or replace battery.
	3. Defective wiring.	3. Check wiring and electrical connections.
	4. Open circuit breaker.	4. Find cause for open circuit breaker. Reset.
	5. Defective solenoid valves.	5. Service or replace solenoid valves.
	6. Defective control switch.	6. Replace switch.

DIAGNOSIS OF TELL-TALE WARNING LIGHT "SET LEVEL TO TRAVEL AUTO"

(REFER TO FIGURE 13)

PROBLEM	POSSIBLE CAUSE	CORRECTION
START VEHICLE. MOVE TRANS-MISSION SELECT-OR LEVER TO "DRIVE" POSITION.	1. Defective bulbs (two bulbs.)	1. Replace light bulbs.
	2. Defective time delay relay.	2. Replace thermal time-delay relay (located behind instrument panel). (Refer to Section 12 of this supplement).
TELL-TALE LIGHT DOES NOT ILLUM-UMINATE.	3. Defective tell-tale warning light fuse.	3. Replace fuse. (Fuse is located in fuse panel behind glove com-partment).
	4. Defective wiring.	4. Check wiring and electrical connections.
	5. Defective neutral start, B/U, and safety switch.	5. Adjust switch or replace as necessary.
START VEHICLE. MOVE TRANS-MISSION LEVER TO "DRIVE" POSITION. TELL-TALE LIGHT ONLY PARTIALLY ILLUMINATES	1. Defective light bulb.	1. Replace burnt out bulb.

DIAGNOSIS OF TELL-TALE WARNING LIGHT "SET LEVEL TO TRAVEL AUTO" (CONT'D)

PROBLEM	POSSIBLE CAUSE	CORRECTION
START VEHICLE. MOVE TRANS-MISSION LEVER TO "DRIVE" POSITION. TELL-TALE LIGHT REMAINS ON AFTER 10-15 SECOND DELAY.	1. Defective time-delay relay.	1. Replace relay.
START VEHICLE. TALL-TALE LIGHT INTERMITTENTLY LIGHTS WHEN MOVING TRANS-MISSION SELECTOR LEVER TO "DRIVE"	1. Defective time-delay relay. 2. Defective neutral start, B/U and safety switch.	1. Replace relay. 2. Adjust switch or replace as necessary.

DIAGNOSIS OF SHOCK ABSORBER

PROBLEM	POSSIBLE CAUSE	CORRECTION
SHOCK ABSORBER— WEAK.	1. Low or uneven tire pressure.	1. Inflate tires to recommended pressure.
	2. Excessive or incorrect vehicle loading.	2. Instruct driver.
	3. Worn out shock absorber. Front.	3. Perform on-vehicle test. Push down and lift up at end of bumper nearest front shock in question. Right and left shocks must be comparable in rebound resistance to compression ratio (usually 2 to 1). If in doubt compare with vehicle having acceptable ride quality.
	4. Worn out shock absorber. Rear.	4. Disconnect the lower shock mountings. Stroke shocks at various rates of speed through maximum travel in both directions. Compare side to side for rebound and compression resistance. Rebound resistance is normally stronger than compression (approximately 2 to 1). It is mandatory that right and left shocks feel comparable. If in doubt about condition, compare with a known good shock.

DIAGNOSIS OF SHOCK ABSORBER (CONT'D)

PROBLEM	POSSIBLE CAUSE	CORRECTION
SHOCK ABSORBER— NOISY.	1. Loose mounting.	1. Check all shock mounting torques (bolt and/or nut).
	2. Faulty shock absorber.	2. Observe hoisting instructions and instructions for removal of front shock absorbers. Clamp shock upside down. Clamp vise on top mount with shock vertical in vise (do not clamp on reservoir tube). Rear shocks may be tested on the vehicle by disconnecting the lower mount. Completely extend to full rebound then exert an extra pull. If a "give" is felt, a loose piston is indicated and the shock should be replaced. A hissing noise (orifice swish) is normal; however, replace shock absorber for any of the following: 1. A skip or lag at reversal near mid-stroke. 2. A seize (except at either extreme end of travel). 3. A noise such as a grunt or squeal after completing one full stroke in both directions. 4. A clicking noise at fast reversal.
SHOCK ABSORBER— LEAKS.	1. Faulty shock absorber.	1. A slight trace of shock fluid is NOT cause for replacement as the seal permits some seepage for lubrication of the piston rod. The shock contains a fluid reverse to compensate for seepage. A shock that is truly leaking is easily detected as there will be evidence of shock fluid around the seal cover and on down the reservoir tube; any leaking shock should be replaced.

AIR LEAKS

With the air system at normal operating pressure, coat all suspension air line connections with soap and water solution. Air leakage will produce soap bubbles. No leakage is permissible. Leakage at air line connections can sometimes be stopped by tightening connection. If this does not stop the leak replace the affected fittings.

1. Cut end of hose (tube) off square.
2. Place brass insert into end of tube and put appropriate fitting over it (figure 14).
3. Crimp fitting in place with Special Tool J-25520. This tool is designed so that crimp must be completed before tool will release (figure 15).
4. Air line leaks can be repaired with the coupling illustrated in figure 16.

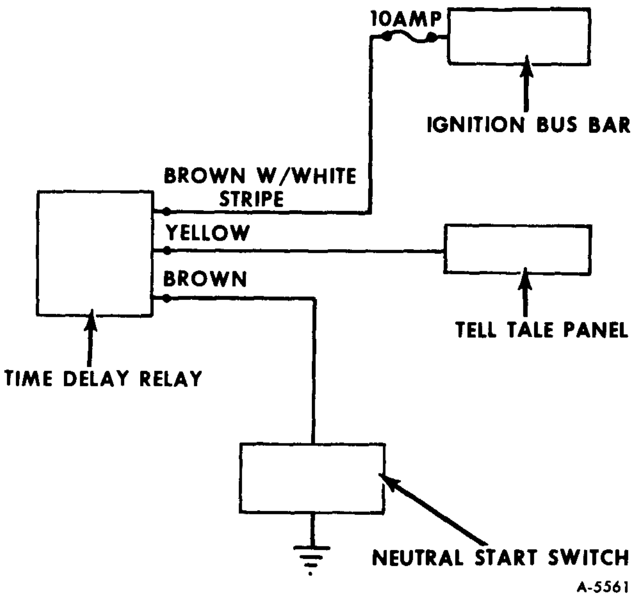


Figure 13—Tell-Tale Warning Light Schematic

HEIGHT CONTROL VALVE AIR LEAKAGE CHECKS

NOTE: Air leakage check can be performed for air line connections only when valve is installed on vehicle. The following instructions give procedure for performing air leakage check on valve when valve is removed from vehicle.

1. Clean exterior of valve assembly.
2. Connect air pressure line to air inlet port, then open the air pressure (90-120 psi).
3. Submerge valve assembly in a container of water, then watch for air bubbles when the valve arm is in center (neutral) position. No

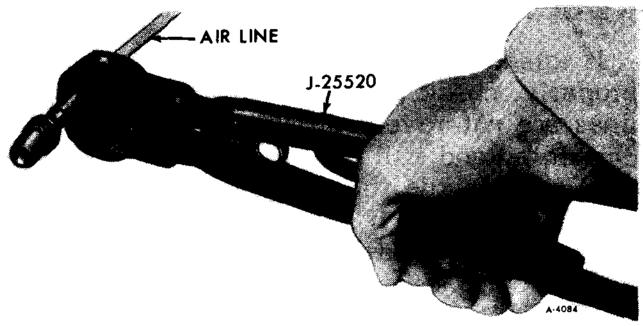


Figure 15—Special Tool J-25520 Crimping Air Line

air should escape from any point of valve assembly.
4. If bubbles appear from the bellows port, this is an indication the air inlet valve assembly is defective and must be replaced.
5. Remove air pressure line from air inlet fitting and connect it to the bellows port. If bubbles appear at the air inlet check valve port, this is an indication that check valve unit is defective and must be replaced.
6. If bubbles appear at the exhaust port it is an indication the exhaust valve assembly is defective and must be replaced.
7. If bubbles appear around edge of valve cover plate, the cover plate gasket must be replaced.
8. If no leaks are detected, remove valve assembly from water. Then, with air pressure still connected to bellows port, actuate valve arm to expel any water which may have entered exhaust valve chamber. Remove air line and connect it to air inlet port. Actuate valve with air pressure to remove water from air inlet valve chamber.

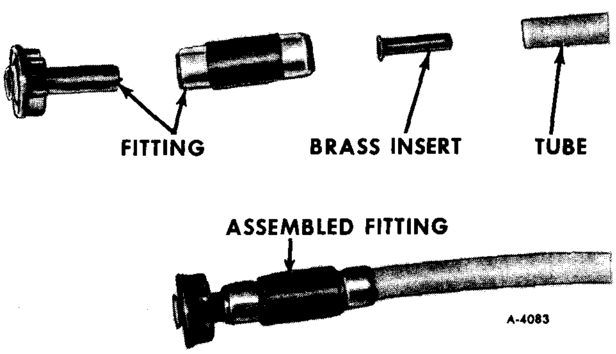


Figure 14—Coupling Assembly

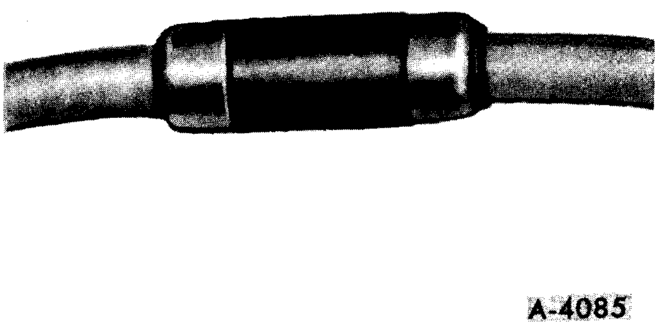


Figure 16—Air Line Repair Coupling

DIAGNOSIS OF SOLENOID VALVES

If solenoid does not appear to be functioning properly, check to see that connections to air lines are not reversed. If solenoid is properly connected and still malfunctions, remove solenoid and use the following procedure to bench check solenoid. If solenoid fails bench test, unit can be disassembled for cleaning and inspection. Plunger, spring, and seals are available for service replacement. If replacing entire solenoid unit, be sure to use equivalent solenoid valve.

BENCH CHECK OF SOLENOID

An air source of approximately 50-100 psi and an electrical 12-volt source are required for a bench test of the solenoid. Apply air to the supply (IN) port of the solenoid. Actuate the valve from the electrical source and note air outlet change to the other port.

Two-Way Normally Closed Solenoid

Air pressure applied at inlet port. Air is stopped internally. No air at out port. With 12 volts applied (solenoid energized) air will flow from inlet port through out port.

Three-Way Multipurpose Valves

The three-way valves used are multipurpose valves and their operation as a normally open or normally closed valve depends upon hookup. Port stampings on multipurpose valves are as follows: "1" for normally closed, "2" for common, and "3" for normally open. Inlet pressure can be applied at any port.

- Inlet pressure applied at normally closed port (1): Air is stopped internally. With 12 volts applied (solenoid energized) air will flow from normally closed port (1) to common port (2). No air at normally open port (3).
- Inlet pressure applied at common port (2): Air flows out normally open port (3). With 12 volts applied (solenoid energized) air will flow from common port (2) through normally closed port (1). No air at normally open port (3).
- Inlet pressure applied at normally open port (3): Air flows out common port (2). With 12 volts applied (solenoid energized) air will flow from normally open port (3) to normally closed port (1). No air at common port (2).

TESTING DIODE ASSEMBLIES

With the Electro-Level option there are two diode assemblies in the wiring harness (figure 17). These can be tested using an ohmmeter. Holding two meter leads to either side of diode, measure the resistance in one direction. Reverse the test lead connections to measure the resistance in the other direction. If the diode is good, the resistance in one direction will be much higher than the resistance in the other direction. If diode does not test good, replace.

COMPONENT REPLACEMENT

CAUTION: *Whenever it is necessary to support the rear suspension with jack stands or other supporting equipment, be sure the jack stands are used only at junction points of the frame rail and crossmember. Failure to locate jack stand as instructed could result in damage to frame of vehicle.*

Removal procedure for height control valve, air bellows, control arm and shock absorber are given in REAR SUSPENSION (SEC. 4) of Maintenance Manual X-7525.

AIR COMPRESSOR REPLACEMENT

REMOVAL

1. Release pressure in system through Schrader valve at wet tank.
2. Disconnect electrical leads at rear of compressor motor.
3. Disconnect air lines at back of compressor and at head of one piston.
4. Remove bolts securing compressor to mounting bracket and remove compressor.

INSTALLATION

1. Install bolts securing compressor to mounting bracket.
2. Connect air lines at back of compressor and at head of one piston.
3. Connect electrical leads at rear of compressor.

PRESSURE SWITCH REPLACEMENT

REMOVAL

1. Release pressure in system through wet tank Schrader valve.
2. Remove screw at top of pressure switch cover and remove switch cover.
3. Disconnect two electrical leads secured by screws inside switch body.
4. Remove bolts securing pressure switch in place. Remove copper fitting securing pressure switch to wet tank.
5. Remove pressure switch.

INSTALLATION

1. Install pressure switch at wet tank fitting. Install bolts securing pressure switch in place.
2. Connect electrical leads secured inside switch body with screws.
3. Install switch cover and secure with screw.

HEIGHT CONTROL VALVE REPLACEMENT

Refer to SEC. 4, REAR SUSPENSION, Maintenance Manual X-7525 for height control valve removal and installation procedure.

WET TANK REPLACEMENT

REMOVAL

1. Release air from system at Schrader valve on wet tank.
2. Disconnect air lines.
3. Remove wet tank mounting elbow from manifold.
4. Remove copper fitting, check valve and Schrader valve from tank.

INSTALLATION

1. Install check valve, Schrader valve and copper fittings at wet tank.
2. Connect air lines.
3. Install wet tank mounting elbow.

SOLENOID VALVE REPLACEMENT

REMOVAL

1. Release air from system at Schrader valve on wet tank.
2. Disconnect electrical leads from solenoid at connector.

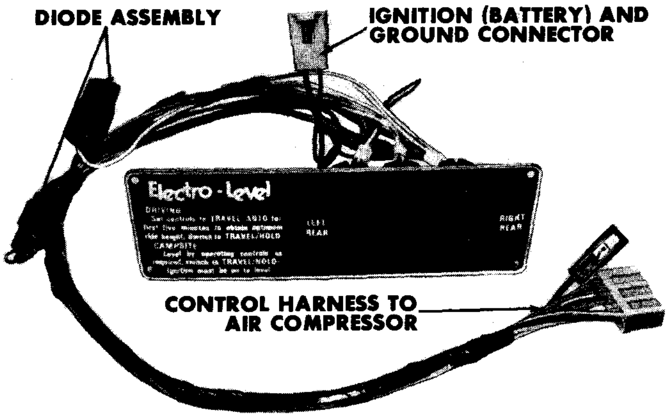


Figure 17—Location of Diodes

3. Identify air lines and ports. Disconnect air lines to solenoid valve.
4. Remove solenoid.

INSTALLATION

1. Secure solenoid to bracket or copper fittings. Be sure to hook up solenoid ports identical to original installation.
2. Connect air lines to solenoid valve. Refer to air line schematics given in figures 4 and 7.
3. Connect electrical leads.

ELECTRO-LEVEL CONTROL PANEL REPLACEMENT

REMOVAL

1. Remove four screws securing control panel to lower dash panel.
2. Disconnect electrical leads at switches.
3. Remove switches from control panel.

INSTALLATION

1. Install switches into control panel.
2. Connect harness leads to switches.
3. Install control panel to lower dash panel and secure in place with four mounting screws.

CONTROL ARM REPLACEMENT

Refer to SEC. 4, REAR SUSPENSION, Maintenance Manual X-7525 for control arm removal and installation procedure.

SHOCK ABSORBER REPLACEMENT

Refer to SEC. 4, REAR SUSPENSION, Maintenance Manual X-7525 for shock absorber removal and installation procedure.

AIR BELLOWS REPLACEMENT

Refer to SEC. 4, REAR SUSPENSION, Maintenance Manual X-7525 for air bellows removal and installation procedure.

AIR LINE REPLACEMENT

Nylon tubing is used throughout the vehicle for rear suspension air lines (as shown in schematics). It is flexible, durable and weather-resistant.

If tubing has been disconnected and must be replaced, new tubing must be cut to required length and related fittings assembled.

NOTE: Whenever threaded fittings on the rear suspension (excluding the height control valve itself) are disassembled for any reason, be sure threads on male portion of fitting are wrapped with teflon tape or equivalent to avoid leakage.

1. After nylon tubing is cut to required length, be sure components assembled are free of nicks or scratches.

2. Position nut and sleeve over tube.

3. Push tube insert into tube, then push tube and insert into fitting until firmly seated.

4. Seat sleeve into fitting, then tighten nut securely.

5. Install fitting at other end of nylon tube using the above procedure, then check for leaks.

6. If any trouble symptoms, such as slow suspension operation, indicate a restricted air line, disconnect suspected tube or hose at both ends and blow through it to make sure the passage is clear. Inspect tubing and hose for partial restrictions such as dents or kinks. If such condition is found, replace the tubing.

COMPONENT REPAIR

Overhaul procedures for air compressor and height control valve are given in REAR SUSPENSION (SEC. 4) of Maintenance Manual X-7525.

SOLENOID VALVE REPAIR

Disconnect air lines from solenoid and remove solenoids from manifold (or bracket).

Solenoid valve shown in figure 12 can be disassembled for cleaning and inspection. Plunger, spring and seals are available for service replacement.

DISASSEMBLY

1. Remove adapter and seal from sleeve assembly, then remove sleeve nut which holds housing and coil assembly to sleeve assembly.
2. Remove name plate, housing, and coil assembly by sliding off lower end of sleeve assembly. Remove washer.
3. Using spanner wrench (SKINNER # VD-233, or equivalent) remove sleeve, plunger and spring from valve body. (See figure 18).
4. Separate plunger and spring from sleeve and remove nylon seal from valve body.

INSPECTION

1. Seals should be discarded and new seals installed when assembling valve.
2. Inspect plunger inserts (both ends) for cuts, nicks, and depressions caused from hitting valve seats. Replace if necessary. Wear must be significant before necessary to replace.
3. Replace spring if broken. If plunger is replaced, spring should be replaced at the same time. Plunger and spring are included in a repair kit.
4. Visually inspect valve threads for damage and clean if necessary.

ASSEMBLY

NOTE: DO NOT use any lubricant during asesmbly of valve components.

Reverse the disassembly procedure for reassembly of valve. DO NOT tighten sleeve nut excessively.

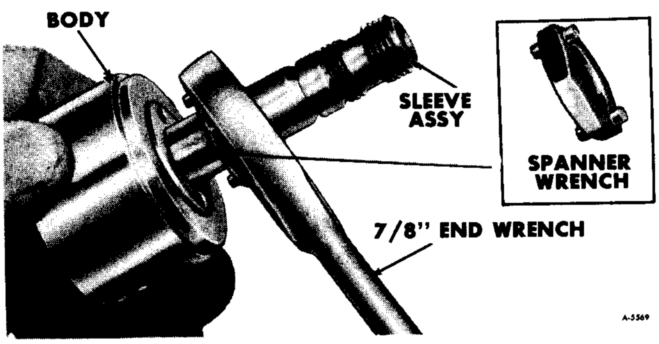


Figure 18—Removing or Replacing Sleeve With Special Tool (Spanner Wrench — Skinner # VO233)

ON-VEHICLE ADJUSTMENTS

REAR WHEEL ALIGNMENT

Proper rear wheel alignment must be maintained to ensure correct handling and satisfactory tire life.

Before checking alignment the following inspections should be made:

1. Check that tires are inflated to recommended pressure.
2. Check wheel bearing adjustment and correct if necessary.

NOTE: Rear wheel alignment requires the vehicle to be level while being checked. Vehicle must be empty and full weight must be on wheels.

TOE-IN MEASUREMENT

Toe-in is measured from center of tire tread. Measurements at both wheels must be made in same relationship.

NOTE: Both sets of tandems should be checked for toe-in to assure alignment of front and rear tandems (see figure 19).

Hoist vehicle and spin wheels to obtain a center line on tire tread. Roll vehicle ahead several feet to where the inspection is to be made. This will remove any slack caused by looseness in wheel bearings.

Measure toe on the front tandem wheels and the rear tandem wheels.

If the toe reading on the front tandem wheels or rear tandem wheels exceeds plus or minus 3/16", shims must be added to bring the rear suspension into proper alignment.

NOTE: Prior to adding a shim, determine the effect it will have on each set of tandems. If adding a shim brings one set of the tandems into specification and moves the other out of specification, refer to the 'Misalignment between front and rear tandems' later in this section.

TOE-IN ADJUSTMENT

If toe-in is not correct, it must be shimmed as shown in figure 20. Follow this procedure for adjustment.

1. Raise vehicle off floor.
2. Loosen six bolts on mounting bracket.
3. Insert proper shim as shown in figure 20.

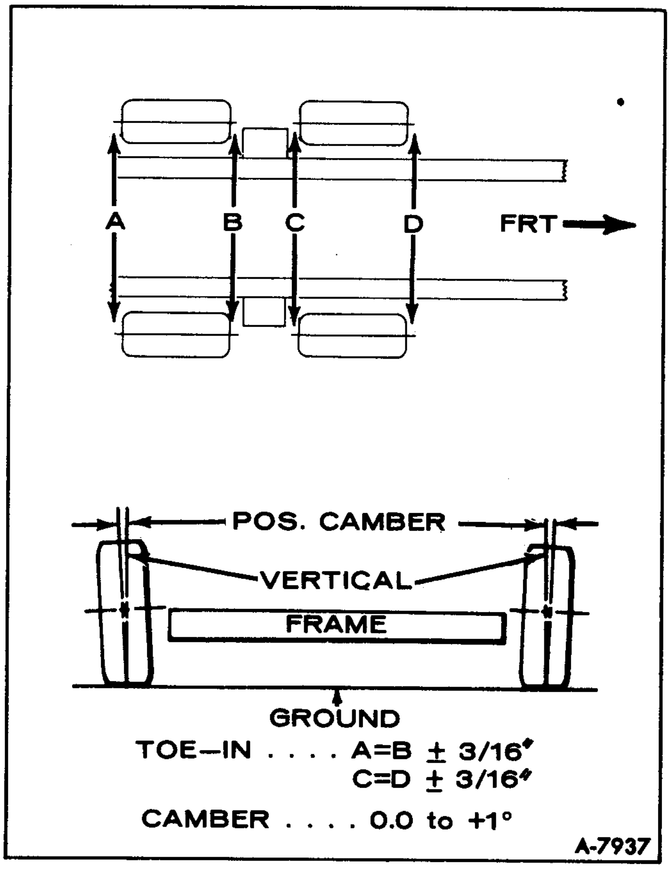


Figure 19—Rear Wheel Alignment Chart

4. Tighten retaining nuts on frame rail. Tighten two retaining nuts on crossmember. See Specifications at the end of this section for torque values.
5. Lower vehicle to floor and roll backward and forward several feet.
6. Recheck alignment.

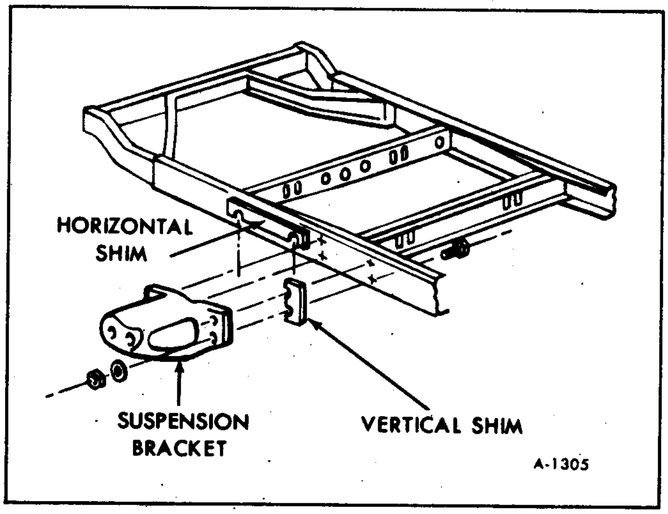


Figure 20—Rear Wheel Skim Location

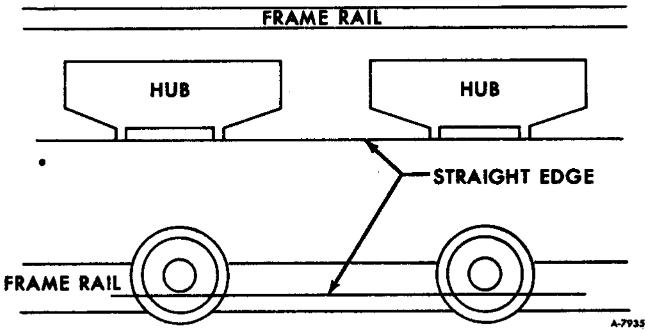


Figure 21—Measuring for Toe at Rear Suspension

MISALIGNMENT BETWEEN FRONT AND REAR TANDEMS

If one side of the rear suspension appears to be the primary cause of excessive toe, review the following factors to assist you in determining which rear suspension component is defective or damaged.

1. Loose wheel bearings.
2. Worn control arm bushings.
3. Loose suspension bracket bolts.
4. Bent control arm.
5. Bent wheel assemlby.
6. Bent frame.

Loose Wheel Bearings

If a loose wheel bearing is found, it should be inspected and then adjusted according to the following procedure.

While rotating hub assembly—

1. Tighten nut to 25-30 lbs. ft. torque.
2. Back off nut 1/2 turn.
3. Retighten nut finger tight; secure if possible.
4. If unable to secure at finger tight, back off to first securing position.
5. Rear hub must be rotated at least three revolutions of spindle nut during tightening and retightening operations.
6. Check dimensions—.001—.005 end play between hub and spindle.

Worn Control Arm Bushing

1. Raise vehicle.
2. Remove wheel bearing dust caps, and wipe grease from end of spindle.
3. Place dial indicator at end of spindle. Mount dial indicator on a suitable stand.
4. Check wheel and control arm assembly. Total indicated reading on dial indicator should not exceed .050". If later movement is greater than this, bushings and/or mounting pins should be replaced.

Loose Suspension Bracket Bolts

Be sure bracket bolts to frame rail have a bolt torque of 65-85 lbs. ft, and the retaining nuts to the crossmember have a torque of 50-60 lbs. ft.

If any of these nuts are found to be loose, inspect all components for wear. Replace worn parts as required.

Bent Control Arm

1. Raise vehicle.
2. Remove the wheels, wheel covers, outer dust cap, and inner dust cap on the side of the vehicle that appears to be the primary cause of rear suspension misalignment.
3. Place straight edge across the face of the hubs as shown in figure 21.
4. The straight edge should lie flat on each hub as shown in figure 21. If the straight edge does not visibly rest on both points of each hub, a bent control arm will be evident and it should be replaced.

Bent Wheel Assembly

Check lateral run-out of wheel assembly. Refer to Section 10 of the Maintenance Manual X-7525.

Bent Frame

Check frame for straightness following the procedure set forth in Section 2 of the Maintenance Manual X-7525.

REAR WHEEL CAMBER

The rear wheels are set with positive camber. Positive camber is outward inclination of wheels at top.

To check camber, use an accurate gauge. The camber should be set at 0° to $+1^{\circ}$. (See figure 19.)

Excessive positive camber results in irregular wear of tires at outer shoulder. Negative or reverse camber causes wear at inner shoulders.

Camber is adjusted by shimming as shown in figure 20. Follow the same shimming procedure used to set toe-in.

AIR COMPRESSOR PRESSURE SWITCH ADJUSTMENT

The pressure switch is designed to maintain air pressure in the air reservoir between 100 and 120 psi. If the pressure in the reservoir drops to 100 psi the contact points will close and this will complete the circuit, supplying electricity to the compressor. If the pressure raises above 120 psi the contact points will open the circuit to the compressor. This setting may be adjusted at the nut which is located on the end of the spring inside the cover. (Refer to figure 22.) The pressure will rise by tightening the spring. Both the cut-in pressure and the cut-out pressure will be affected by this adjustment. The pressure can be measured at the Schrader valve on the wet tank.

Figure 22—Air Compressor Pressure Switch Adjustment

RIDE HEIGHT ADJUSTMENT

Measure the rear suspension ride height at the elongated slot on the frame rail. Refer to figure 23.

To adjust ride height loosen adjustment nut on height control valve (See figure 24.) The valve arm has an elongated hole at the adjustment nut. This allows the valve arm to move in relation to the valve itself, and thus allows the ride height to change. Intake and exhaust valves of height control valve can then be operated independently of linkage. When proper ride height is reached tighten nut to 70-80 in. lbs.

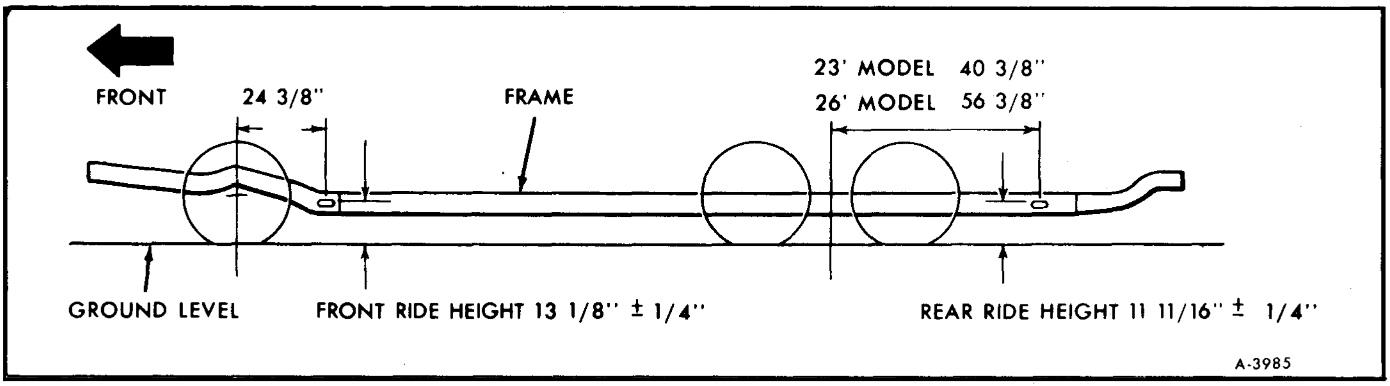


Figure 23—Checking Vehicle Ride Height

Height control valve lever will move 1/4 inch up or down from neutral position (free travel) without causing any valve action. If amount of adjustment required falls within these limits, adjust lever the required amount. However, frame will not raise or lower until load is increased or decreased to actuate height control valve.

If either of the height control valves does not function properly with the lever correctly adjusted, check for restricted air lines. If valve still does not hold frame at normal ride height with lever properly adjusted, and with no restriction in air line, valve should be overhauled or replaced with a new or rebuilt unit.

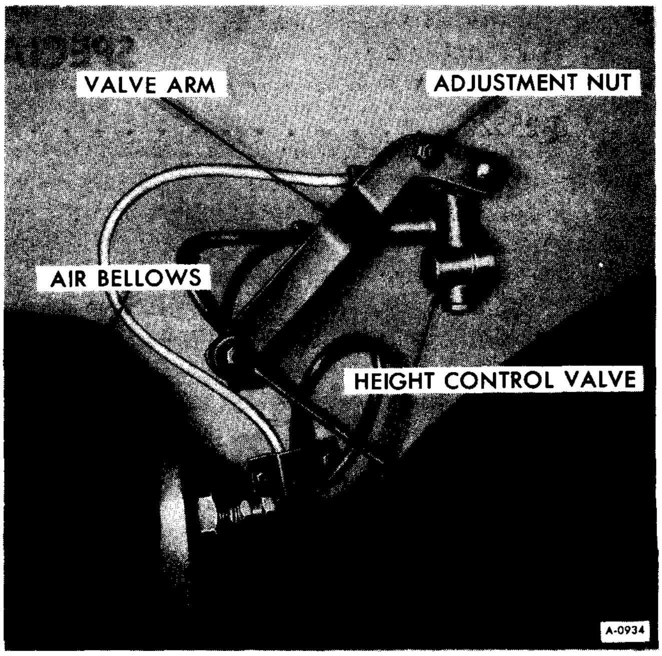


Figure 24—Location for Rear Ride Height Adjustment

PERIODIC MAINTENANCE

AIR COMPRESSOR FILTER REPLACEMENT

The air filter on the compressor should be cleaned or replaced every six months or 6,000 miles.

Remove tubing at back of each housing assembly. Remove filter retainer and pull intake assembly off and carefully take filter out from behind inside retainer. Wash filter with soap and water, and dry completely before replacing.

WET TANK MAINTENANCE

Condensation should be drained at least once a month. To drain tank properly, leave Schrader valve drain cock open until air escapes and draining stops.

Wet tank mounting bolts and brackets should be checked at regular intervals for looseness. Tighten if necessary. Wet tank may be cleaned inside using steam or hot water. If corrosion or other damage has weakened tank it must be replaced.

LUBRICATION

Details on lubrication of rear suspension components are covered in Section 0 of Maintenance Manual X-7525.

SPECIFICATIONS

LOCATION	TORQUE
Control Arm Mounting Bracket to Frame Rail Nuts (4)	65-85 Ft. Lbs.
Control Arm Mounting Bracket to Crossmember Nuts (2)	50-60 Ft. Lbs.
Height Control Valve Mounting Bolt	80-120 Ft. Lbs.
Height Control Valve Link	
Link to Arm Nut	69-90 Ft. Lbs.
Link to Control Arm Nut	60-90 Ft. Lbs.
Control Arm Lock Nut	15-20 Ft. Lbs.

SPECIAL TOOLS

J-25520 . . . . Air Line Crimp Tool

SECTION 4B

1978 REAR SUSPENSION

The information described in Maintenance Manual X-7525 under the heading REAR SUSPENSION (SEC. 4) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

GENERAL DESCRIPTION

1978 model vehicles are equipped with either a Type I or Type II rear suspension system. (Refer to figures 1 and 2 for identification of suspension type.) Early 1978 model vehicles with Type I (Electro-Level I) rear suspension are discussed in subsection 4A of this section. Late model 1978 vehicles with Type II rear suspension (Electro-Level II) are discussed in the following:

ELECTRO-LEVEL II

The Type II rear suspension system—Electro-Level II—operates automatically or manually. In automatic mode, the suspension is adjusted as vehicle load varies, to retain frame at proper ride height. In addition, the Electro-Level II system provides the ability to raise or lower the rear of the vehicle approximately four inches from normal ride height. This function is controlled manually at the Electro-Level Control panel (see later in this section for information on controls operation). Electro-Level II system wiring can be seen in figure 3. Components on the new Electro-Level II suspension are discussed immediately following.

SYSTEM COMPONENT DESCRIPTION

The Electro-Level II rear air suspension system consists of the following control components:

Control Panel (1)
Air Compressor (2)
Air Dryer (2)
Compressor Relay (2)
Exhaust Solenoid (2)
Shut-Off Solenoid (2)
Electronic Height Sensor (2)
Air Lines and Fittings

Additional suspension system components include air bellows, shock absorbers and control arms.

COMPRESSOR
(FIGURE 4)

There are two compressor assemblies, one for each side of the vehicle. The compressor assembly used with this system is a permanently lubricated, positive displacement single-piston air pump powered by a 12-volt DC permanent magnet motor. The compressor head casting contains both piston intake and exhaust valves plus a solenoid operated exhaust valve which releases air from the system when energized. The compressors are located in the closet of Motorhome model ZEO6581 and in front of the driver side wheelhousing (rear) in TransMode models ZEO6083 and ZEO6583.

AIR DRYER
(FIGURE 5)

Two air dryers are used with this system, one with each compressor. The air dryer is attached externally to the compressor output. It contains a dry chemical that absorbs moisture from the air before it is delivered to the air bellows and returns the moisture to the air when it is being exhausted. This action provides a long chemical life.

The air dryer also contains a valving arrangement that helps maintain air pressure in the bellows for good ride characteristics.

COMPRESSOR RELAY

There is one control relay for each compressor. The relay is a single-pole, single-throw type that completes the 12-volt circuit to the compressor motor when energized by the electronic height sensor or the driver's control switches. Relays are located above the compressor mounting bracket in Motorhome models, and are fastened to the wall in the closet module with screws (figure 6.) TransMode relays are located at either end of the compressor mounting bracket (see figure 7).

EXHAUST SOLENOID
(FIGURE 8)

There are two exhaust solenoids, one located in the head of each compressor assembly. The exhaust solenoid has two functions:

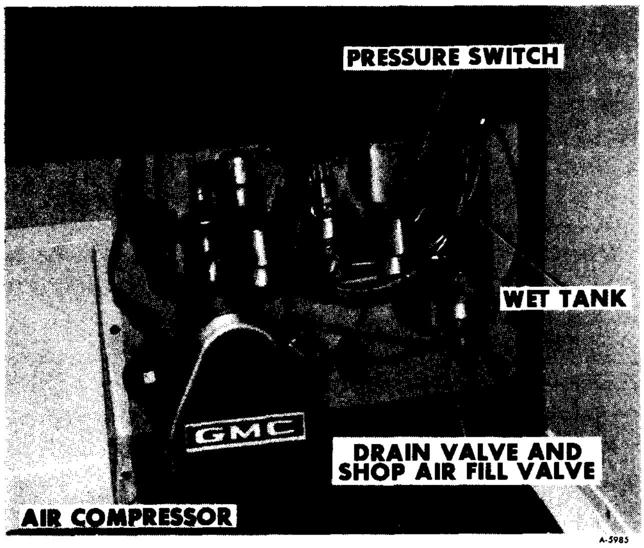


Figure 1—Type I Rear Suspension—Electro-Level I

1. It exhausts air from the system when energized. The electronic height sensor and driver control switch control this function.
2. It acts as a pressure protection valve to limit maximum pressure output of the compressor to 150-180 psi.

"SHUT-OFF" SOLENOID

Two "shut off" solenoids are wired in series between the compressor and the air bellows, one solenoid for each side of the suspension system (refer to figures 6 and 7). These solenoids are 2-way, normally closed valves that must be energized to permit air to enter or exit the bellows. In the de-energized position, the single orifice is closed and no flow can occur between the inlet and the outlet ports. Figure 9 shows the components of this solenoid valve.

When the ignition key is turned to the "ON" or "ACCESSORY" position, these valves are electrically energized, allowing positive air flow in either direction (i.e., either into or out of the bellows). The demand for air is either "read" by the electronic height sensors (automatic mode) or created by use of Electro-Level control switches (manual mode). When the ignition switch is turned to the "OFF" or "LOCK" position, these valves are de-energized or "shut off". Ignition switch control of the "shut off" solenoids will aid in preventing bellows leak down when vehicle is parked.

PRINCIPLES OF OPERATION

The solenoid valve is an electromagnet so arranged that when current is applied to the coil (when the valve is "energized") the plunger either opens or seals an orifice, thereby controlling the flow of air.

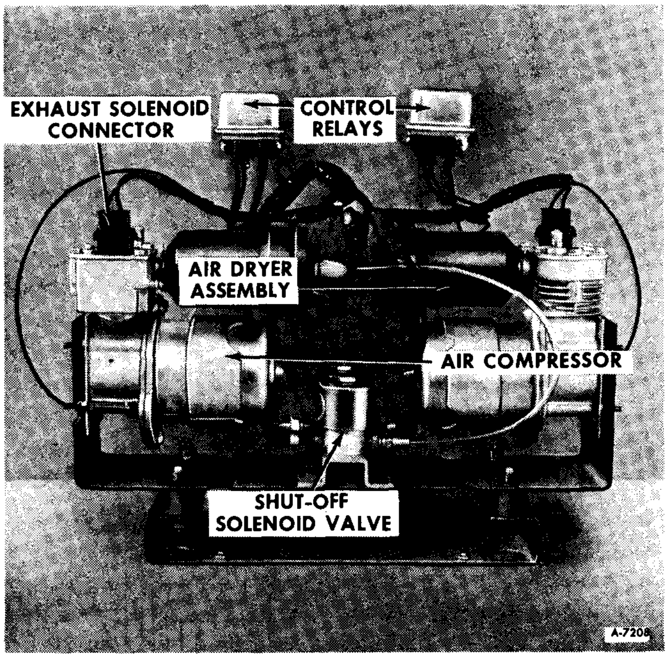


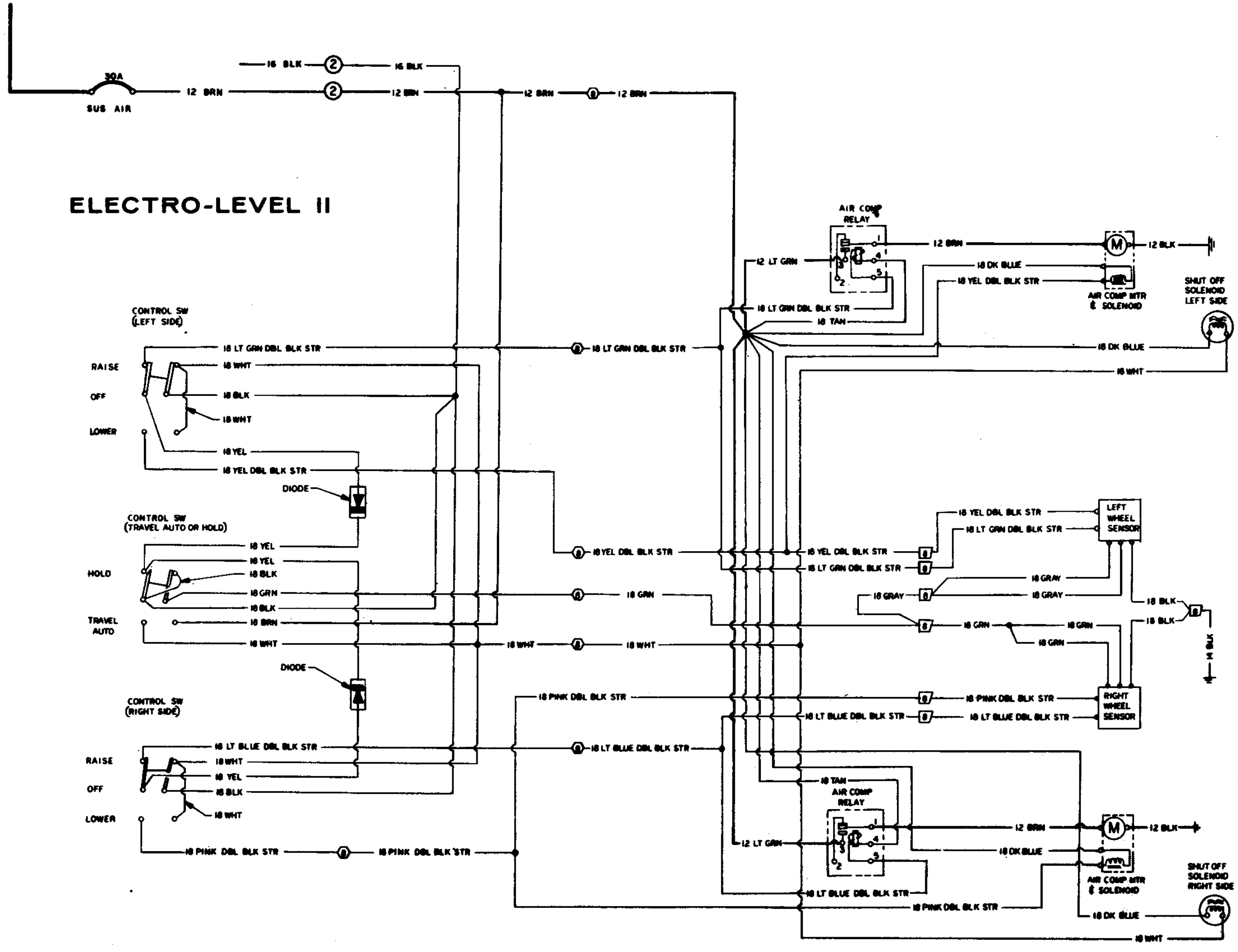
Figure 2—Type II Rear Suspension—Electro-Level II

The solenoid valve has two basic functional parts: a solenoid coil and a plunger or armature. The coil surrounds the plunger which has a soft synthetic seal at one end . The valve body has an orifice which is sealed by the insert in the plunger. The orifice is opened or closed by the movement of the plunger. The coil causes the plunger to move when the coil is energized. When the coil is de-energized the plunger is returned to its original position by means of a spring.

The only moving parts of the valve are the plunger and the spring which are enclosed in the sleeve assembly. This arrangement within the sleeve is referred to as an internal solenoid. The plunger closes the negative circuit of the coil by coming into "face to face" contact with the stop. The stop, magnetic steel, is welded to a nonmagnetic stainless steel flange to make up the sleeve assembly. The "face to face" design permits the plunger to be spring loaded for positive operation regardless of valve mounting position.

ELECTRONIC HEIGHT SENSOR
(FIGURE 10)

There are two height sensors, one for each side of the vehicle. The height sensor is an



ELECTRO-LEVEL SYSTEM WIRING DIAGRAM A-7221

Figure 3—Electro-Level II System Wiring Diagram

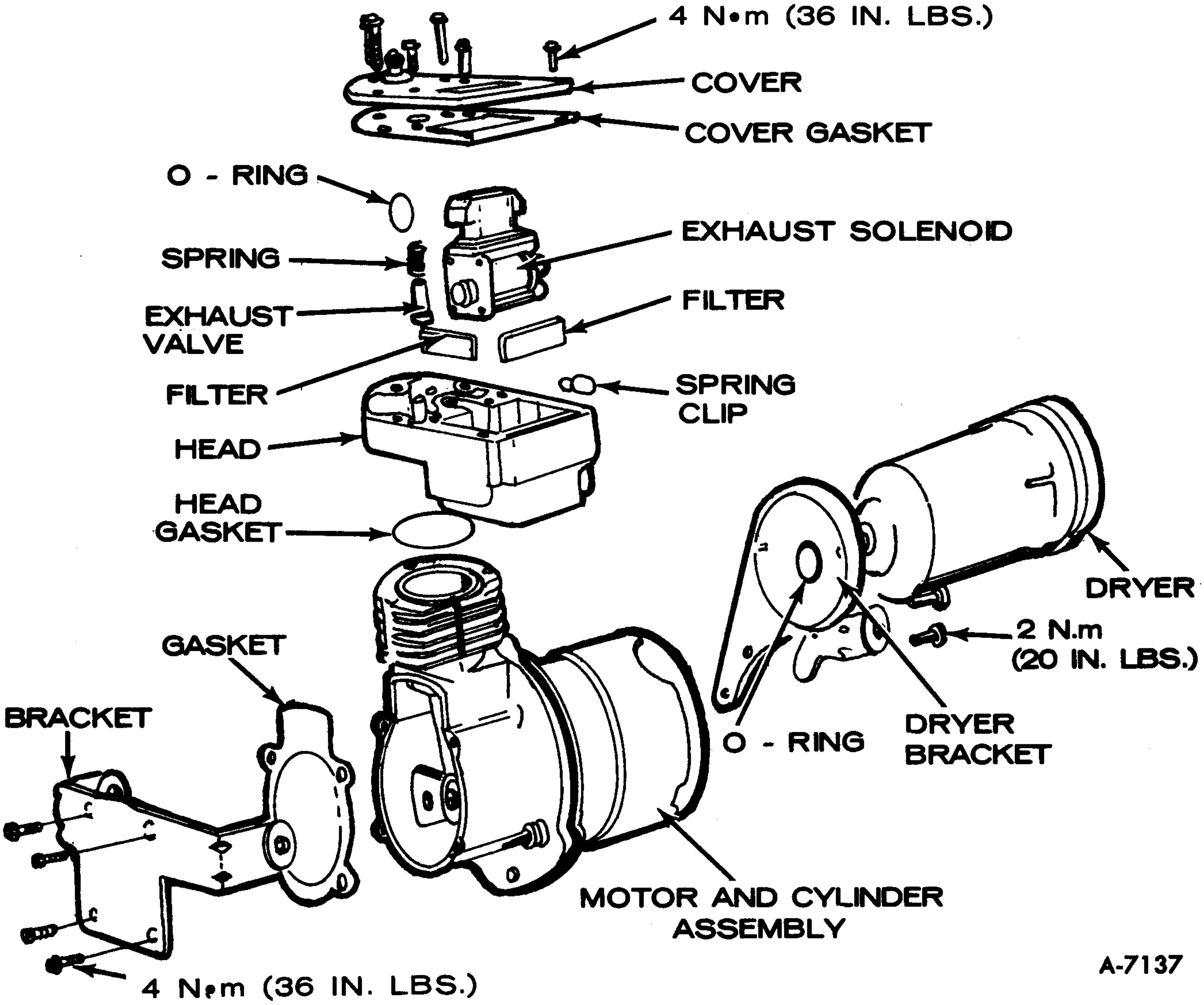


Figure 4—Compressor Components

electronic device that controls two basic circuits:

1. The compressor relay coil ground circuit.
2. Exhaust solenoid coil ground circuit.

The height sensor, through the use of photo couplers , can determine rear trim height and provide the necessary system response to do one of three things:

1. determine that the rear trim height (either side) is low and provide a ground circuit for the compressor relay, operate the compressor to inflate the air bellows and raise the rear of the vehicle (either side);
2. determine that the rear trim height (either side) is high and provide a ground circuit for the exhaust solenoid, deflate the bellows and lower the rear of the vehicle, or
3. determine that the rear trim height is correct and maintain that position by not grounding the relay or the solenoid.

The actual method by which the height sensor senses the need for air is through the use of two optic devices known as photo couplers, which consist of a light-emitting diode and a light-sensitive transistor.

These devices are powered any time the ignition is "ON". Depending upon rear standing height, a shutter is used to block or allow light from the light emitting diode to reach the light sensitive transistor (figure 11). With light in contact with the transistor, it is "ON"; with no light it is "OFF." As shown, both transistors "ON" results in compressor relay activation and in turn, compressor operation; both transistors "OFF" results in exhaust solenoid operation, and one transistor "ON"—one "OFF" is interpreted as trim, or correct ride height.

The height sensor, besides providing these two basic functions, also has time circuits

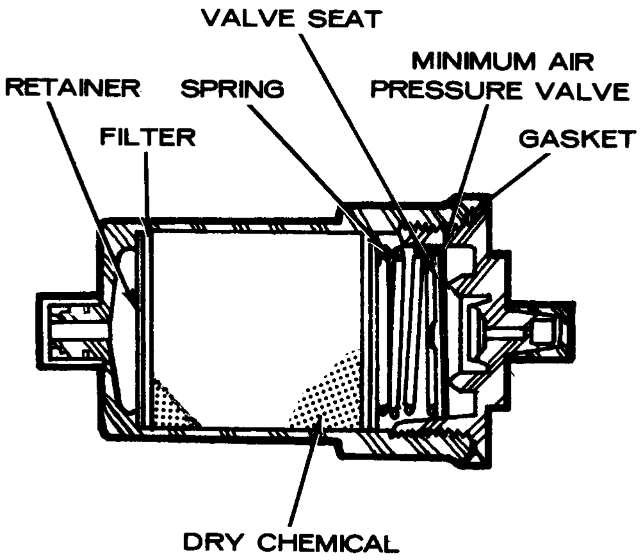


Figure 5—Air Dryer Detail

built into its operation. One is a 14-28 second delay any time height sensor arm movement calls for compressor or exhaust solenoid activation. This is done to rule out any false cycling caused by temporary changes in trim height. Another feature of the height sensor is the "dead band"—the capability of the sensor to tolerate as much as a 5^{o} amount of movement with no action forthcoming.

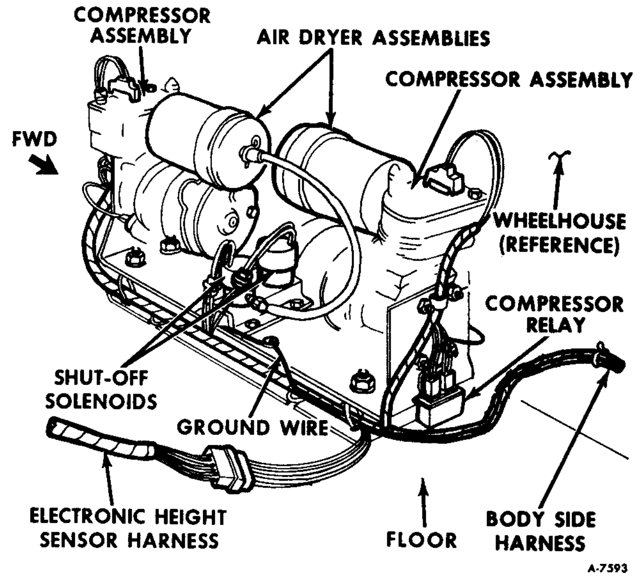


Figure 7—Compressor Wiring—Electro-Level II (TRANSMODE)

HEIGHT SENSOR CONNECTOR

An oval connector lock is included at the wiring connector to the height control sensor.

If harness disconnection is required, squeeze the oval sides of the connector lock to release the two locking tabs and pull the harness connector from the height sensor plug.

To assure proper circuit connections, the height sensor plug has an indexing slot and a matching boss is molded into the outer dia-

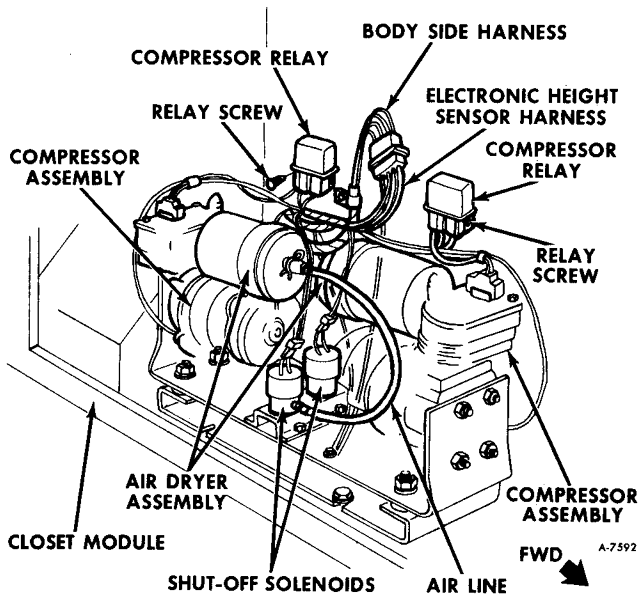


Figure 6—Compressor Wiring—Electro-Level II (MOTORHOME)

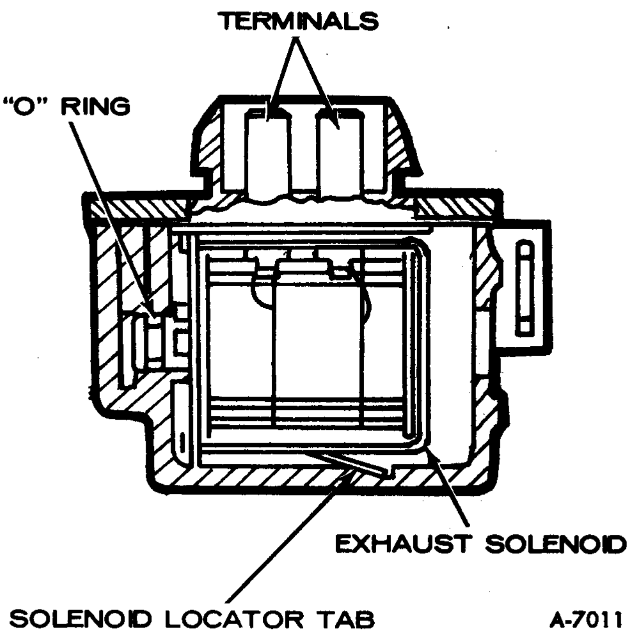


Figure 8—Exhaust Solenoid In Compressor Casting

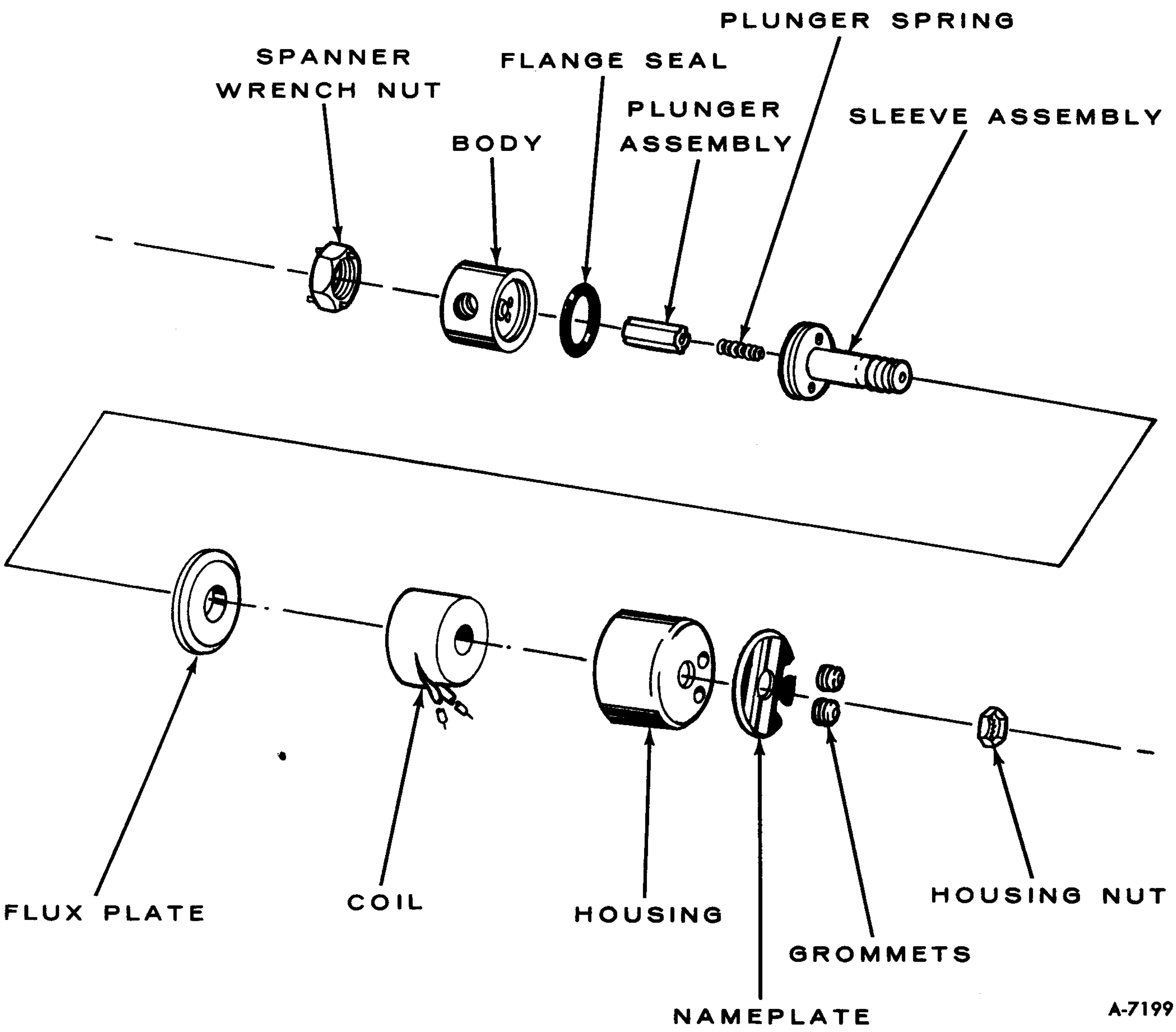


Figure 9—Solenoid Valve Components

meter of the weatherproof connector.

When reconnecting the harness to the sensor, push the connector into the sensor plug until the sloped shoulder on the rear edge of the boss it is visible in the plug slot, then push the oval connector lock onto the plug until its two locking tabs snap over the shoulder of the sensor plug. Refer to figure 12 for view of height sensor harness routing.

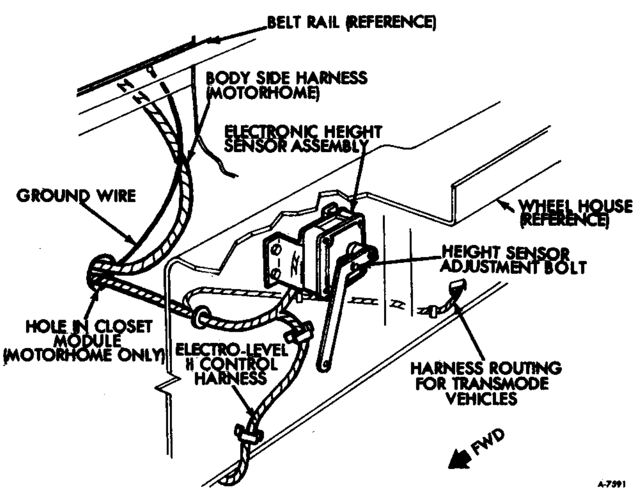


Figure 10—Electronic Height Sensor Wiring

AIR LINES AND FITTINGS

Clear flexible air lines of 1/8 inch diameter tubing are used to attach the air dryer to the shut-off solenoid (see figures 6 and 7). A new type of "snap-on" connector attaches the tubing to the dryer. When the air line is

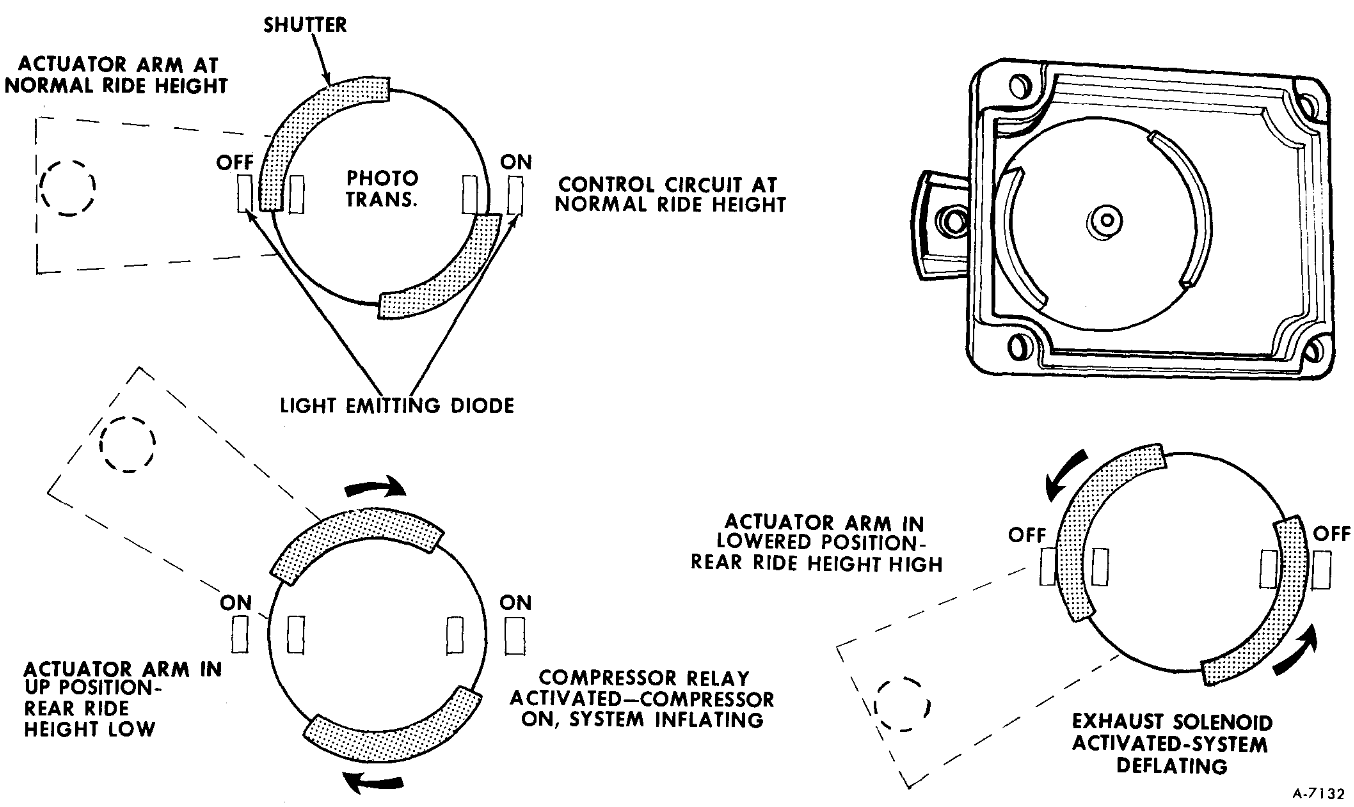


Figure 11—Electronic Height Sensor Light Shutter Operation

attached to the fitting at the air dryer, a retainer clip snaps into a groove in the fitting, locking the air line into position (figure 13).

To remove the air line, rotate the retainer clip 90° to release it from the groove and pull on the air line.

NOTE: While the lines are flexible for easy routing and handling, care should be taken not to kink them.

Additional nylon tubing is used for remaining rear suspension air lines, connecting output side of shut off solenoid to air bellows (one air line for each side of vehicle). (Refer to figure 14). This tubing is flexible, durable and weather resistant.

Whenever threaded fitting on rear suspension is disassembled for any reason, be sure threads on male portion of fitting are wrapped with teflon tape or equivalent to avoid air leakage.

CONTROL PANEL

The Electro-Level control panel is mounted to the left of the driver's seat, in the side interior trim panel (figure 15). The controls consist of three rocker switches that automatically or manually level the vehicle.

The two RAISE-LOWER switches are used as necessary to raise or lower the rear of the vehicle (as when parked on surface that is not level). Engine need not be running to operate the system in either of these modes. However, the ignition switch must be in the "ON" or "ACCESSORY" position.

The center TRAVEL SWITCH has two positions—TRAVEL HOLD and TRAVEL AUTO.

TRAVEL HOLD is the switch position to be used for normal highway driving. This mode allows the vehicle to maintain a designed ride height and eliminates unnecessary operation of the air compressor. TRAVEL AUTO is the position to be used to "ready" the vehicle for highway driving after it has been parked in a raised or lowered position. This leveling of the vehicle will take place in the first five minutes with the rocker switch in TRAVEL AUTO position.

AIR BELLOWS

The air bellows for the tandem rear wheels are mounted between the control arms. On

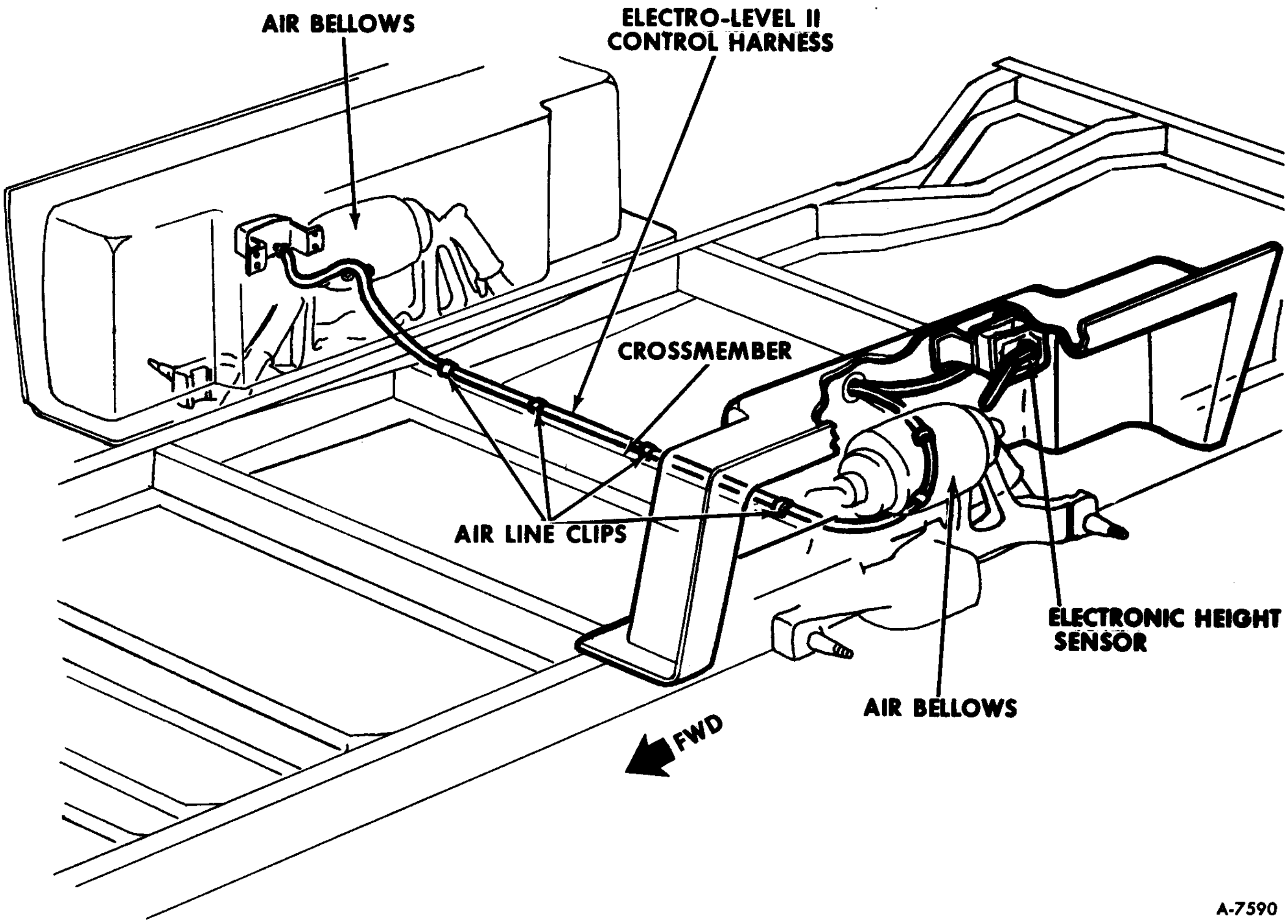


Figure 12—Height Sensor Harness Routing

each side of the air bellows is a piston which is connected directly to the control arm.

The air bellows serve as a flexible connection between the two control arms on each side of suspension bracket. The flexing of the air bellows allows the control arms to move up and down in relation to the frame. This action absorbs road shocks in the same manner as an inflated rubber tire cushions shock caused by road roughness.

CONTROL ARMS
(FIGURE 16)

The rear suspension control arms (one on either side of air bellows) attach to a control arm mounting bracket which in turn mounts to the vehicle frame rail. The control arms support the air bellows and the tandem rear wheels.

SHOCK ABSORBERS

A double acting shock absorber is used at

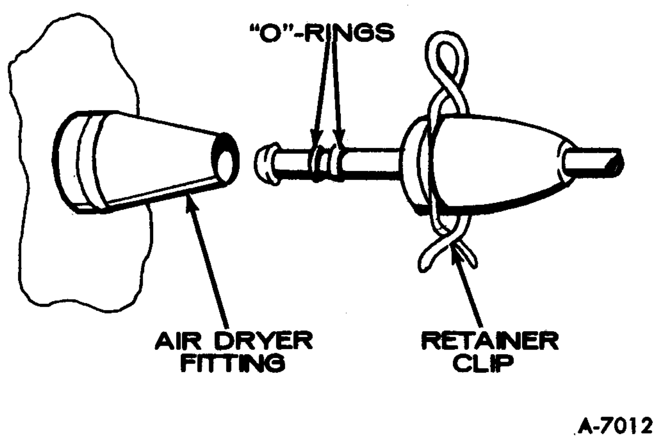


Figure 13—Connecting Air Line to Air Dryer

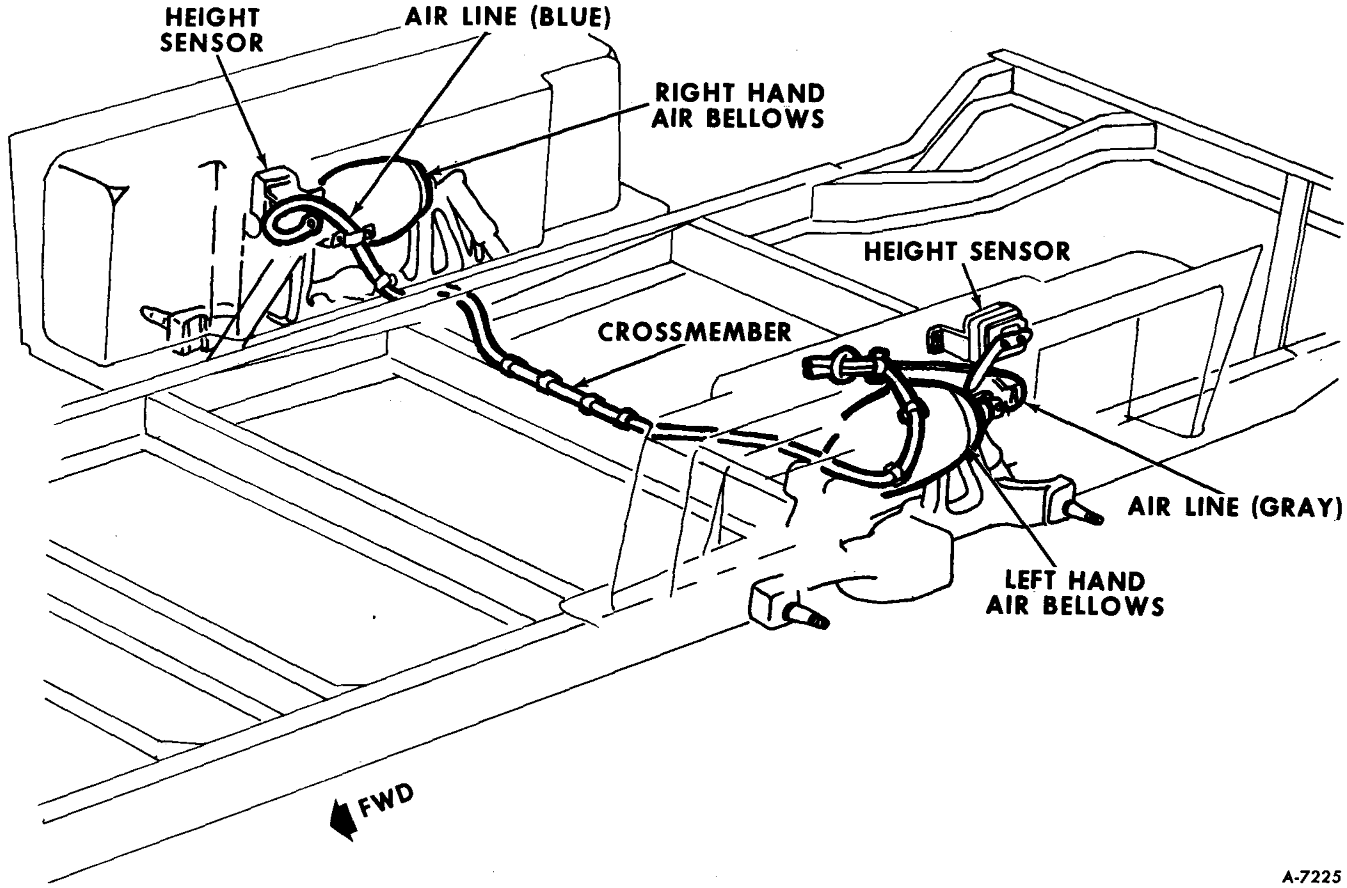


Figure 14—Rear Suspension Air Hose Routing (Electro-Level II)

each wheel on the rear suspension. The shocks are mounted to the control arms and to the frame.

The shock absorbers are gas filled celltype shocks. They are filled with a calibrated amount of fluid and sealed during production. They are nonadjustable, nonrefillable and cannot be disassembled. The only service they require is replacement if they have lost their resistance, are damaged or leaking fluid.

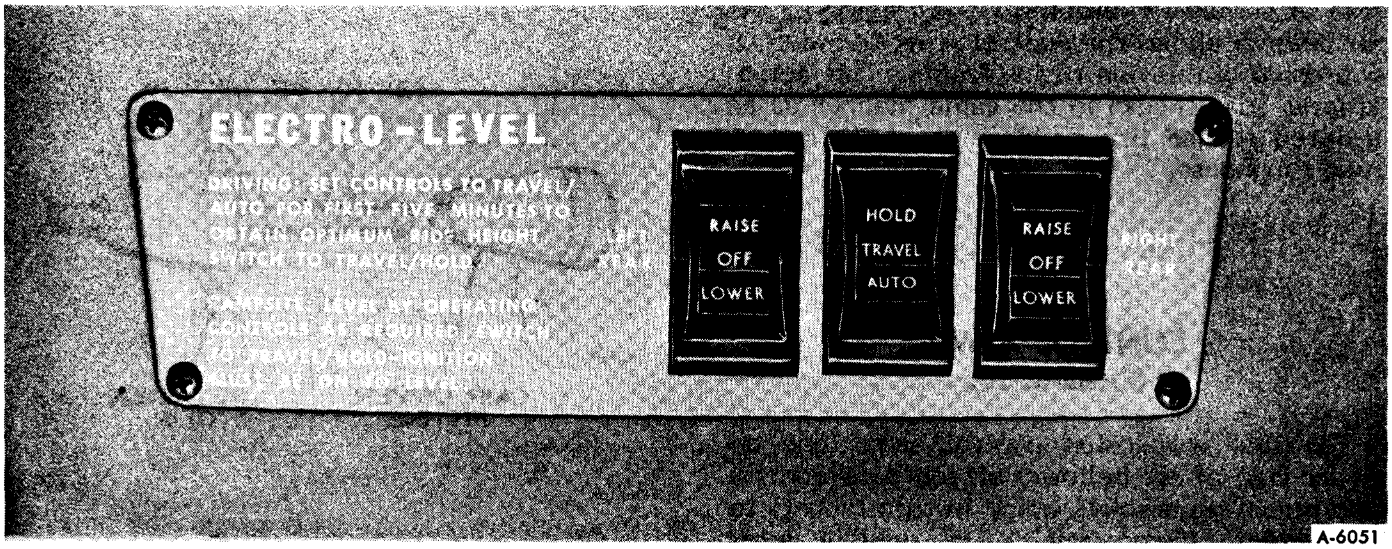


Figure 15—Electro-Level Control Panel

DIAGNOSIS OF REAR SUSPENSION SYSTEM (1978)

SYSTEM OPERATION CHECK

1. Check to see that vehicle is at recommended ride height. If correction is necessary, adjust as described later in this section.
2. Start and run engine.
3. Set Electro-Level controls for LOWER (both sides) and lower vehicle approximately 2-3 inches. Then put right and left side switches in OFF and move TRAVEL switch to AUTO.
   a. There should be a 14-28 second delay before compressor turns on and vehicle starts to raise.
   b. Vehicle should raise to within $\frac{1}{4}$" of measurement made in Step 1 by the time the compressor shuts off. If vehicle does not raise, refer to diagnosis charts.
4. Set Electro-Level controls for RAISE (both sides) and raise vehicle approximately 2-3 inches. Then put right and left-side switches in OFF and move TRAVEL switch to AUTO.
   a. There should be a 14-28 second delay before vehicle starts to lower.
   b. Vehicle should lower to within $\frac{1}{4}$" of measurement made in Step 1 in approximately 5 minutes. If vehicle does not lower, refer to diagnosis charts in this section.

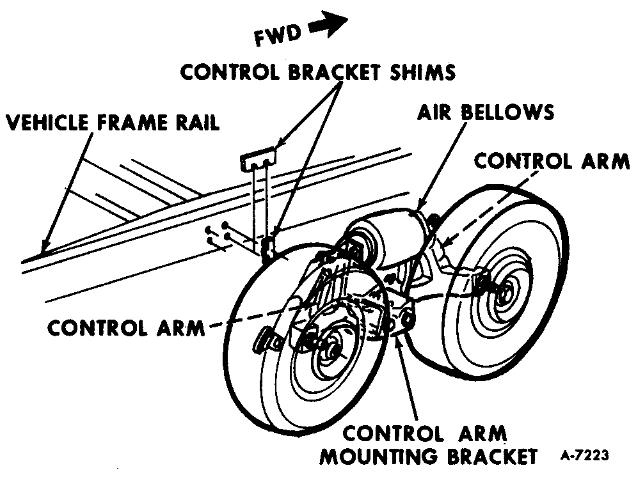


Figure 16—Rear Suspension Control Arms And Mounting Bracket

COMPRESSOR/DRYER PERFORMANCE TEST

COMPRESSOR CURRENT DRAW, PRESSURE OUTPUT AND LEAKDOWN TEST

1. Disconnect wiring from compressor motor and exhaust solenoid terminals.

2. Disconnect existing air line from dryer and attach pressure gage J-22124-A to dryer fitting (refer to figure 17).

3. Connect ammeter to 12-volt source and to compressor as shown in figure 17.
   a. Current draw should NOT exceed 14 amps.
   b. When gauge reads 110-120 psi, SHUT COMPRESSOR OFF and observe if pressure leaks down.
   c. Leak down—pressure should not drop below 90 psi when compressor is shut off.
4. Refer to compressor/dryer diagnosis chart if compressor fails to meet specification.

NOTE: If compressor is permitted to run until it reaches its maximum output pressure, the solenoid exhaust valve will act as a relief valve. The resulting leak down when compressor is shut off will indicate a false leak.

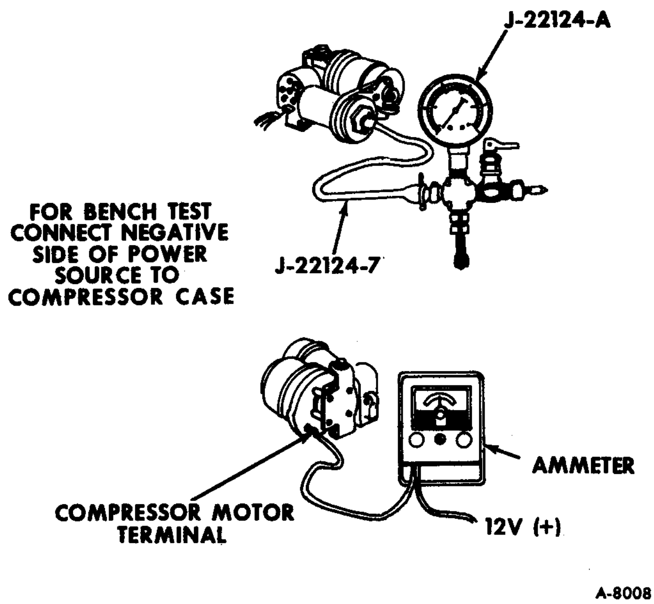


Figure 17—Testing Compressor Performance

DIAGNOSIS OF COMPRESSOR/DRYER

PROBLEM	CORRECTION
1. Current draw exceeds 14 amps.	1. Replace motor cylinder assembly.
2. Compressor inoperative.	2. Replace motor cylinder assembly.
3. Pressure build up OK but leaks down below 90 psi before holding steady.	3. Replace solenoid exhaust valve assembly.
4. Compressor pressure leaks down to 0 psi.	4. Leak test compressor/dryer assembly. Refer to "Compressor Leak Test Procedure."
5. Compressor output less than 11 psi and current draw normal.	5. Perform compressor/dryer leak test. If no leak is found, replace motor cylinder assembly.

COMPRESSOR LEAK TEST

1. Attach pressure gauge J-22124A to dryer (refer to figure 17) and pressurize compressor/dryer assembly to 100 psi through the gauge fill valve.
2. Using soap bubble solution, check following items (see figure 18):
   a. dryer O-ring casting bore.
   b. service valve (tighten or replace as required).
   c. around edge of cover gasket (if leak is found, check torque of cover bolts before replacing gasket).
   d. around edge of solenoid valve terminal housing (replace solenoid valve if leak is found).
   e. head casting air intake and exhaust opening (replace solenoid valve if leak is found).

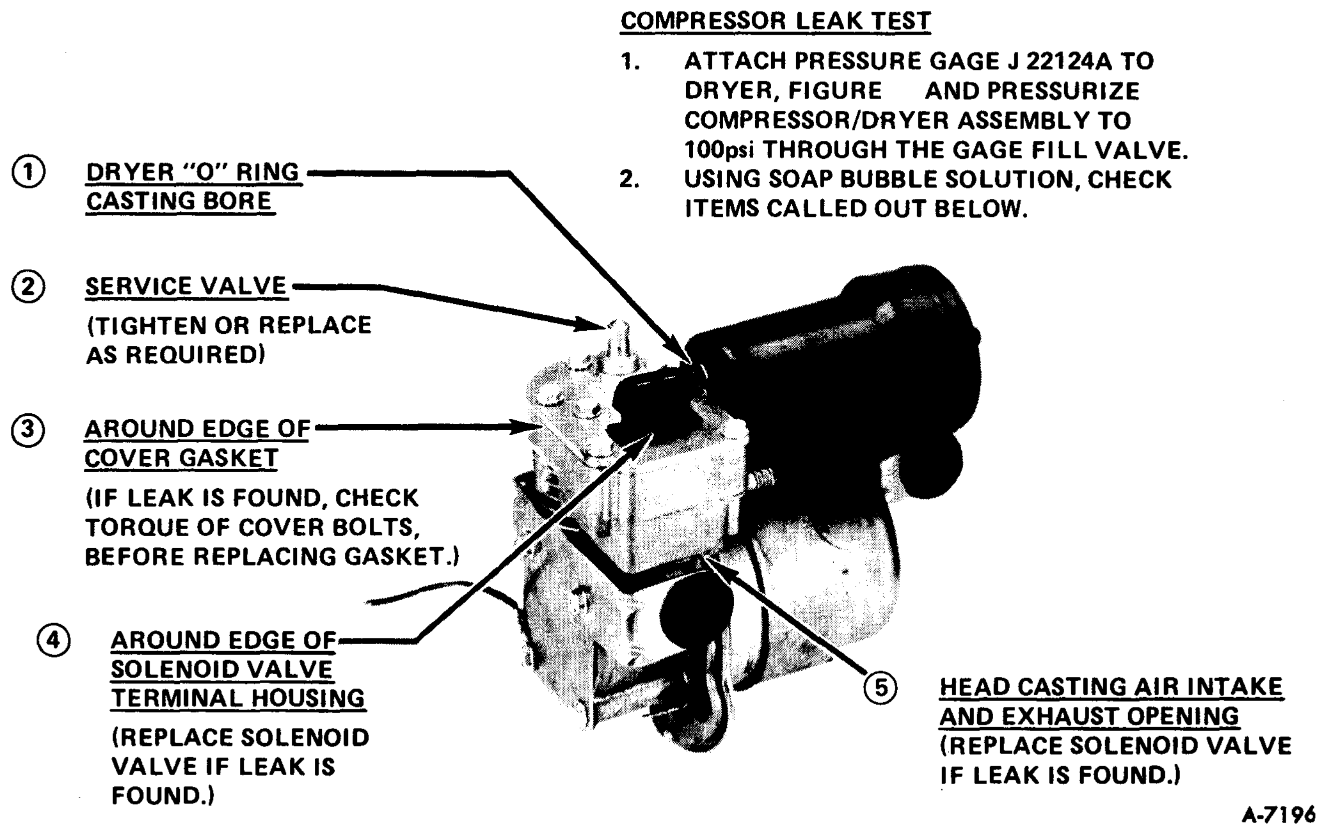


Figure 18—Compressor Leak Test

DIAGNOSIS OF AIR COMPRESSOR

PROBLEM	POSSIBLE CAUSE	CORRECTION
COMPRESSOR NOT OPERATING	1. Open circuit breaker. (Circuit breaker is located behind glove box door.)	1. Find cause of circuit breaker being open and correct it.
	2. Faulty wiring. (Compressor ground wire or height sensor ground wire not connected.)	2. Check to see that wiring is intact.
	3. Low battery.	3. The compressor runs off the automotive battery. Check battery condition and correct as necessary.
	4. Defective relay.	4. Replace relay.
	5. Compressor motor has developed an open circuit.	5. Motor brushes or commutator worn out. Replace motor.
	6. Defective diode.	6. Replace diode assembly in wiring harness. Refer to "Testing Diode Assemblies" in this section.
COMPRESSOR OPERATES. NO AIR PRESSURE.	1. Leak in air system.	1. Eliminate air leaks in system as described later in this section.
	2. Piston rings are worn—air leaks heavily at rings.	2. Replace compressor.
AIR PRESSURE IN SYSTEM. COMPRESSOR OPERATES ERRATICALLY—TAKES TOO LONG TO PRESSURIZE SYSTEM.	1. Air leak in system.	1. Eliminate air leaks in system as described later in this section.
	2. Compressor worn—air leaks heavily by rings.	2. Replace compressor.
	3. Battery voltage too low to operate motor.	3. Charge battery.

DIAGNOSIS OF ELECTRO-LEVEL CONTROLS

PROBLEM	POSSIBLE CAUSE	CORRECTION
COMPLETE OR PARTIAL LOSS OF AIR WITH TRAVEL SWITCH IN "HOLD".	1. Leak in air bellows.	1. Eliminate air leak.
	2. Leak at air lines between bellows and solenoid.	2. Eliminate air leak.
	3. Leak in 2-way solenoid.	3. Service or replace solenoid.
COMPLETE OR GRADUAL LOSS OF AIR OVERNIGHT AT CAMPSIGHT WITH IGNITION OFF.	1. Leak at air bellows.	1. Eliminate air leak.
	2. Leak in air line between solenoid and bellows.	2. Eliminate air leak.
	3. Leak at fitting between solenoid and air line or bellows and air line.	3. Eliminate air leak.
	4. Defective 2-way solenoid.	4. Service or replace solenoid.
COMPLETE OR PARTIAL LOSS OF AIR WITH TRAVEL	1. Air leak in system.	1. Eliminate air leak. Note: Vehicle should be operated with travel switch in "HOLD"

DIAGNOSIS OF ELECTRO-LEVEL CONTROLS (CONT'D)

PROBLEM	POSSIBLE CAUSE	CORRECTION
SWITCH IN "AUTO" IGNITION ON (COMPRESSOR RUNS TOO FREQUENTLY).		position. Do not operate vehicle with travel switch in "AUTO".
	2. Defective height sensor.	2. Replace sensor.
TRAVEL SWITCH IN "AUTO". VEHICLE WILL NOT RAISE OR LOWER.	1. Compressor not operating.	1. Check compressor ground wire.
	2. Defective control switch.	2. Replace switch.
	3. Defective wiring.	3. Check wiring and electrical connections.
	4. Defective relay.	4. Replace relay.
	5. Defective solenoid valves.	5. Service or replace solenoid valves.
	6. Leak at air bellows.	6. Eliminate air leak.
	7. Leak in air lines.	7. Eliminate leak.
	8. Defective height sensor.	9. Replace height sensor.
VEHICLE DOES NOT RAISE WITH LEFT OR RIGHT SWITCH IN "RAISE" POSITION, BUT COMPRESSOR RUNS.	1. Leak in air bellows.	1. Eliminate air leak.
	2. Leak in air lines.	2. Eliminate air leak.
	3. Faulty 2-way solenoid valve.	3. Service or replace valve.
	4. Faulty control switch.	4. Replace switch.
	5. Defective wiring between control switch and solenoid.	5. Check wiring and electrical connections.
VEHICLE DOES NOT RAISE WITH LEFT OR RIGHT SWITCH IN "RAISE" POSIION. COMPRESSOR DOES NOT OPERATE.	1. Open circuit in compressor motor.	1. Motor brushes or commutator worn out. Replace motor.
	2. Defective relay.	2. Replace relay.
	3. Battery undercharged.	3. Charge or replace automotive battery.
	4. Defective diode.	4. Replace diode.
	5. Defective wiring. (Compressor feed at ground wire not connected.)	5. Check wiring and electrical connections.
	6. Open circuit breaker.	6. Check for cause of open circuit breaker. Correct cause.
	7. Faulty control switch.	7. Replace switch.
VEHICLE DOES NOT LOWER WITH LEFT OR RIGHT SWITCH IN "LOWER" POSITION.	1. Undercharged battery.	1. Charge or replace battery.
	2. Defective wiring.	2. Check wiring and electrical connections.
	3. Open circuit breaker.	3. Find cause for open circuit breaker. Reset.
	4. Defective 2-way solenoid valves.	4. Service or replace solenoid valves.
	5. Defective control switch.	5. Replace switch.

DIAGNOSIS OF TELL-TALE WARNING LIGHT "SET LEVEL TO TRAVEL AUTO"

(REFER TO FIGURE 19)

PROBLEM	POSSIBLE CAUSE	CORRECTION
START VEHICLE. MOVE TRANS-MISSION SELECT-OR LEVER TO "DRIVE" POSITION. TELL-TALE LIGHT DOES NOT ILLUMINATE.	1. Defective bulbs (two bulbs.) 2. Defective time-delay relay. 3. Defective tell-tale warning light fuse. 4. Defective wiring. 5. Defective neutral start, B/U, and safety switch.	1. Replace light bulbs. 2. Replace thermal time-delay relay (located behind instrument panel). (Refer to Section 12 of this supplement.) 3. Replace fuse. (Fuse is located in fuse panel behind glove compart-ment). 4. Check wiring and electrical connections. 5. Adjust switch or replace as necessary.
START VEHICLE. MOVE TRANS-MISSION LEVER TO "DRIVE" POSITION. TELL-TALE LIGHT ONLY PARTIALLY ILLUMINATES.	1. Defective light bulb. (Two bulbs.)	1. Replace burnt out bulb.
START VEHICLE. MOVE TRANS-MISSION LEVER TO "DRIVE" POSITION. TELL-TALE LIGHT REMAINS ON AFTER 10-15 SECOND DELAY.	1. Defective time-delay relay.	1. Replace relay.
START VEHICLE. TELL-TALE LIGHT INTERMITTENTLY LIGHTS WHEN MOVING TRANS-MISSION SELEC-TOR LEVER TO "DRIVE"	1. Defective time-delay relay. 2. Defective neutral start, B/U and safety switch.	1. Replace relay. 2. Adjust switch or replace as necessary.

HEIGHT SENSOR OPERATION CHECK

1. Cycle ignition switch "OFF" then "ON". This will assure resetting the height sensor timer circuits.

2. Check that wiring is properly and securely connected to height sensor and harness ground wire is securely connected.

3. Disconnect link from height sensor arm.

4. Move metal sensor arm up. There should be a 14-28 second delay before compressor

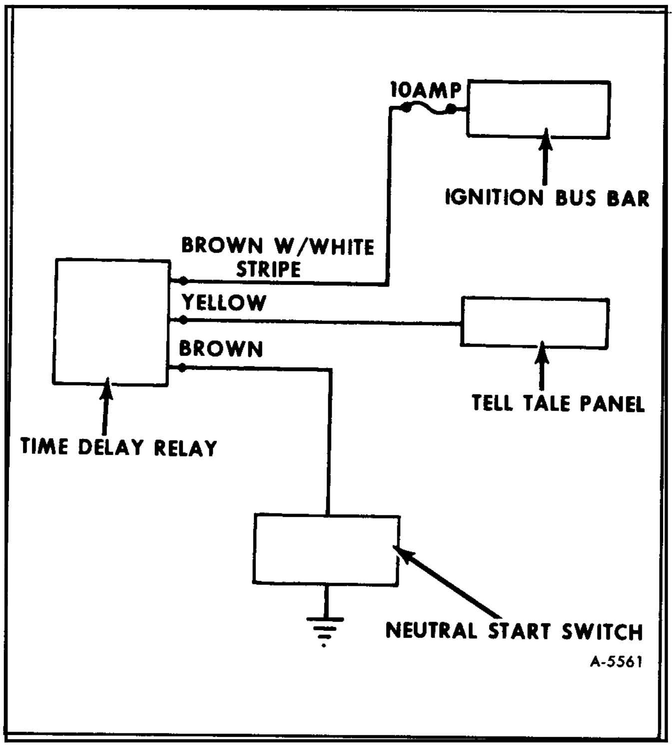


Figure 19—Tell-Tale Warning Light Schematic

turns "ON" and bellows start to inflate. As soon as air bellows noticeably fill, stop compressor by moving sensor arm down.

5. Move sensor arm down below position where compressor stopped. There should be a 14-28 second delay before bellows start to deflate and vehicle lowers.

DIAGNOSIS OF SHOCK ABSORBER

Refer to sub-section 4A of this section for Shock Absorber diagnosis.

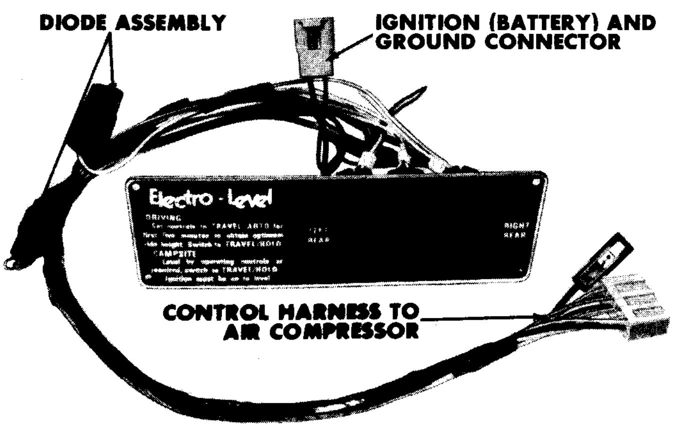


Figure 20—Location of Diodes

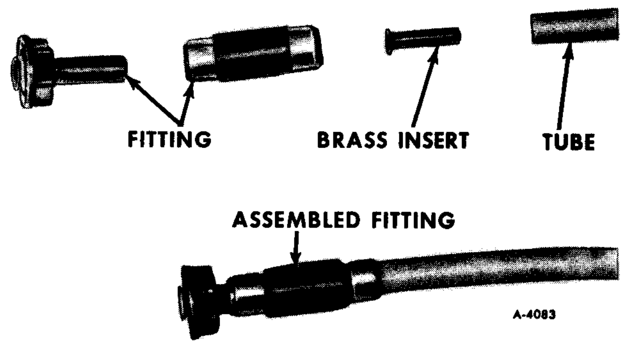


Figure 21—Coupling Assembly

TESTING DIODE ASSEMBLIES

With the Electro-Level suspension system there are two diode assemblies in the wiring harness near the control panel (figure 20). These prevent cross-feed between right and left side systems when used in manual mode.

These diodes can be tested using an ohmmeter. Holding two meter leads to either side of diode, measure the resistance in one direction. Reverse the test lead connections to measure the resistance in the other direction. If the diode is good, the resistance in one direction will be much higher than the resistance in the other direction. If diode does not test good, replace.

AIR LEAKS

With the suspension system at normal operating pressure coat air line connections with soap and water solution. Air leakage will produce soap bubbles. No leakage is permissible. Leakage at air line connections (between dryer and bellows) can sometimes be stopped by tightening connection. If this does not stop the leak replace the affected fitting(s) as follows:

1. Cut end of hose (tube) off square.
2. Place brass insert into end of tube and put appropriate fitting over it (figure 21).
3. Crimp fitting in place with Special Tool J-25520. This tool is designed so that crimp must be completed before tool will release (figure 22).
4. Air line (gray or blue line) leaks can be

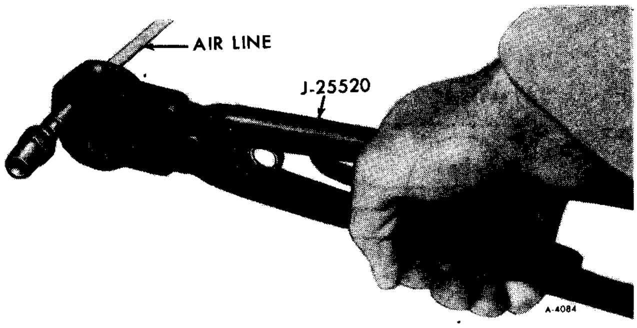


Figure 22—Special Tool J-25520 Crimping Air Line

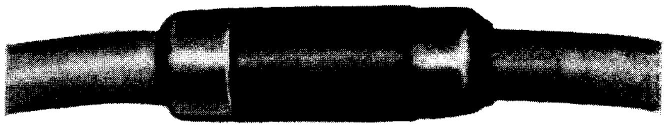


Figure 23—Air Line Repair Coupling

repaired with the coupling illustrated in figure 23.

NOTE: This crimping procedure applies only to ¼" I.D. air lines, connecting compressors and bellows.

DIAGNOSIS OF "SHUT-OFF" SOLENOID VALVES

If "shut-off" solenoid does not appear to be functioning properly, check to see that connections to air lines are not reversed. If solenoid is properly installed and still appears to malfunction, remove solenoid and use the following procedure to bench check solenoid. If solenoid fails bench test, unit can be disassembled for cleaning and inspection. Plunger, spring and seal are available for service replacement. If replacing entire solenoid unit, be sure to use equivalent solenoid valve.

BENCH CHECK OF SOLENOID

An air source of approximately 50-100 psi and an electrical 12-volt source are required for bench test of the solenoid. Apply air pressure to the supply, or "INLET" port of the solenoid. Because this is a two-way normally closed valve, air should be stopped internally (no air at "OUTLET" port). With 12 volts applied (solenoid energized) air should flow from inlet to outlet port.

MAINTENANCE AND ON-VEHICLE ADJUSTMENTS

MAINTENANCE

No routine maintenance is required on Type II rear suspension systems other than an occasional check of the air bellows to see if they are caked with mud deposits. If deposits are present, remove them from bellows.

LUBRICATION

Details on lubrication of rear suspension components are covered in Section O of Maintenance Manual X-7525.

REAR WHEEL ALIGNMENT

Refer to subsection 4A of this section for "Rear Wheel Alignment" procedure.

RIDE HEIGHT ADJUSTMENT
(FIGURE 24)

Rear suspension ride height is measured at the elongated slot on the frame rail. (Refer to figure 21.)

To adjust vehicle ride height:

NOTE: Link should be attached to actuator arm when making the adjustment.

1. Loosen adjustment bolt on height control sensor. The actuator arm has an elongated hole at the adjustment bolt. This allows the actuator arm to move in relation to the height sensor itself.

2. To increase vehicle ride height, move actuator arm upward and tighten adjustment bolt.

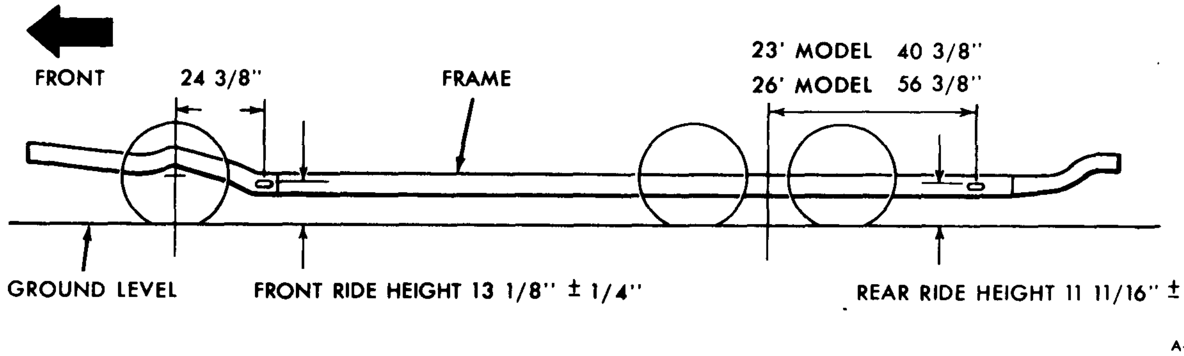


Figure 24—Checking Vehicle Ride Height

NOTE: If all adjustment is used up, check vehicle ride height at frame rail. Refer to figure 24.

3. To lower vehicle ride height, move actuator arm downward and tighten adjustment bolt.

4. If adjustment cannot be made, check for correct height sensor. (Sensor identification code for Motorhome and TransMode vehicles is "AL".)

Actuator arm is adjustable with respect to sensor ± 5°. Refer to figure 25.

COMPONENT REPLACEMENT

CAUTION: *Whenever it is necessary to support the rear suspension with jack stands or other supporting equipment, be sure the jack stands are used only at junction points of the frame rail and crossmember. Failure to locate jack stand as instructed could result in damage to frame of vehicle.*

COMPRESSOR AND BRACKET REPLACEMENT

REMOVAL

1. Disconnect battery ground cable.
2. Disconnect air line at solenoid output (both solenoids).
3. Disconnect solenoid and motor connectors.
4. Disconnect height sensor ground and Electro-Level wiring harness connector.

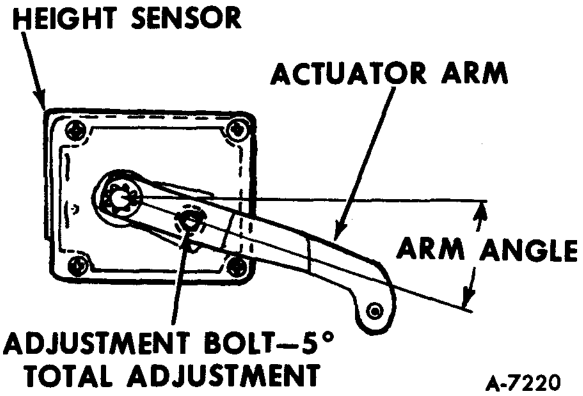


Figure 25—Height Sensor Adjustment

5. Remove relay to wall screws (Motorhome) or relay to compressor bracket screws (TransMode) and allow relays to hang free.
6. Remove riser bracket bolts and lift compressor mounting bracket (with riser bracket) out of compartment.
7. Disconnect air line at air dryer by revolving spring clip 90° while holding connector end and removing tube assembly.
8. Remove stud nuts securing compressor to mounting bracket, then remove compressor and dryer from bracket. Refer to figure 26.
9. If replacing compressor assembly, remove dryer bracket bolts and disconnect air dryer from compressor by revolving spring clip and pulling air dryer assembly away from compressor.

INSTALLATION

1. If compressor was replaced install dryer and bracket and torque dryer bracket bolts to 2 N.m (20 in. lbs.).
2. Install compressor assembly to mounting bracket and torque stud nuts (4 each compressor) to 2.8 to 4.0 N.m (24-36 in. lbs.).
3. Connect solenoid and motor connectors, and Electro-Level wiring harness connector.

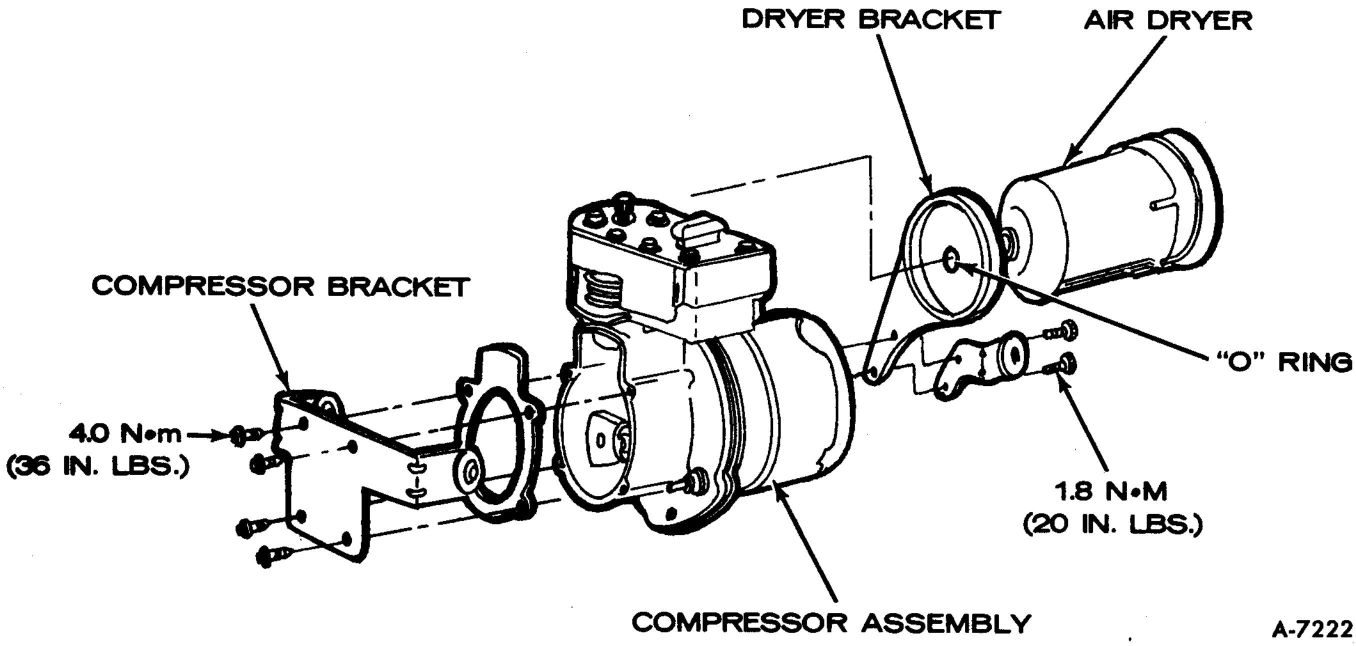


Figure 26—Compressor, Dryer and Mounting Brackets

Secure sensor ground wire at compressor mounting bracket.

4. Install four bolts mounting compressor riser bracket to floor.
5. Install relay attaching screws.
6. Rotate clip on air pressure line until clip snaps in groove, then connect air pressure line at air dryer.
7. Connect battery ground cable.
8. Turn ignition key "ON" and cycle air suspension system "ON" at control panel by pressing RAISE switch first for one side of vehicle, then for the other side. Check for system operation and leaks at air dryer. When satsified that system operation is OK, lower vehicle to normal ride height.

AIR DRYER REPLACEMENT

REMOVAL

1. Remove compressor and mounting bracket as described under "Compressor and Bracket Replacement".
2. Remove dryer bracket bolts and disconnect air dryer from compressor by revolving spring clip 90° and pulling air dryer assembly away from compressor. Remove O-ring from compressor lead.

INSTALLATION

Lubricate dryer O-ring with Vaseline or equivalent before installing dryer in head casting.

1. Reverse removal procedure.
2. Torque dryer bracket bolts to 1.8 N.m (20 in. lbs.). Refer to figure 26.
3. Check for leaks.

HEIGHT SENSOR REPLACEMENT

NOTE: Replacement height sensors are supplied without the mounting bracket.

REMOVAL

1. Disconnect battery ground cable.
2. Disconnect electrical connector from back of height sensor by squeezing sides of connector retainer.
3. Disconnect link from height sensor arm.
4. Remove height sensor bracket nuts from mounting plate and remove sensor and bracket.

INSTALLATION

1. Position sensor bracket to mounting plate and secure. Torque nuts to 95-120 in. lbs. Refer to figure 27.
2. Connect link to actuator arm and tighten nut to 60-90 ft. lbs.
3. Connect electrical connector to height sensor and snap retainer securely on sensor boss.
4. Make sure that ride height adjustment bolt is in center of slot.
5. Connect battery ground cable.
6. Check vehicle ride height. Refer to Specifications at the end of this section, and

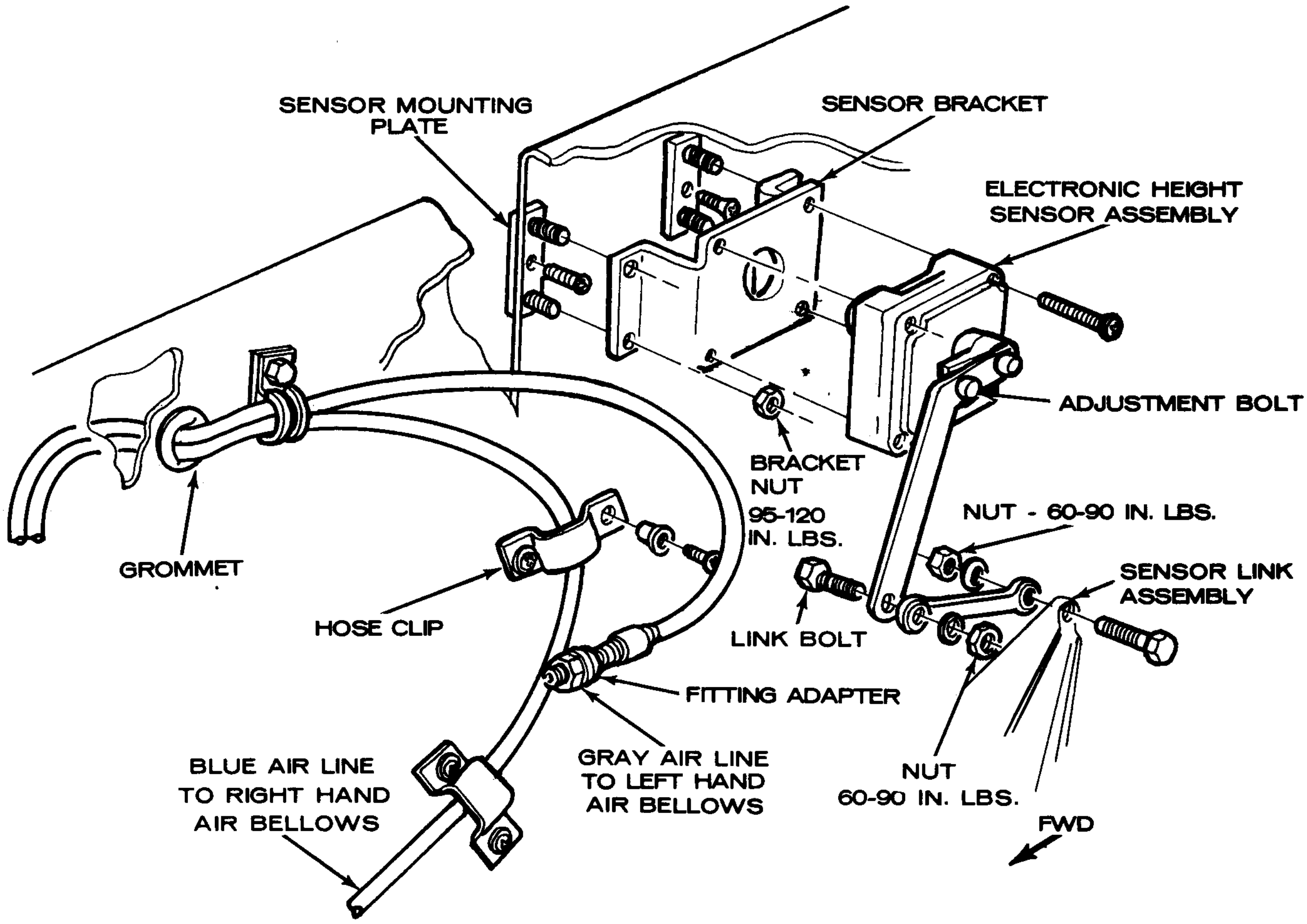


Figure 27—Electronic Height Sensor Assembly

"Ride Height Adjustment" earlier in this section if adjustment is necessary.

ELECTRO-LEVEL CONTROL PANEL REPLACEMENT

REMOVAL

1. Remove four screws securing control panel to side trim panel at left of driver's seat.
2. Disconnect electrical leads at switches.
3. Remove switches from control panel.

INSTALLATION

1. Install switch into control panel.
2. Connect wiring harness leads to switches.
3. Install control panel to side trim panel at left of driver's seat.

"SHUT-OFF" SOLENOID REPLACEMENT

REMOVAL

1. Disconnect air line fitting from each side of solenoid.
2. Disconnect solenoid wiring connectors from sensor wiring harness.
3. Remove three bolts and nuts securing solenoid mounting bracket to compressor mounting bracket.
4. Remove solenoid from bracket.

INSTALLATION

1. To install, reverse removal procedure.

NOTE: Solenoids must be assembled to mounting bracket with arrows in position shown prior to assembly of solenoid mounting bracket to compressor mounting bracket (see figure 28).

CONTROL ARM REPLACEMENT

Refer to "Control Arm Removal" and "Control Arm Installation", SEC. 4, Maintenance Manual X-7525.

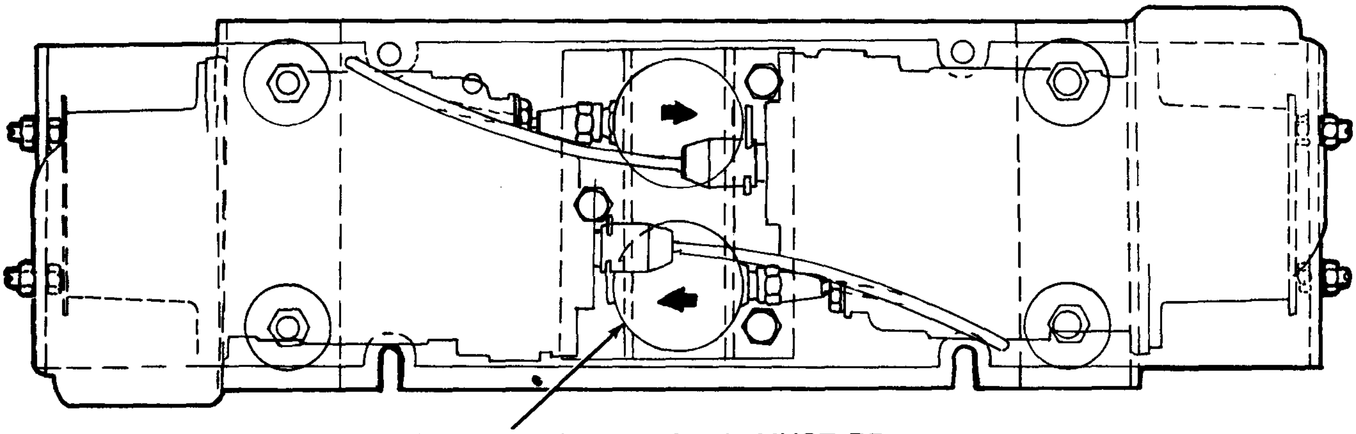


Figure 28—Solenoid Mounting—Top View

SHOCK ABSORBER REPLACEMENT

Refer to "Shock Absorber Removal" and "Shock Absorber Replacement", SEC 4, Maintenance Manual X-7525.

AIR BELLOWS REPLACEMENT

Refer to "Air Bellows Removal" and "Air Bellows Installation", SEC. 4, Maintenance Manual X-7525.

COMPONENT REPAIR

"SHUT-OFF" SOLENOID VALVE REPAIR

DISASSEMBLY

Solenoid valve shown in figure 9 can be disassembled for cleaning and inspection. Plunger, spring and seal are available for service replacement.

1. Remove housing nut and name plate.
2. Remove valve body from coil housing.
3. After separating flanged washer from valve body, use Spanner wrench (SKINNER # VD-233 or equivalent) to remove sleeve, plunger assembly and spring from valve body.

NOTE: Remove carefully as spring is under considerable tension.

INSPECTION

1. Seal should be discarded and new seal installed when assembling valve.
2. Inspect plunger inserts (both ends) for cuts, nicks, and depressions caused from hitting valve seat. Replace if necessary.
   Wear must be significant before necessary to replace.
3. Replace spring if broken. If plunger is replaced, spring should be replaced at the same time. Plunger, spring and seal are included in a repair kit.
4. Visually inspect valve threads for damage and clean if necessary.

ASSEMBLY

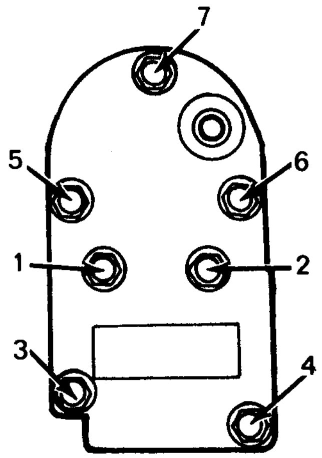
NOTE: DO NOT use any lubricant during assemby of valve components.

Reverse the disassembly procedure for assembly of valve. DO NOT tighten sleeve nut excessively.

COMPRESSOR REPAIR

DISASSEMBLY

1. Remove seven compressor cover screws, then remove compressor cover and gasket.
2. Remove head and solenoid assembly.
3. Remove two filters, exhaust valve and spring and air dryer O-ring from head assembly.
4. Remove solenoid from head by lifting up slightly and sliding to the outlet side.
5. Remove O-ring from solenoid assembly.



TORQUE SCREWS TO 4 N•m (36 IN. LBS.)
IN SEQUENCE SHOWN A-7218

Figure 29—Compressor Head Tightening Sequence

6. Remove head gasket from cylinder assembly.

7. Remove four mounting bracket screws and remove bracket and gasket.

Note ground wire position for installation.

ASSEMBLY

1. Install gasket and mounting bracket to cylinder assembly, then install screws and ground wire. Torque bolts to 4 N.m (36 in. lbs.).
2. Install head gasket on cylinder assembly.
3. Install O-ring on solenoid assembly, then install solenoid in head with valve opposite the dryer outlet.
4. Install two filters, exhaust valve and spring on head assembly.
5. Install cover gasket and cover on head assembly and install four short cover screws.
6. Install head cover assembly to cylinder assembly using three long screws. Torque all seven screws in sequence as shown in figure 29.
7. Position dryer O-ring on compressor end of dryer.

SPECIFICATIONS

FASTENER	TORQUE
Air Dryer Bracket to Compressor Bolts	2 N.m (20 In. Lbs.)
Motor and Cylinder Assembly to Bracket Stud Nuts	4.0-2.8 N.m (36 to 24 In. Lbs.)
Compressor Head Screws*	4 N.m (36 In. Lbs.)
Compressor Mounting Bracket to Riser Bracket Bolts	(20-25 Ft. Lb.)
Solenoid Mounting Bracket to Compressor Mounting Bracket	35-60 In. Lbs.
Connector-Tube Assembly to Shut-Off Solenoid	100-125 In. Lbs.
Adapter-Tube Assembly to Shut-Off Solenoid	10-15 In. Lbs.
Height Sensor Mounting Bracket to Sensor Mounting Plate Nuts	95-120 In. Lbs.
Height Sensor Link Assembly Nuts (Upper and Lower)	60-90 In. Lbs.
Link Arm To Height Sensor Actuator Arm-Nut	60-90 Ft. Lbs.
Link to Control Arm Nut	60-90 Ft. Lbs.
Control Arm Mounting Bracket to Frame Rail Nuts (4)	65-85 Ft. Lbs.
Control Arm Mounting Bracket to Crossmember Nuts (2)	50-60 Ft. Lbs.
Control Arm Lock Nut	15-20 Ft. Lbs.

*Compressor Head Screws must be torqued in sequence. See figure 29.

SPECIAL TOOLS

J-22124-A	Pressure Gauge
J-25520	Air Line Crimp Tool

SECTION 5
BRAKES

The information described in Maintenance Manual X-7525 under the heading BRAKES is applicable to models covered by this supplement with the exception of the following:

The following caution applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 5-1 of this supplement".

CAUTION: 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 OF 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. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

WARNING: WHEN SERVICING WHEEL BRAKE PARTS DO NOT CREATE DUST BY GRINDING OR SANDING BRAKE LININGS OR BY CLEANING WHEEL BRAKE PARTS WITH A DRY BRUSH OR WITH COMPRESSED AIR. (A WATER DAMPENED CLOTH SHOULD BE USED.) MANY WHEEL BRAKE PARTS CONTAIN ASBESTOS FIBERS WHICH CAN BECOME AIRBORNE IF DUST IS CREATED DURING SERVICING. BREATHING DUST CONTAINING ASBESTOS FIBERS MAY CAUSE SERIOUS BODILY HARM.

ON-VEHICLE SERVICING

BLEEDING BRAKE SYSTEM

A new brake bleeding sequence is shown in figure 1. This new sequence reduces the possibility of having to rebleed wheel cylinders a second time to eliminate air from the system.

REAR BRAKE SHOE ADJUSTMENT

Under normal operating conditions it is not necessary to make any manual adjustment to this type brake due to the automatic adjustment feature. However, when it is necessary to remove a brake drum it may also be necessary to "back-off" the adjusting screw in order to pull edge of drum past linings. (see figure 2)

1. If shoes are being adjusted for the first time, use a suitable punch to knock out the metal blank in backing plate (located at lanced area, see figure 3). Be sure all metal is removed from the brake assembly.
2. Install hub and drum assembly. Refer to BRAKE DRUM INSTALLATION.
3. Use brake adjusting tool (J-4735) to turn brake adjusting screw. Expand brake shoes at each wheel until the wheel can just be turned by hand. The drag should be equal at all wheels.
4. Back off brake adjusting screw (figure 2) at each wheel 30 notches. If shoes drag lightly on drum back off adjusting screw one or two additional notches.

NOTE: Brake should be free of drag when screw has been backed off approximately 12 notches. Heavy drag at this point indicates tight parking brake cables.

5. Install brake adjustment cover in backing plate when adjustment is completed.
6. Check parking brake adjustment.

COMPONENT REPLACEMENT

BRAKE DRUM REMOVAL

1. Hoist wheels off ground.

NOTE: It may be necessary to back off the brake shoe adjustment before the brake drum can be removed. To back off brake shoe adjustment, refer to Figure 2.

2. Remove wheel and tire.
3. Remove outer dust cap as shown in Figure 4, and then inner cap.

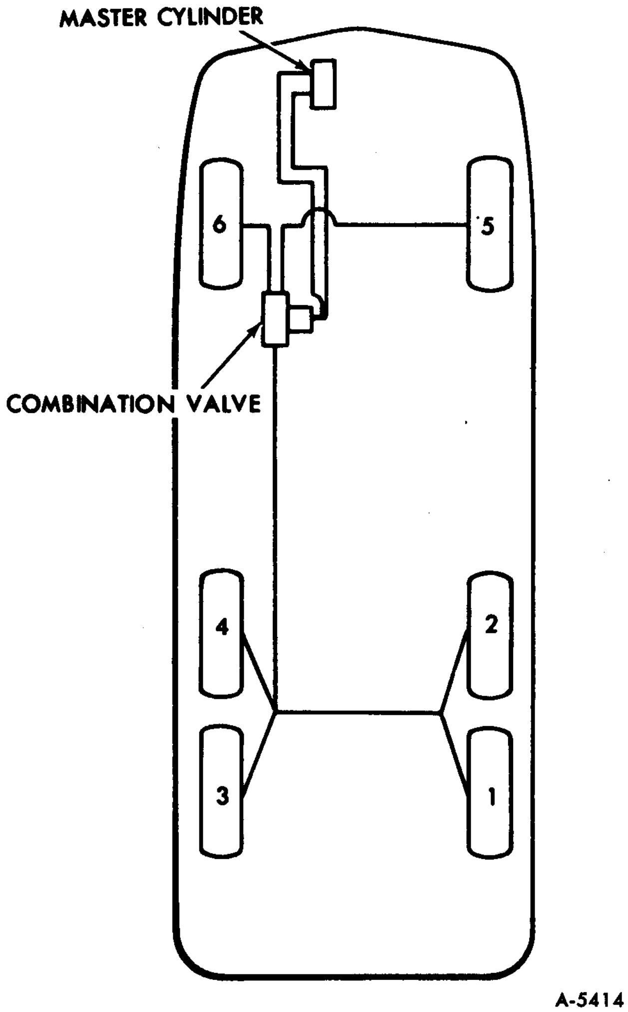


Figure 1—Brake Bleeding Sequence

4. Remove cotter pin and castillated nut from hub as shown in Figure 5.

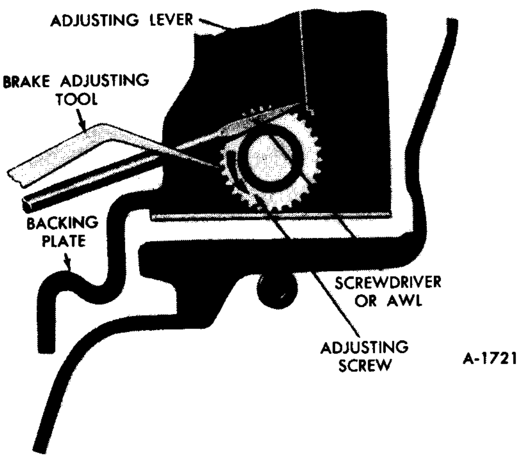


Figure 2—Backing Off Brake Adjustment

Figure 3—Lanced Area in Backing Plate

5. Hub and drum assembly can now be removed. See Figure 6.

6. Using a suitable punch, knock out the metal blank in backing plate (located at lanced area, see figure 3). Be sure all metal is removed from the brake assembly.

BRAKE DRUM INSTALLATION

CAUTION: *See "Caution" on page 5-1 of this supplement.*

1. Install hub and drum assembly (figure 6).
2. Install flat washer and castillated nut on hub while rotating hub and drum assembly.

Figure 4—Removing Dust Cap

3. Tighten castillated nut to 25-30 lbs. ft. torque to position bearings. (Be sure drum is rotating while tightening nut).
4. Back off nut 1/2 turn.
5. Retighten nut finger tight, secure if possible with cotter pin.
6. If unable to secure at finger tight, back off nut to first securing position.
7. Check end play between hub and spindle it should be .001 to .005 inch.
8. Replace inner and outer dust caps.
9. Adjust brake shoes as outlined under BRAKE SHOE ADJUSTMENT.
10. Be sure brake adjustment cover is installed in lanced area opening of backing plate, see figure 3.
11. Install wheel and tire assembly. Refer to Section 10 of Maintenance Manual X-7525 for details.

REAR BRAKE SHOE REMOVAL
(Refer to Figure 7)

1. Hoist vehicle. Remove wheel and brake drum.
2. Remove the brake shoe return springs actuating link and guide.
3. Remove the brake shoe hold-down springs, adjuster lever, return spring and parking brake lever strut and spring.
4. Spread shoes to clear wheel cylinder links then remove the brake shoes as an assembly.
5. Disconnect the parking brake cable from the operating lever.
6. Using a suitable punch, knock out the metal blank in backing plate (located at lanced area, see figure 3). Be sure all metal is removed from the brake assembly.

REAR BRAKE SHOE INSTALLATION

CAUTION: *See "Caution" on page 5-1 of this supplement.*

WARNING: WHEN SERVICING WHEEL BRAKE PARTS DO NOT CREATE DUST BY GRINDING OR SANDING BRAKE LININGS OR BY CLEANING WHEEL BRAKE PARTS WITH A DRY BRUSH OR WITH COMPRESSED AIR. (A WATER DAMPENED CLOTH SHOULD BE USED.) MANY WHEEL BRAKE PARTS CONTAIN ASBESTOS FIBERS WHICH CAN BECOME AIRBORNE IF DUST IS CREATED DURING SERVICING. BREATHING DUST CONTAINING ASBESTOS FIBERS MAY CAUSE SERIOUS BODILY HARM.

1. Lubricate the adjusting screw threads, thrust washer mating surfaces and backing plate ledges with brake lubricant, such as Part No. 1050110 or equivalent.
2. Assemble the adjusting screw.
3. Attach the primary to secondary shoe spring to the shoes and install the adjusting screw. The primary to secondary shoe spring must not contact the adjusting screw sprocket.
4. Position shoe assembly on the backing plate. Be sure wheel cylinder links are properly positioned in the shoe notches.
5. Position the upper end of the actuating link on the brake shoe guide.

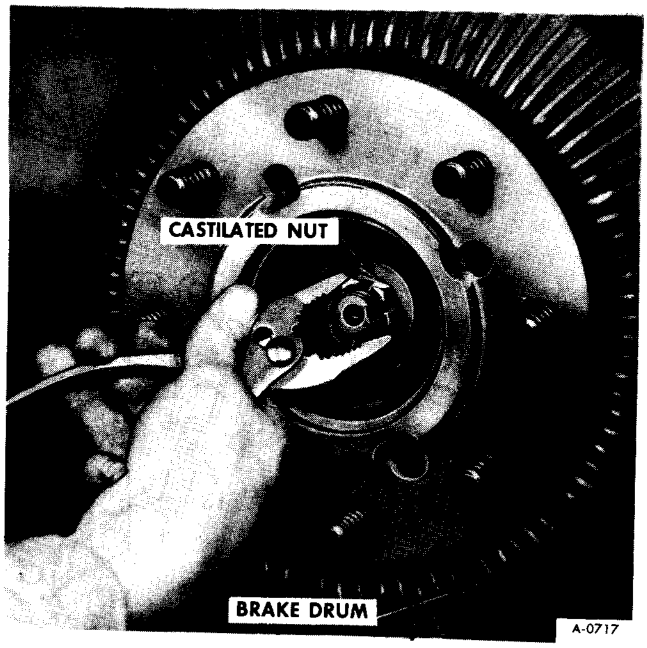
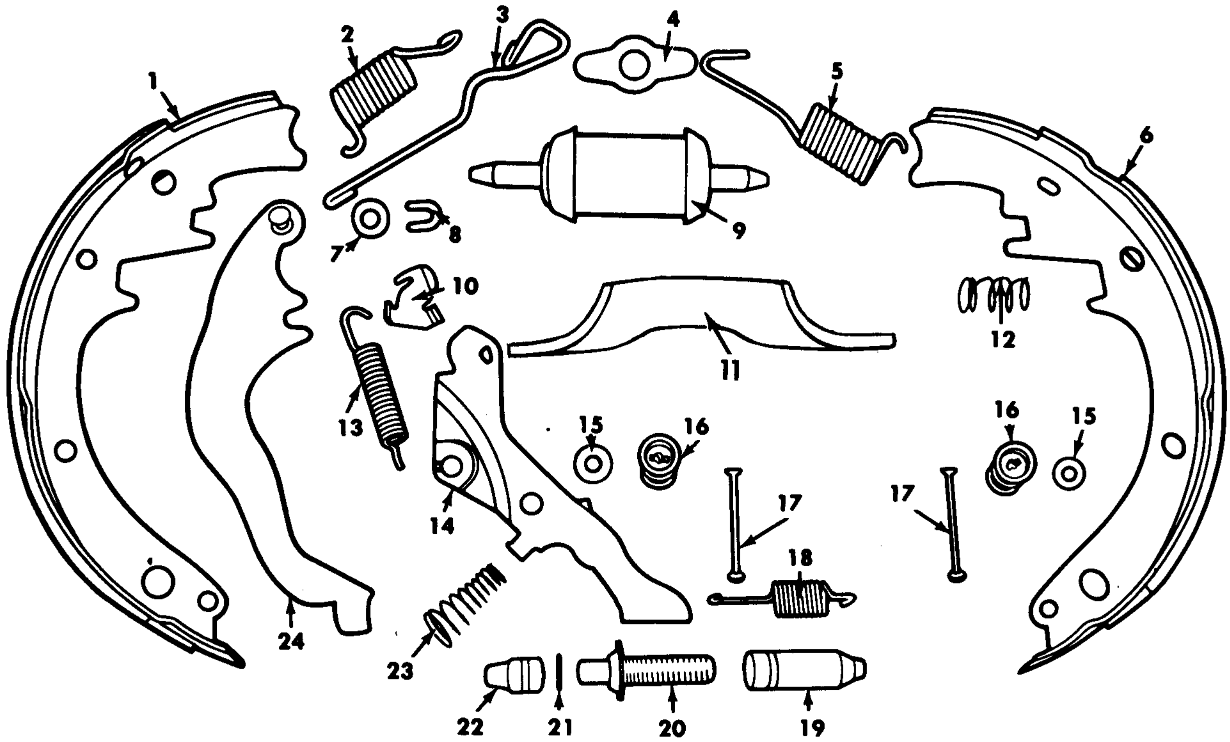


Figure 5—Removing Castillated Nut

Figure 6—Removing Hub and Drum



1. Secondary Shoe And Lining	13. Override Spring
2. Return Spring	14. Adjuster Lever
3. Actuating Link	15. Washer
4. Guide Plate	16. Hold Down Spring
5. Return Spring	17. Pin
6. Primary Shoe And Lining	18. Spring
7. Washer	19. Nut
8. Clip	20. Adjusting Screw
9. Wheel Cylinder	21. Washer
10. Pivot	22. Socket
11. Strut	23. Return Spring
12. Spring	24. Lever

A-4129

Figure 7—Brake Assembly (Rear)

6. Engage the actuating link with the override pivot. Then position the adjuster lever and return spring on the secondary shoe. Position sleeve in the hole in secondary shoe and fasten to backing plate with hold-down spring assembly and pin.

7. Install the remaining primary hold-down spring, washer and pin.

8. Install the primary and secondary brake shoe return springs.

9. Install hub and drum assembly. Refer to BRAKE DRUM INSTALLATION.

10. Adjust brake shoes as outlined under BRAKE SHOE ADJUSTMENT.

11. If wheel cylinder was removed, bleed brakes.

12. Check fluid level in master cylinder. Fluid level should be no more than 1/4" below the reservoir opening at rear.

13. Install wheel and tire assembly. Refer to Section 10 of Maintenance Manual X-7525 for details.

COMPONENT REPAIR

DELCO-MORAINE DUAL DIAPHRAGM POWER BRAKE BOOSTER REPAIR

A new power booster repair procedure is required due to following internal component changes within the booster:

1. Secondary diaphragm and support ring has been replaced by a diaphragm with an integral ring.
2. The retainer plate has been deleted.
3. A new divider housing.

DISASSEMBLY

1. Scribe a mark on the top center of the front and rear housings in line with master cylinder reservoir cover to facilitate re-assembly.

2. Remove the two nuts which hold the master cylinder to the front housing, and remove the master cylinder from the mounting studs.

3. Remove front housing seal (figure 8).

4. Install booster assembly in brake booster separating fixture (J-23456) as shown in figure 9.

> **CAUTION:** *When separating housings maintain light pressure on rear housing as it is under spring tension.*

5. With booster clamped slightly, rotate bar counterclockwise to unlock housings. If the front housing cannot be readily loosened, tap the rear housing lightly with a plastic hammer.

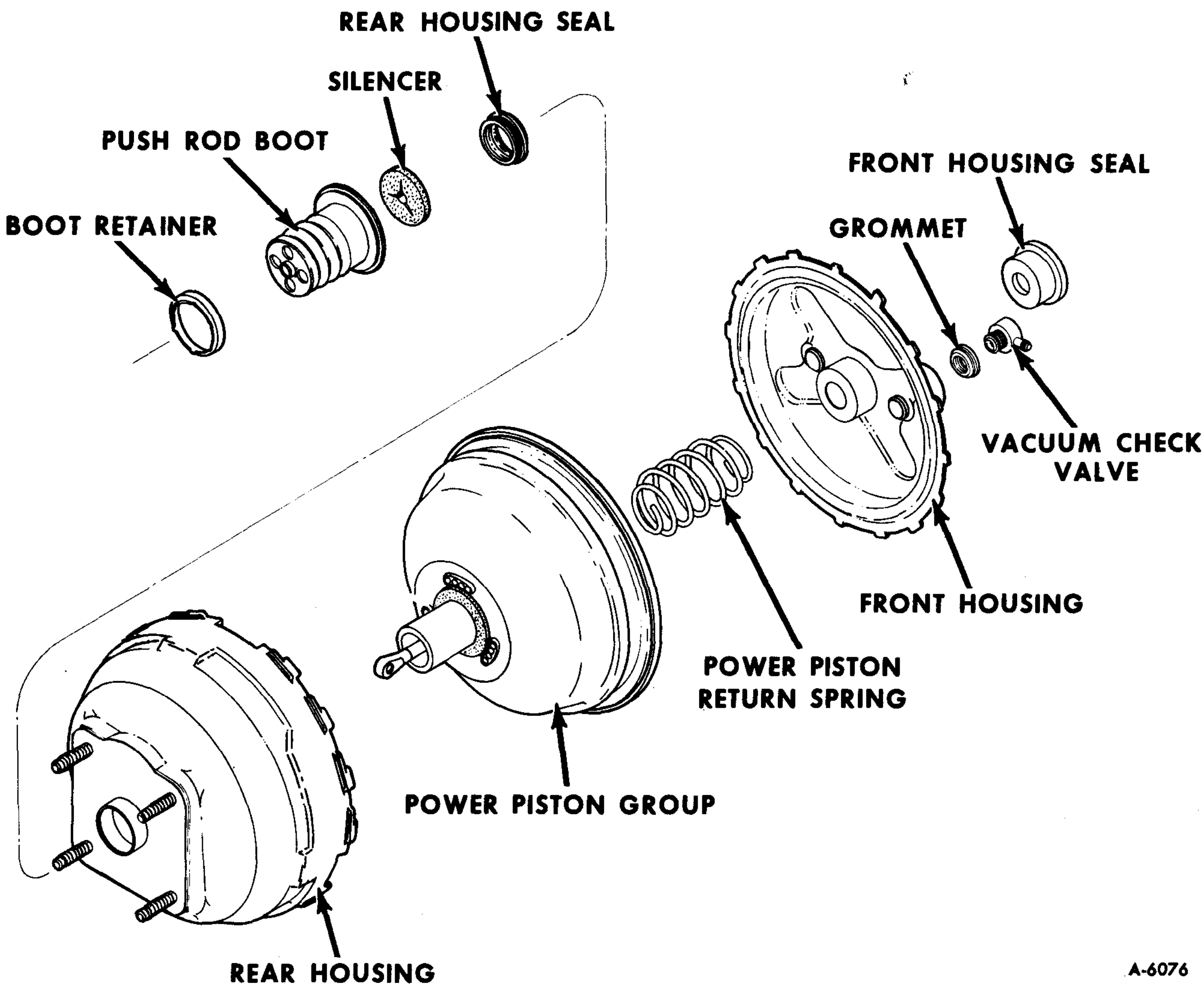


Figure 8—Delco Moraine Power Booster Components

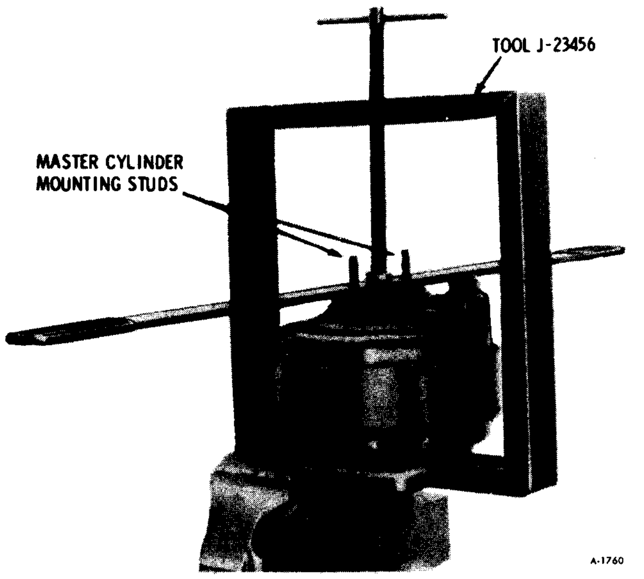


Figure 9—Using Brake Booster Separating Fixture

NOTE: Care must be exercised not to damage or loosen studs in housings. Also take care that no pressure is exerted on plastic power piston.

6. Back off the hold down bar sufficiently to remove front housing.

FRONT HOUSING GROUP DISASSEMBLY

1. Remove the power piston return spring and piston rod retainer.
2. Remove the vacuum check valve and grommet from the front housing. If the check valve is defective or the grommet cracked, cut or damaged it must be replaced.
3. Remove the front housing seal.

REAR HOUSING GROUP DISASSEMBLY

1. Remove the boot retainer and piston rod boot from the rear housing.
2. Remove the felt silencer from inside the piston rod boot.
3. Remove the power piston group from the rear housing.
4. Remove the rear housing seal from the center opening in the rear housing.

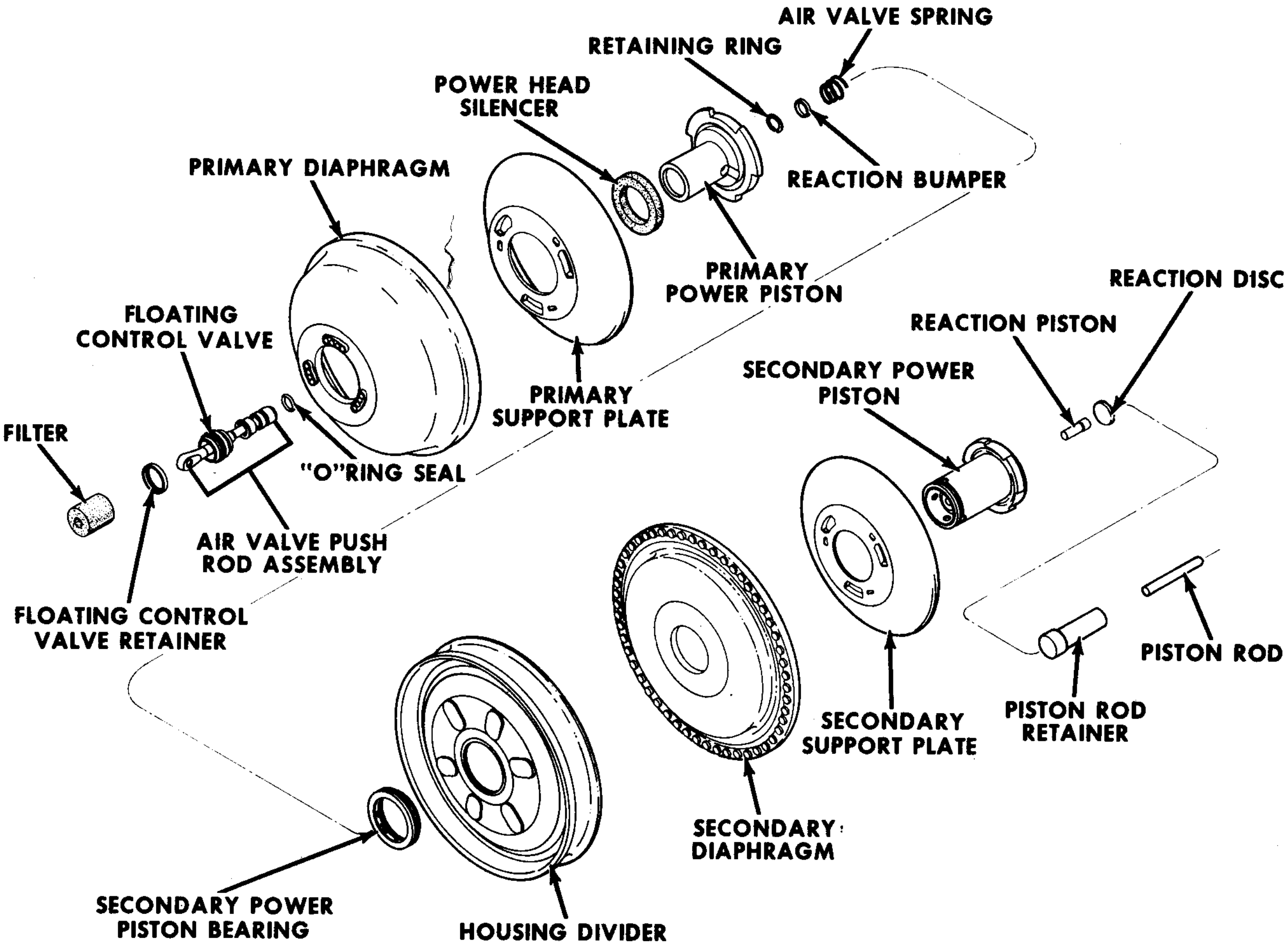


Figure 10—Power Piston Group

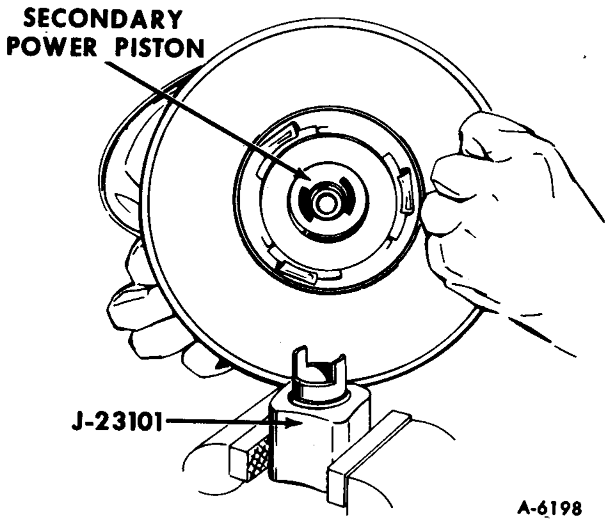


Figure 11—Positioning Secondary Power Piston on Tool J-23101

POWER PISTON GROUP DISASSEMBLY (Figure 10)

1. Lift the bead on the outside diameter of the secondary diaphragm.
2. Remove the piston rod retainer and piston rod from the secondary piston.
3. Mount double-ended Tool J-23101 (with large diameter end up) in a vise. Position the secondary power piston so that the two radial slots in the piston fit over the ears (tangs) of the tool (figure 11).
4. Fold back the primary diaphragm from the outside diameter of the primary support plate. Grip the edge of the support plate and rotate counterclockwise to unscrew the primary power piston from the secondary power piston.

NOTE: It is possible that the primary support plate will unlock from the primary piston before the primary piston unscrews from the secondary piston. If this happens, continue to turn the primary support plate counterclockwise. Tabs (stops) on the primary support will temporarily lock the primary support plate to the primary power piston and permit continued counterclockwise rotation to unscrew the primary power piston from the secondary power piston. (figure 12).

5. Remove the housing divider from the secondary power piston. Remove the secondary power piston bearing from the housing divider.
6. The secondary power piston should still be positioned on Tool J-23101. Fold back secondary diaphragm from outside diameter of secondary support plate. Grip the edges of the support plate and rotate clockwise to unlock the secondary support plate from the secondary power piston (figure 13).
7. Remove the secondary diaphragm from the secondary support plate.
8. Remove the reaction piston and reaction disc from the center of the secondary power piston by pushing down on the end of the reaction piston with a small object, such as a pencil, wooden dowel or metal rod (figure 14).
9. Remove the air valve spring from the end of the air valve (if it didn't come off during disassembly of the power piston).
10. Mount Tool J-23101 in a vise (with small diameter end up). Position the primary power

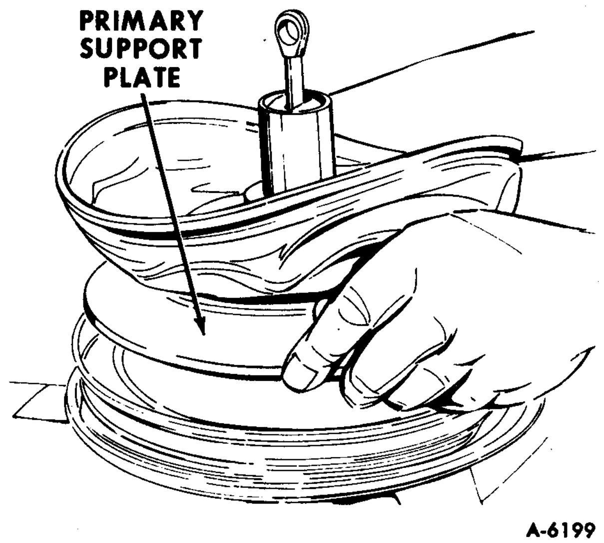


Figure 12—Locking or Unlocking Primary And Secondary Power Pistons

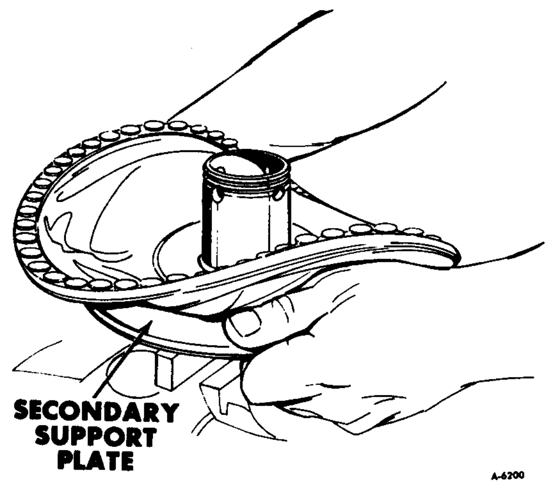


Figure 13—Locking or Unlocking Secondary Support Plate and Secondary Power Piston

Figure 14—Removing Reaction Piston And Reaction Disc from Secondary Power Piston

piston so that the two radial slots in the piston fit over the ears (tangs) of the tool (figure15).

11. Fold back primary diaphragm from the support plate. Grip the edge of the support plate and rotate in a counterclockwise direction to unlock the primary support plate from the primary power piston (figure 16).

12. Remove the primary diaphragm from the primary support plate.

13. Remove the air filter from the tubular section of the primary power piston.

14. Remove the power head silencer from the neck of the power piston tube.

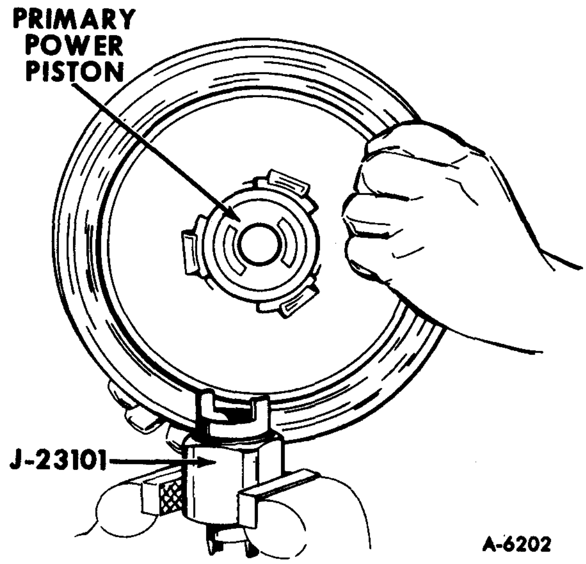


Figure 15—Positioning Primary Power Piston in Tool J-23101 (Small Dia. End Up)

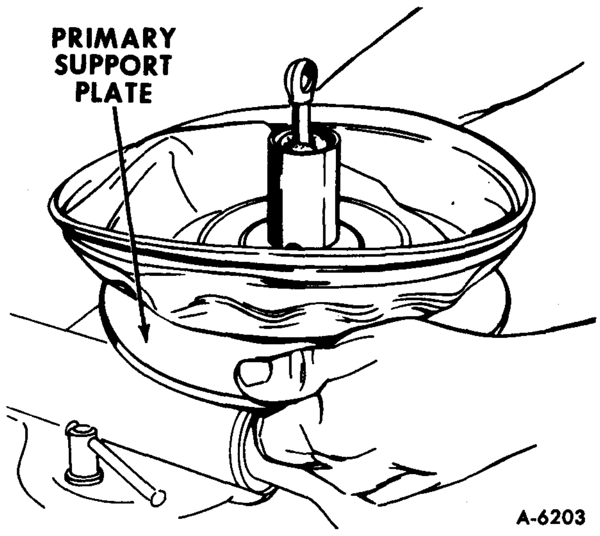


Figure 16—Locking or Unlocking Primary Support Plate from Primary Power Piston

15. Remove the rubber reaction bumper from the end of the air valve.

16. Using snap ring pliers J-4880, remove the retaining ring from the air valve (figure 17).

17. Remove the air valve-push rod assembly from the tube end of the primary power piston. The following removal method is recommended:

Place the primary power piston in an arbor press and press the air valve push rod assembly out the bottom of the power piston tube with a rod not exceeding 1/2" in diameter.

18. Removal of air valve push rod assembly will disassemble control valve retainer.

19. Remove "O" ring seal from air valve.

Figure 17—Removing Retaining Ring Front Air Valve

INSPECTION CHART		
Part	**Inspect For**	**Corrective Action**
Power Pistons and Support Plates	1. Damaged threads.	1. Replace
	2. Cracks, distortion, chipping, pitted or rough holes, worn seal surfaces (tubes).	2. Clean up or replace.
Piston Rod Retainer	1. Cracks, distortion, chipping.	1. Replace
Air Valve—Push Rod Assembly	1. Air Valve scratches, dents, distortion, or corrosion of I.D. or O.D. All seats to be smooth and free of nicks and dents.	1. Do not repair—Replace.
	2. Push rod must move freely in air valve, but must not pull out.	2. If worn, replace air valve push rod assembly.
	3. Deterioration of rubber or warped valve face in floating control valve.	3. Replace
Spring Retainers	1. Check for cracks, deformation.	1. Replace
Front and Rear Housings	1. Scratches, scores, pits, dents, or other damage affecting rolling or sealing diaphragm or other seals.	1. Replace, unless easily repaired.
	2. Cracks, damaged threads on studs, broken studs.	2. Replace, unless easily repaired.
	3. Bent or nicked locking lugs.	3. Replace, unless easily repaired.
	4. Loose studs.	4. Replace or repair.
Filter and Silencers	1. Dirty	1. Replace

A-6205

Figure 18—Delco-Moraine Power Booster Inspection Chart

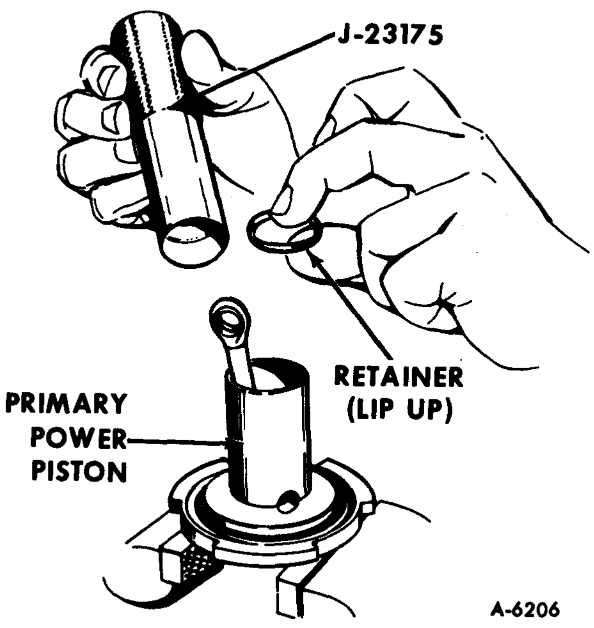


Figure 19—Installing Floating Control Valve Retainer with Installer J-23175

CLEANING

Use denatured alcohol to clean all metal, plastic and rubber parts of the power cylinder. Immerse parts in cleaning fluid and use a hair brush to remove foreign matter. Blow out all passages, orifices and valve holes. AIR DRY and place cleaned parts on clean paper or lint-free cloth. If slight rust is found on inside surface of power cylinder housing, polish clean with crocus cloth or fine emery cloth, then follow with a thorough cleaning as outlined above.

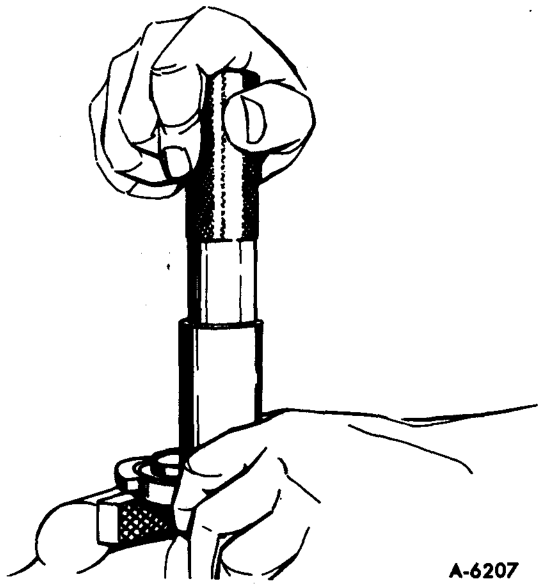


Figure 20—Seating Floating Control Valve with Installer J-23175

CAUTION: *Use of gasoline, kerosene, antifreeze alcohol or any other cleaner with even a trace of mineral oil, will damage rubber parts.*

INSPECTION

Wipe cleaning fluid from all parts and carefully inspect each part for damage and wear. Inspect rubber parts for cuts, nicks and distortion. These rubber parts are the key to control of air flow and should account for the majority of troubles traceable to leakage. If there is any question whatever as to serviceability of any part, replace it.

Refer to "Inspection Chart" (figure 18) for more detailed instructions.

ASSEMBLY

CAUTION: *See "Caution" on page 5-1 of this supplement.*

CAUTION: *Be sure to keep parts clean until reassembly. Re-wash at reassembly if there is any occasion to doubt cleanliness - such as parts dropped or left exposed for eight hours or longer.*

If you suspect there is any contamination or any evidence of corrosion, completely flush the vehicle hydraulic brake system in accordance with the Maintenance Manual.

Lubricate rubber, plastic and metal friction points with Delco Silicone Lube #5459912 (or equivalent).

Front Housing Group

1. Replace vacuum check valve using a new grommet if old one is cracked or damaged.
2. Place new front housing seal in housing so flat surface of cup lies against bottom of depression in housing.

Power Piston Group

1. Lubricate the inside diameter and outside diameters of the "O" ring seal with Delco Silicone Lube #5459912 (or equivalent) and place on the air valve.
2. Wipe a thin film of Delco Silicone Lube #5459912 (or equivalent) on the large and small outside diameter of the floating control valve.

NOTE: If the floating control valve needs replacement, it will be necessary to replace the complete air valve-push rod assembly.

Since the floating control valve is a component part of this assembly and cannot be disassembled from the push rod.

3. Place the air valve end of the air valve push rod assembly into the tube of the primary power piston. Manually press the air valve push rod assembly so that the floating control valve bottoms on the tube section of the primary power piston. Installer Tool J-23175 can be used to manually press the floating control valve to its seat.

4. Place the inside diameter of the floating control valve retainer on the outside diameter of floating control valve Retainer Installer J-23175. Place over the push rod so that the closed side of the retainer seats on the floating control valve (figure 19). With Installer J-23175, manually press the retainer and floating control valve assembly to seat in the primary power piston tube (figure 20).

5. The filter element can now be stretched over the push rod and pressed into the primary power piston tube.

6. Using Snap Ring Pliers J-4880, place the retaining ring into the groove in the air valve (figure 17).

7. Position the rubber reaction bumper on the end of the air valve.

NOTE: Tolerances of component parts affecting output of the power booster are very critical. To maintain correct power brake output, the power piston assembly is serviced as an assembly which includes a pre-selected REACTION PISTON, PRIMARY POWER PISTON, and SECONDARY POWER PISTON. No gauging is required when power piston service package is used.

8. Assemble the primary diaphragm to the primary support plate from the side of the support plate opposite the locking tangs. Press the raised flange on the inside diameter of the diaphragm through the center hole of the support plate. Be sure that the edge of the support plate center hole fits into the groove in the raised flange of the diaphragm. Lubricate the diaphragm inside diameter and the raised surface of the flange (that fits into a groove in the primary power piston) with a light coat of Delco Silicone Lube #5459912 (or equivalent).

9. Mount Tool J-23101 (small diameter end up) in a vise. Position the primary power piston so that the two radial slots in the piston fit over the ears (tangs) of the tool (figure 15).

10. Fold the primary diaphragm away from the outside diameter of the primary support plate.

11. Holding the edges of the support plate, with the locking tangs down, place the primary support plate and diaphragm assembly over the tube of the primary power piston. The flange on the inside diameter of the primary diaphragm will fit into a groove in the primary power piston.

12. Grip the edges of the primary support plate, press down, and rotate clockwise until the tabs on the primary power piston contact the stops on the support plate (figure 16).

13. Place the power head silencer on the tube of the primary power piston so that the holes at the base of the tube are covered.

14. Apply Delco Silicone Lube #5459912 (or equivalent) to the outside diameter of the primary power piston tube.

15. Remove the primary piston assembly from Tool J-23101 and lay it aside.

16. Assemble the secondary diaphragm to the secondary support plate from the side of the support plate opposite the locking tangs. Press the raised flange on the inside diameter of the diaphragm through the center hole of the support plate. Be sure that the edge of the support plate center hole fits into the groove in the raised flange of the diaphragm. Apply a thin coat of Delco Silicone Lube #5459912 (or equivalent) to the inside diameter of the secondary diaphragm and the raised surface of the flange (that fits into a groove in the secondary power piston).

17. Mount Tool J-23101 (with large diameter end up) in a vise. Position the secondary power piston so that the radial slots in the piston fit over the ears (tangs) of the tool. Apply a light coat of Delco Silicone Lube #5459912 (or equivalent) to the tube of the secondary power piston (figure 11).

18. Fold the secondary diaphragm away from the outside diameter of the secondary plate.

19. Holding the edges of the support plate with the locking tangs down, place the secondary diaphragm and support plate assembly over the tube of the secondary power piston. The flange of the inside diameter of the secondary diaphragm will fit into the groove in the secondary piston.

20. Grip the edges of the secondary support plate, press down, and rotate counterclockwise until the tabs on the secondary power piston contact the stops on the support plate. Fold the secondary diaphragm back into position on the secondary support plate. Leave the secondary power piston assembly on Tool J-23101 in the vise (figure 13).

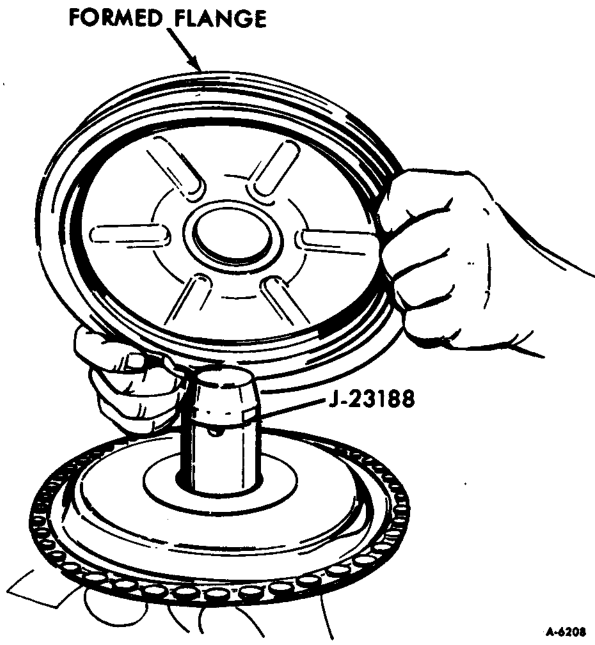


Figure 21—Positioning Housing Divider Over Secondary Bearing Protector Tool J-23188

21. Apply a light coat of talcum powder or Delco Silicone Lube #5459912 (or equivalent) to the bead on the outside diameter of the secondary diaphragm. This will faciltate reassembly of front and rear housings.

22. Hold the housing divider so that the formed over flange (that holds the primary diaphragm) of the divider faces down. Place the secondary bearing in the inside diameter of the divider so that the extended lip of the bearing faces up.

23. Lubricate the inside diameter of the secondary bearing with Delco Silicone Lube #5459912 (or equivalent).

24. Position secondary Bearing Protector Tool J-23188 on the threaded end of the secondary power piston (figure 21).

25. Hold the housing divider so that the six oblong protrusions on the middle of the divider are facing up. Press the divider down over the tool and onto the secondary power piston tube where it will rest against the diaphragm support ring. Remove Tool J-23188 from secondary power piston; however, do not remove the secondary power piston sub-assembly from Tool J-23101.

26. Pick up the primary power piston assembly and fold the primary diaphragm away from the outside diameter of the primary support plate.

27. Position the small end of the air valve return spring on the air valve so that it contacts the air valve retaining ring.

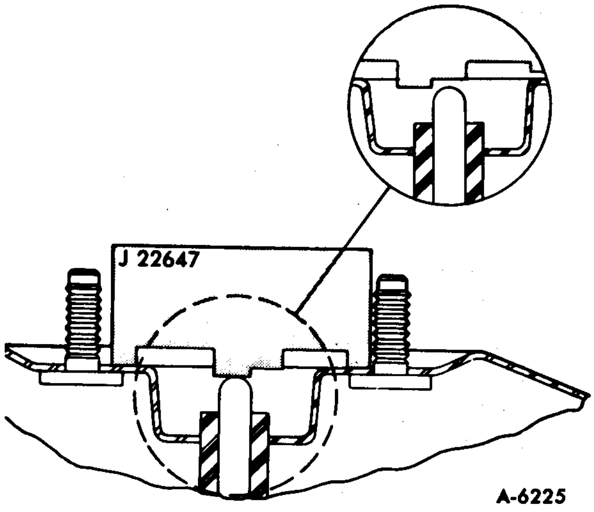


Figure 22—Gauging Piston Rod

28. Position the primary power piston on the tubular portion of the secondary power piston, making sure that the air valve return spring seats down over the raised center section of the secondary power piston.

29. Grip the edge of the primary support plate, press down, and start the threads on the secondary power piston into the threaded portion of the primary power piston by rotating in clockwise direction (figure 12).

30. Continue to tighten the primary power piston until it is securely attached (approximately 5-15ft. lbs.) to the secondary power piston.

31. Fold the primary diaphragm back into position on the primary support plate and pull the diaphragm outside diameter over the formed flange of the housing divider. Check that the bead on the diaphragm is seated evenly around the complete circumference.

32. Wipe a thin film of Delco Silicone Lube #5459912 (or equivlanet) on the outside diameter of the piston rod retainer. Insert the master cylinder piston rod so that the flat end bottoms against the rubber reaction disc in the bottom of the cavity.

Rear Housing Group

1. Coat the inside diameter of the rear housing seal with Delco Silicone Lube #5459912 (or equivalent).

2. Place the NEW seal in the rear housing center hole so that the formed flange of the housing center hole fits into the groove of the seal. The thin lip of the seal will protrude to the outside of the housing.

FINAL ASSEMBLY

1. Mount the front housing assembly in a vise.

2. Position the power piston return spring over the inset in the front housing.

3. Assemble the power piston group to the rear housing by pressing the tube of the primary piston through the rear housing bearing. Press down until the housing divider seats in the rear housing and the primary power piston bottoms against the housing.

4. Hold the rear housing assembly (with mounting studs up) over the front housing. (Make sure that the piston rod retainer does not dislodge from the secondary housing power piston during this operation.) Position the rear housing so that when the tangs on the edge of the front housing are locked in the slots on the edge of the front housing, the scribe marks on the top of the housings will be in line.

5. Lower the rear housing assembly onto the front housing. The power piston spring must seat in the depression in the face of the secondary power piston. Check that the bead on the outside diameter of the secondary diaphragm is positioned between the edges of the housing.

6. Continue to press down on the rear housing and fit the slots in the appropriate tangs on the front housing.

7. To facilitate locking, position front housing seal in the depression in the front housing and apply a vacuum source to the vacuum check valve in the front housing. Using Tool J-23456, press down and rotate the rear housing clockwise into the locked position. Remove Tool J-23456; remove the vacuum source. See Figure 9.

8. Place the silencer in the closed end of the power head boot. Push the boot retainer over the boot. Stretch the boot over the push rod and over the flange in the center of the rear housing.

9. Place the booster assembly in a padded vise with the front housing facing up. Insert the master cylinder push rod, flat end first, into the piston rod retainer.

10. Press down on the master cylinder piston rod (with approximately 40-50 pound load) to be sure it is properly seated.

11. Remove the front housing seal to be sure that no vacuum is in the power head while gauging.

12. Place gauge J-22647 over the piston rod in a position which will allow the gauge to be moved to the left or right without contacting the studs (see figure 22).

NOTE: The adjustment is correct if the lower step contacts the piston rod and the upper step clears the piston rod.

13. If the push rod is not within specifications and the push rod does not have an adjusting screw, a new service adjustable push rod must be installed and adjusted to specification. If the push rod being checked has an adjusting screw, adjust the push rod to specification.

14. Wipe a thin film of lubricant on the inside diameter of the front housing seal and position seal in the depression in the opening.

15. Position the master cylinder assembly on the front housing. Install the master cylinder retaining nuts and tighten to 28 foot - pounds torque.

SPECIAL TOOLS

J-4480	Snap Ring Pliers
J-22647	Push Rod Adjusting Gauge
J-23101	Diaphragm Plate Separator
J-23175	Control Valve Installer
J-23188	Secondary Power Piston Bearing Seal Protector
J-23456	Brake Booster Separating Fixture

SECTION 6A
ENGINE
(403 CUBIC INCH)

CONTENTS

The following "Caution" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "See Caution on page 6A-2 of this supplement".

CAUTION: 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 OF 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. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

GENERAL INFORMATION

DESCRIPTION

Effective with Motorhome Vehicle Identification No. TZE167V101285 and TransMode Vehicle Identification No's TZE337V101287 and TZE367V101312, 1977 Motorhome and TransMode vehicles are equipped with a 403 cubic inch engine (figure 1). 1978 Model Vehicles are equipped with the same engine and all service information in this section applies.

The left bank of cylinders (as viewed from the driver's seat) are numbered (from front to rear) 1-3-5-7. Cylinders in the right bank are numbered (from front rear) 2-4-6-8. Refer to figure 2).

The required engine maintenance, and unit numbers and engine identification is outlined in Section 0 of this supplement. The Engine Specifications are listed at the back of this section.

ENGINE MAINTENANCE AND STORAGE

Refer to SECTION 0 at the beginning of this supplement for recommendations pertaining to engine servicing intervals. Winterization and storage are also covered in SECTION 24A of Maintenance Manual X-7525.

ENGINE LUBRICATION SYSTEM
(FIGURE 3)

The engine oil pan forms a reservoir for engine oil to provide lubrication and also hydraulic fluid to operate the valve lifters. Oil pressure for lubrication is furnished by a gear type oil pump that is bolted to the rear main bearing cap and driven by the camshaft gear through a hexagonal drive shaft.

Oil enters the pump through a screened inlet located near the bottom rear of the oil pan. The pressurized oil from the pump passes through the engine oil cooler located in the radiator tank then to the oil filter located on the right rear side of the engine block, see figure 4. The oil filter base has a by-pass valve which in the event of filter restriction will open at 5.3 to 6.3 psi. It then enters the right oil gallery where it is distributed to the five main bearings. The right bank valve lifters receive oil from this gallery from eight feed holes that intersect the gallery.

The five camshaft bearings are lubricated from vertical passages intersecting the main bearing oil passages. At the front main bearing a third passage connects the right main oil gallery to the left gallery which then feeds the left bank of valve lifters.

The engine oil pressure warning light switch is connected to the front of the left oil gallery. The switch is calibrated to turn on the instrument panel warning light when engine oil pressure is too low. The switch, normally closed, is set to open at 2-6 psi. The rear oil gallery plug has a .040" orifice to help purge contaminants from the gallery.

At the front end of the right gallery, a small

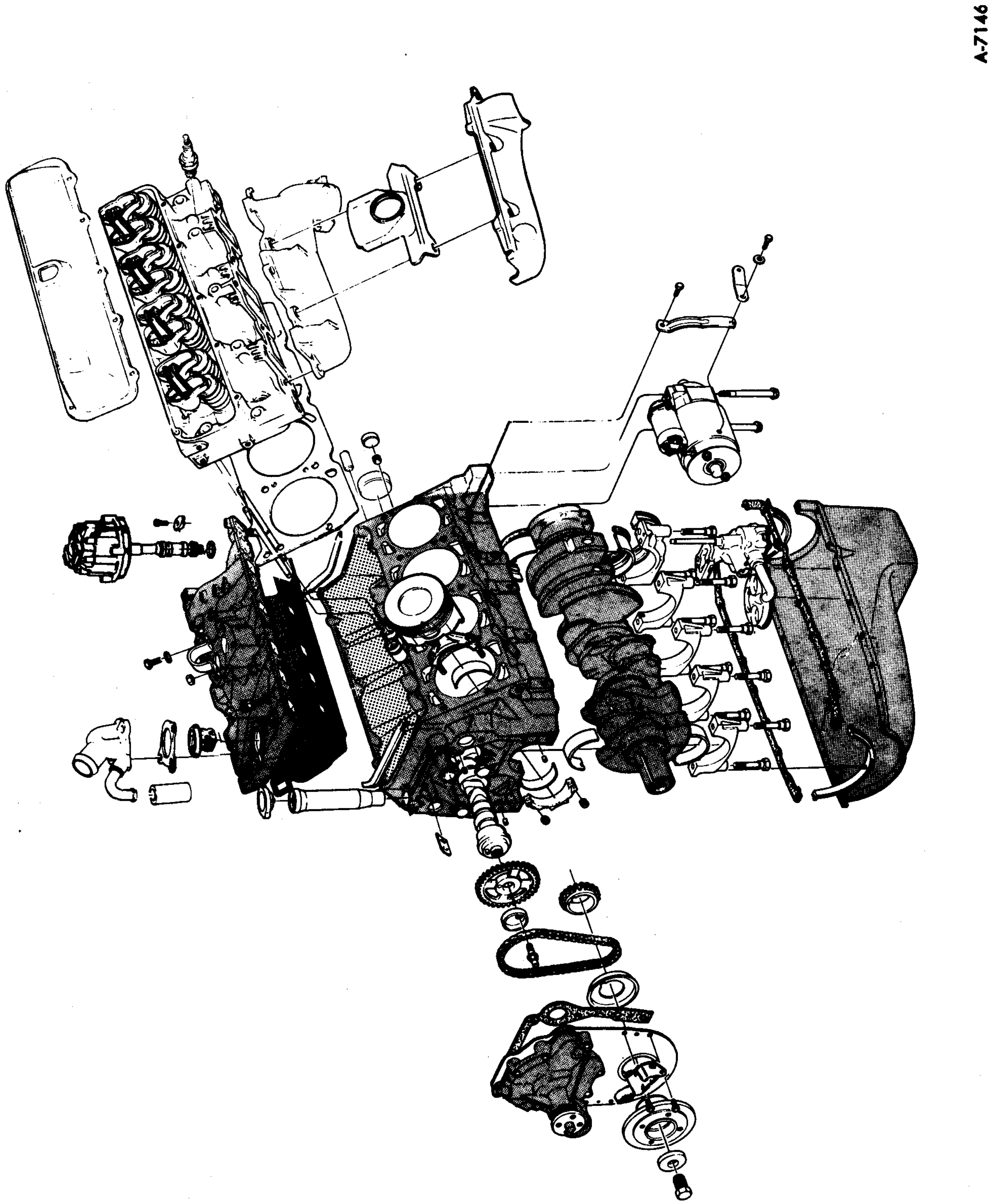


Figure 1—403 Engine Components

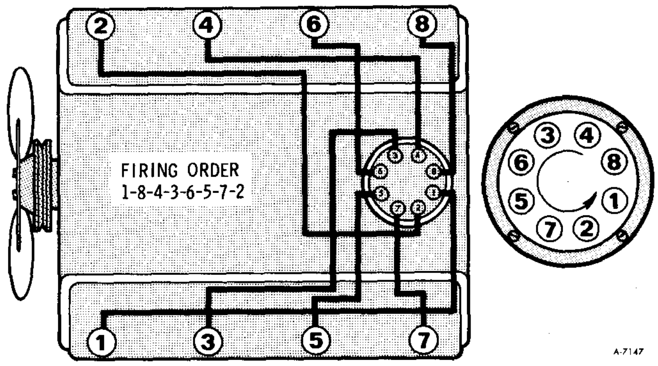


Figure 2—Cylinder Numbers and Secondary Wiring

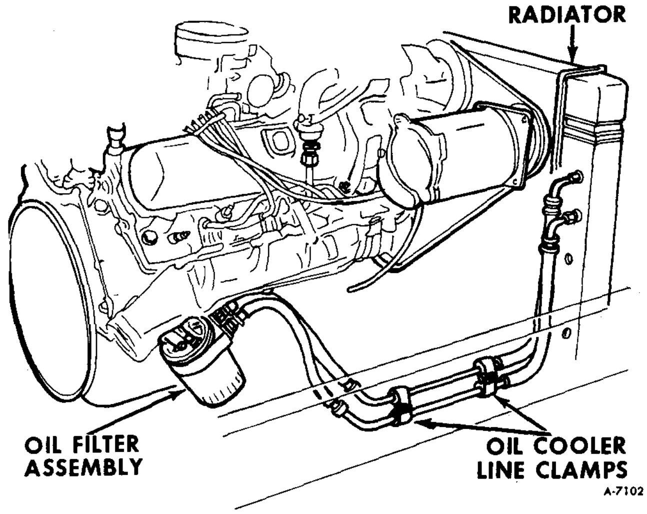


Figure 4—Oil Lines to Cooler

orifice sprays oil to lubricate the fuel pump eccentric cam and the timing chain.

The oil pump and distributor drive gear are lubricated by splash from the rear cam bearing and connecting rod bearings.

The rocker arms and valve tips are lubricated by means of oil furnished through the hydraulic lifters and hollow push-rods. A disc

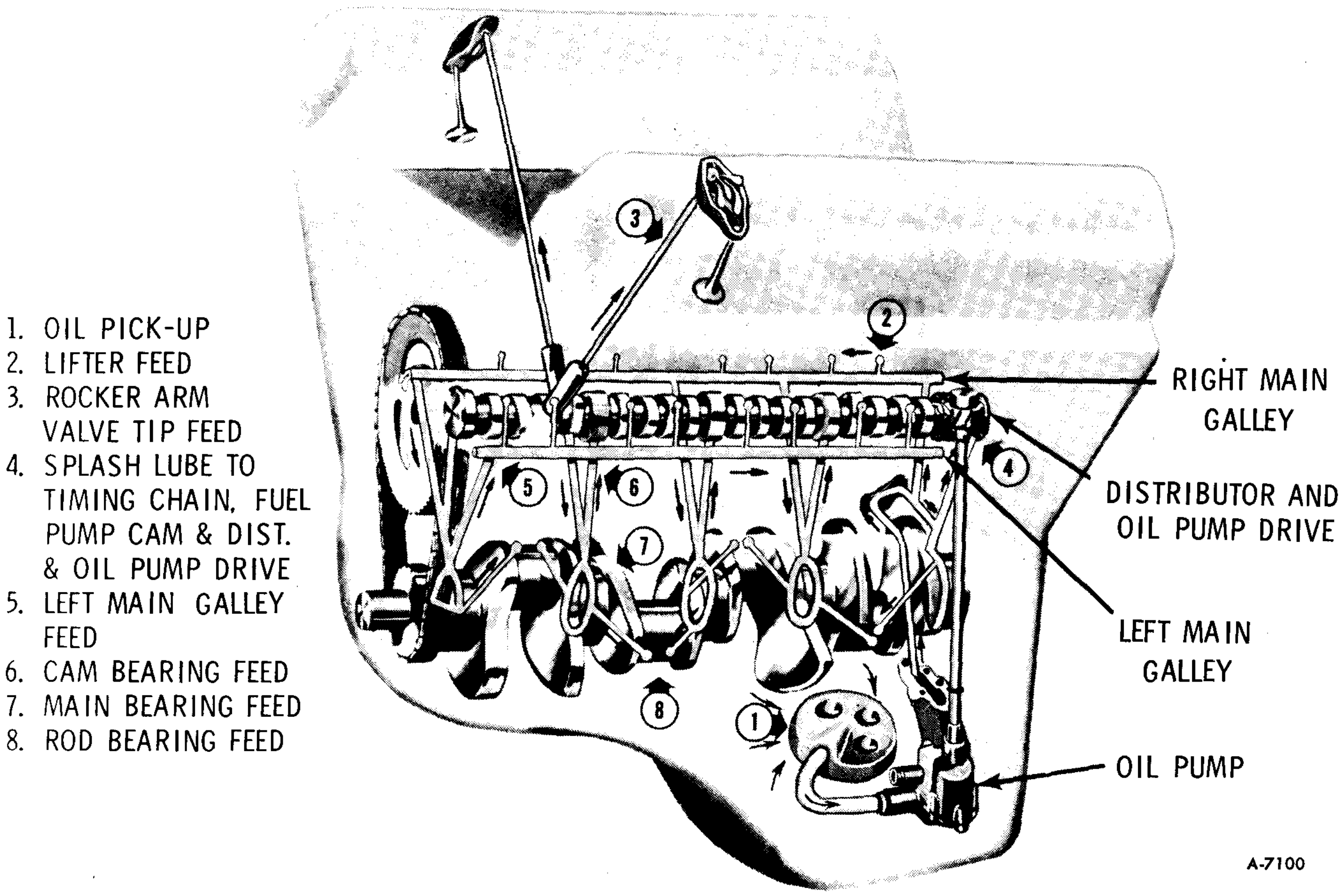


Figure 3—Engine Lubrication

valve in the lifter meters oil to the push rods.

The connecting rod bearings are oiled by constant oil flow from passages drilled through the crankshaft connecting the main journals to the rod journals. A groove around each main bearing furnishes oil to the drilled crankshaft passages.

Oil returns to the oil pan reservoir from the rocker arms through passages at each end of the cylinder heads. Oil from the valve lifter compartment returns through clearance holes in the lower portion of the compartment near the camshaft. The timing chain compartment drains directly into the oil pan.

ENGINE DIAGNOSIS

ENGINE DIAGNOSIS (CONT'D)

GENERAL ENGINE CHECKS

1. EMISSION CONTROL CHECK

To diagnose Emission Control Systems, refer to "Emission Control Charts" in this manual.

2. BATTERY CHECK

The battery must be fully charged before proceeding with engine diagnosis. When the battery has a low charge, determine and repair the cause of the low charge before proceeding with further diagnosis. Refer to "Battery Diagnosis Charts" in Maintenance Manual X-7525.

3. CHOKE CHECK

Freedom of operation may be checked by holding the throttle in the open position and manually operating the automatic choke linkage. When possible, choke linkage should be checked on a cold carburetor. Refer to "Carburetor Diagnosis Charts" in Maintenance Manual X-7525.

4. FLOODING CHECK

Flooding occurs when an excessive amount of fuel enters the cylinders and prevents ignition. If flooding is suspected, look for wet throttle plates, external leakage around the throttle plate shaft, external leakage at the bowl gasket and/or wet spark plugs. If the engine is running, a flooding condition will be indicated by a rough engine idle, poor acceleration, and heavy, black smoke from the exhaust system. Flooding is usually caused by improper operation of the carburetor fuel inlet system or a high float level setting. Additional causes are listed in "Carburetor Diagnostic Procedures" in Maintenance Manual X-7525.

5. CARBURETOR ICING CHECK

Carburetor icing generally occurs when ambient temperatures range from $30^{\circ}F$ to $50^{\circ}F$ ($-1.1^{\circ}C$ to $10^{\circ}C$), and the relative humidity is above 60%. Moisture from in-rushing air collects and freezes between the throttle plates and the throttle base, cutting off the air supply to the engine, and stalling the engine.

NOTE: If icing occurs, check operation of the thermostatically controlled air cleaner as described in Section 6T of this supplement.

If icing occurs after the engine is at a normal operating temperature, allow the engine to stand for a short period of time. The carburetor casting will absorb enough heat from the engine to thaw the ice. If the icing occurs while the engine is still cold, the ice may be melted by pouring a small amount of anti-icing additive directly into the carburetor. Neither of the above procedures will prevent a recurrence of the icing condition.

The most effective way to prevent icing is to add an anti-icing additive to the fuel.

6. SPARK INTENSITY CHECK

Disconnect a spark plug wire (twist boot and remove) and remove spark plug. Install a good properly gapped plug in spark plug wire and lay spark plug on clean dry surface of engine, so spark gap at plug can be seen when cranking engine. The spark should jump the gap regularly and be blue in color. A good spark indicates that the ignition primary and secondary circuits are functioning properly. A weak spark (usually a pale orange color), an intermittant spark or no spark at all indicates trouble within the distributor.

Examine secondary lead wires for deteriorated insulation. Correct as necessary. Examine for cracked or burned condition of the distributor cap "button" (center of distributor cap). Look and listen for spark jumping to ground. This condition may require spark plug wire replacement. (This can best be observed in dark area.)

7. HARD STARTING ENGINE CHECK

The problem of an engine that cranks normally but starts hard when cold can usually be traced to an excessively lean fuel mixture. Excessively lean fuel mixtures are usually caused by an improper choke setting or an insufficient amount of fuel being delivered to the cylinders.

If the engine starts OK cold, but is hard to start when hot, the problem may be due to an excessive amount of fuel being discharged through the carburetor. A hot engine hard start or no start condition may also be due to the coil breaking down after it becomes heated. Hard starting occurring only after a hot engine has been shut down for a few minutes, indicates carburetor percolation or vapor lock which causes a rich fuel condition. Refer to "Carburetor Diagnosis" in Maintenance Manual X-7525 for individual fuel problems. (Corroded or loosened terminal could be the cause.)

8. ACCELERATING PUMP DISCHARGE CHECK

Remove the air cleaner and manually operate the throttle linkage while observing the fuel discharge from the accelerator pump nozzles. When the throttle plates are opened, a quick steady stream of fuel should be discharged into the carburetor. Failure of the accelerator pump to discharge a sufficient amount of fuel usually indicates a problem in the fuel delivery system between the supply tank and the carburetor. Refer to "Fuel Pump and/or Carburetor Diagnosis" charts in Maintenance Manual X-7525. Insufficient fuel discharge, however, may also be due to the operation of the accelerator pump circuit within the carburetor.

9. VACUUM LEAKAGE CHECK

With the engine at idle speed, squirt a mixture of kerosene and 10W motor oil around areas where vacuum leakage may occur. A noticeable change in the engine idle when the mixture is squirted on a given point indicates a vacuum leak at that point.

CAUTION: *Kerosene and oil mixture is flammable. Careless application may result in fire. DO NOT use gasoline.*

10. EXCESSIVE FUEL CONSUMPTION CHECK

There are a number of factors, other than engine or carburetor problems, that will contribute to excessive fuel consumption. One of the most important of these is the driving habits of the operator.

When the operator habitually makes "jack-rabbit" starts and stops, "rides" the brake pedal, overloads the vehicle, drives at excessively high speeds for prolonged periods, fails to hold a consistent throttle position, (continuously accelerates, then coasts) and/or operates the vehicle under short run conditions (cold engine) the majority of the time, this could be the problem.

Vehicle air resistance at high speeds has a major effect on fuel consumption. Head winds, excessively high speeds, or added protrusions to the vehicle profile will cause an increase in fuel consumption.

When it has been determined that the operator is not at fault, make a fuel consumption test using a calibrated fuel measuring device. The amount of fuel used to drive the vehicle a measured distance should be recorded. Then record the amount of fuel used to return to the starting point. An average of the two readings should be used in determining the existence of a fuel consumption problem. While making the fuel consumption test, the vehicle odometer should be checked over a measured mile for proper calibration.

If the results of the fuel consumption test indicate that a fuel consumption problem does exist, the diagnostic procedures outlined in this manual under "Excessive Fuel Consumption in Carburetor" and/or "Ignition Diagnosis" charts should be followed.

VAPOR LOCK CHECK

The term "vapor lock" means the flow of fuel to the mixing chamber in the carburetor has been stopped (locked) by the formation of vaporized fuel pockets or bubbles caused by overheating the fuel by hot fuel pump, hot fuel lines or hot carburetor.

The more volatile the fuel the greater the tendency for it to vapor lock. Vapor lock is encouraged by high atmospheric temperature, hard driving, defective engine cooling and high altitude.

A mild case of vapor lock will cause missing and hard starting when engine is warm; also, a "sag" during an acceleration or surge during cruise. Somewhat more severe vapor lock will stop the engine which cannot be started again until it has cooled off enough so that any vaporized fuel has condensed to a liquid.

NOTE: Percolation means simply that gasoline in the carburetor bowl is boiling over into the intake manifold. This condition is most apt to occur immediately after a hot engine is shut off. The carburetor has provision for relieving the vapor pressure of overheated fuel in the carburetor bowl by means of internal vents. If, however, percolation should take place, the engine may be started by allowing it to cool slightly and then holding the throttle wide open while cranking to clear the intake manifold of excess fuel.

Some causes of vapor lock may be due to winter grade fuel used in summer (most vapor lock occurs in April due to this), or temperature under hood is too high.

NOTE: Applying wet cloths to fuel lines, fuel pump and/or carburetor can cause fuel to condense and permit engine to run.

ENGINE WILL NOT TURN OVER

GENERAL

Neutral safety switch (located on steering column).

Check dipstick for congealed oil, improper viscosity, or presence of water in oil.

Remove spark plugs to check for hydrostatic lock (liquid in combustion chamber).

ELECTRICAL

Check ignition switch and wiring.

BATTERY

See "Battery Diagnosis Charts".

STARTER

See "Starter Diagnosis Charts".

MECHANICAL

Seized bearings, rings, and/or pistons.

ENGINE TURNS OVER SLOWLY BUT DOES NOT START

GENERAL

Bad or corroded connections.

Undersized battery cable.

Poor ground.

Oil viscosity too heavy.

MECHANICAL

Tight bearings, rings, pistons, etc.

BATTERY

See "Battery Diagnosis Charts".

STARTER

See "Starter Diagnosis Charts".

ENGINE TURNS OVER AT NORMAL SPEED—STARTS HARD WHEN COLD

NOTE: Most conditions under "Does Not Start" may also cause hard starting when cold.

IGNITION

Ignition timing incorrect.

Defective electronic module.

FUEL

If condition occurs only when ambient temperature is below 32°F (0°C), check for ice restriction in the fuel supply system. If necessary, thaw system and add anti-icing additive to the fuel.

NOTE: "In cold weather" cranking speed is reduced by thickening of oil and reduction of battery efficiency.

ENGINE TURNS OVER AT NORMAL SPEED—STARTS HARD WHEN HOT

NOTE: This condition is usually caused by an over-supply of fuel due to any of the items listed under "Does Not Start" due to excessive fuel supply.

GENERAL

Check proper starting procedure (setting choke, accelerator pumping, accelerator position, etc.)
Ignition timing incorrect.
Defective electronic module (ignition).
Engine overheating. Refer to ENGINE OVERHEATS in this section.

FUEL

Vapor lock.
Flooding.
Accelerator pump.
Carburetor faulty.
Fuel pump faulty.
Fuel restricted.

MECHANICAL

Choke mechanism binding, sticking and/or improper adjustment.

IGNITION

Check for faulty spark plugs.

ENGINE STARTS—FAILS TO KEEP RUNNING OR STALLS HOT OR COLD

GENERAL

Vapor lock.
*Engine overheats. (refer to ENGINE OVERHEATS).
*Engine runs too cool.
Idle speed too low.
Positive crankcase ventilation valve.
Leak in intake manifold (vacuum line faulty or disconnected).
Exhaust crossover in intake manifold plugged.
Exhaust system restricted.
Air intake restricted.
Carburetor icing.
Ignition timing incorrect.
Defective electronic module (ignition).

MECHANICAL

Throttle linkage defective or improperly adjusted.
Valve train faulty.
Valve lifter or valve clearance.
Low compression.
Choke valve faulty, stuck, or binding.
Head cracked or gasket leaking.
Excessive engine friction.

FUEL

Dirt and/or water in fuel system.
Faulty fuel pump.
Float level too high.
Idle adjustment incorrect.
Idle compensator valve faulty.
Needle valve seat faulty.
Mixture too rich or too lean.
Faulty carburetor.

IGNITION

Spark plugs damp or dirty and/or gap incorrectly set or not installed properly.

Faulty coil.
Faulty capacitor (radio suppression).

Defective module.

Distributor advance mechanism faulty or timing improperly set.

Worn rotor or loose distributor cap; deteriorated or corroded wiring or connections; incorrect wiring.

ENGINE TURNS OVER AT NORMAL SPEED BUT DOES NOT START OR STARTS HARD

NOTE: If ignition timing is set too far advanced, spark may occur too early when engine is cranked. The first (and only) explosion runs the engine backward. A kick-back may jam the starter or break the starter drive housing.

IGNITION

OPEN PRIMARY
Defective electronic module.
Primary lead connection loose at distributor.
Primary windings in coil broken.
Open ignition switch circuit.

GROUNDED PRIMARY

NOTE: A grounded coil primary winding, a grounded ignition switch, or a grounded switch-to-coil primary lead will cause excessive current flow and will usually cause wires to burn.

Grounded or faulty capacitor (radio suppression).
Cracked or faulty insulator at distributor primary terminal.
Distributor-to-coil lead grounded.
Primary coil winding grounded.
Broken or loose ignition wire or faulty switch.

FAULTY SECONDARY
Corroded spark plug cable terminals.
Chafed or cracked cable insulation.
Ignition coil weak or inoperative.
Moisture on ignition coil, terminals, distributor cover, spark plug porcelains, or in distributor.

ENGINE TURNS OVER AT NORMAL SPEED BUT DOES NOT START OR STARTS HARD (CONT'D)

FAULTY SECONDARY (CONT'D)

Improper type of spark plugs.

Cracked distributor cap or a burned carbon track from distributor cap center terminal to housing.

Improper installation of spark plug cables (not correct for firing order).

Spark plugs damaged, dirty, or wet, porcelains cracked, or gaps improperly spaced.

Rotor contact spring bent or broken.

Distributor cap center terminal (inner) broken or missing.

MECHANICAL

Choke binding, sticking, or improper adjustment.

Low or erratic compression. (Check valve train mechanism, rings, blown head gasket, etc.)

FUEL

Hot engine vapor lock.

No fuel or insufficient fuel.

Water and/or dirt (Fuel System).

Excessive fuel.

Accelerator pump faulty.

Fuel pump worn or defective.

Fuel filter dirty.

Carburetor dirty or defective.

Vent in fuel tank clogged or restricted.

Carburetor mounting bolts loose.

GENERAL

Defective ignition switch.

Check proper starting procedure (setting choke, accelerator pumping, accelerator position etc.)

Air cleaner dirty.

Engine timing.

Restricted exhaust.

Poor ground or faulty wiring.

ENGINE STALLS AT IDLE—ENGINE COLD (OK WHEN HOT)

CARBURETOR

Idle too low.

Choke high, idle too low.

MECHANICAL

Linkage improperly adjusted or damaged.

ENGINE STALLS AT IDLE—ENGINE HOT (OK WHEN COLD)

GENERAL

Vapor lock.

Engine overheats. (Refer to "Engine Overheats" in this section.)

Positive crankcase ventilation valve.

CARBURETOR

Idle set too low.

MECHANICAL

Throttle linkage improperly adjusted or faulty.

ROUGH ENGINE IDLE

NOTE: When repairs have been made it may be necessary to re-adjust idle speed.

GENERAL

Check all vacuum hoses for proper routing, broken or disconnected hoses and/or caps. Also vacuum leaks.
Restricted air cleaner. (Remove air cleaner with engine running and note engine rpm.)
Incorrect ignition timing.
Defective electronic module (ignition).
Positive crankcase ventilation valve dirty or stuck.
Restricted exhaust.
Cold engine (faulty thermostat).
Fuel volatility too high or low.

IGNITION

Improper plug or plug gap.
Faulty plugs.
Defective coil.
Defective capacitor (radio suppression).
Faulty rotor or cap.
Loose wiring.
Damaged or corroded coil wiring or spark plug cables.
Moisture on wiring or in distributor cap.
Cracked distributor cap.

FUEL

Engine idle speed improper.
Mixture too rich or lean.
Float level.
Dirt and water in fuel system.
Carburetor mounting bolts loose.

MECHANICAL

Choke linkage, secondary throttle plates sticking, binding or damaged.
Low compression.
Valve train faulty (burnt or sticky valves, broken spring, bent push rod etc.)
Loose engine mounts or worn insulation.
Improperly torqued cylinder head.
Leaking or worn valve guides.

ENGINE HAS INCONSISTENT IDLE SPEED (LOPES)

NOTE: If idle speed is slow, unstable, rolling, frequent stalling, and oily engine compartment, the positive crankcase ventilation valve may be completely plugged, or the valve may be stuck in the "OPEN" position. A valve stuck in the "CLOSED" position is indicated by breather back-flow at heavy throttle and oily engine compartment. If the valve is stuck in the intermediate position it will be indicated by rough, fast idle and stalling.

GENERAL

Restricted exhaust.
Vacuum leak. (Intake valve stem leaking, carburetor mounting gasket leaking, carburetor throttle shaft in carburetor leaking, intake manifold or vacuum hoses leaking).
Ignition timing incorrect.
Defective electronic module (ignition).
Restricted air cleaner.
Overheated engine (refer to "Engine Overheats" in this section).
Blown head gasket.
Low compression.
Quality of fuel.
Lean idle mixture.

FUEL

Dirt and/or water in fuel system.
Too rich or lean mixture.
Filter restricted.
Faulty fuel pump.
Faulty carburetor.

MECHANICAL

Throttle shaft, accelerator pedal and/or throttle linkage sticking or binding.
Timing chain or gears and/or camshaft lobes worn.
Burned, warped, pitted, leaky or sticking valves.
Inoperative choke.
Sticking hydraulic lifter.

ENGINE HAS INCONSISTENT IDLE SPEED (LOPES) (CONT'D)

IGNITION

Defective electronic module.
Excessive oil or dirt on ignition system.
Spark plugs damp or gap incorrectly set.
Excessive moisture on ignition wires and caps.
Leaks in ignition wiring (dirty, corroded, or faulty wiring).
Ignition wires making poor contact.
Faulty coil.
Defective capacitor (radio suppression).
Cracked distributor cap, radial contacts in distributor cap burned or worn.
Defective pole piece and plate assembly.
Faulty spark advance mechanism.

ENGINE RUNS—MISSES AT IDLE ONLY

GENERAL

Vacuum leak.
Ignition timing incorrect.
Exhaust restriction.
Blown head gasket.
Low compression.
Fuel quality poor.
Air cleaner dirty.

MECHANICAL

Leaky or incorrect valve.
Worn or leaky valve guide.
Worn timing chain, gears, sprocket or camshaft lobe.
Dirt in hydraulic lifter.

IGNITION

Spark plugs wrong type, defective, worn or wrong gap.
Leaks in ignition wiring.
Faulty coil.
Defective capacitor (radio suppression).
Defective electronic module.
Defective or worn rotor and/or cap.

FUEL

Flooding in carburetor.

Refer to "Engine Has Inconsistent Speeds" covered earlier in this section.

ENGINE RUNS—MISSES AT HIGH SPEED ONLY

GENERAL

Overheating (refer to "Engine Overheats" in this section).
Detonation or pre-ignition.
Sub-standard fuel.
Faulty or dirty air cleaner.
Valve train faulty or worn.
Mild vapor lock.
Exhaust vapor lock.
Exhaust manifold clogged or restricted.
Air cleaner plugged.

FUEL

Faulty fuel pump.
Restricted fuel filter.
Choke valve not completely closed.
Carburetor throttle lever loose on shaft.
Exhaust manifold clogged with carbon.
Exhaust manifold, muffler, or tail pipe restricted.
Intermittent delivery of fuel to carburetor so that momentarily the mixture is too weak for combustion.

IGNITION

Clean, gap, and/or replace spark plugs, as necessary.
Too hot spark plugs—change to colder type, but note that a hot plug may be due to loose installation or lack of plug gasket (if gasket is called for).
Weak spark or coil.
Improper ignition timing.
Defective electronic module.
Centrifical advance not functioning properly.
Distributor shaft worn.
Defective pole piece and plate assembly.
Worn rotor or damaged distributor cap.

MECHANICAL

Incorrect valve timing.
Sticking hydraulic lifters.
Valve springs broken.
Valve springs shimmy.
Valve springs too weak to close valves promptly.

ENGINE RUNS—MISSES ERRATICALLY AT ALL SPEEDS

GENERAL

Restricted exhaust.
Compression low.
Internal coolant leakage.
Engine overheating.
Timing improperly set.

MECHANICAL

Compression leak at head gasket or between cylinders (this can be noted when missing occurs in two adjacent cylinders).
Intermittently sticking valves.
Broken valve spring.
Valve(s) held open slightly by faulty mechanism.

IGNITION

Wrong type spark plugs.
Fouled spark plug or broken porcelain.
Faulty spark plug cables.
Low battery voltage.
Low generator voltage.
Faulty coil
Defective capacitor (radio suppression).
Weak spark or no spark in one or more cylinders.
Faulty distributor cap or rotor.
Primary circuit restricted or open intermittently.
Primary circuit detoured by short intermittently.
Secondary circuit restricted or open intermittently.
Secondary circuit detoured by short intermittently.

FUEL

Fuel pump faulty.
Needle valve in carburetor sticking.
Improper float level.
Mixture too rich or too lean.
Passage in carburetor dirty.

ENGINE RUNS—MISSES STEADILY AT ALL SPEEDS

GENERAL

Worn camshaft lobes.
Compression low.
Vacuum leak in intake manifold.
Ignition timing off.
Fuel poor quality.
Defective electronic module (ignition).

FUEL

Dirty jets in carburetor.
Water or dirt in fuel.
Fuel filter plugged.
Fuel pump worn or diaphragm faulty.

IGNITION

Worn or dirty plugs or gap set too wide in plugs.
Worn distributor shaft.
Burned distributor rotor.
Faulty coil or capacitor.
Defective pole piece and plate assembly.

MECHANICAL

Valve train faulty.

ENGINE RUNS—BUT MISSES ON ONE CYLINDER

GENERAL

Compression leak.
Vacuum leak at intake manifold.
Ignition timing improperly set.
Defective electronic module (ignition).
Overheated engine. (Refer to "ENGINE OVERHEATS" in this section).
Clogged exhaust.

IGNITION

Defective spark plug or spark plug wire.
Distributor cap defective.

MECHANICAL

Valve train defective.
Stuck hydraulic lifter.
Defective rings or piston.

ENGINE RUNS—BUT MISSES ON DIFFERENT CYLINDERS

GENERAL

Compression leaking.
Vacuum leak at intake manifold or carburetor.
Defective head gasket.
Ignition timing off.
Poor grade fuel.
Carbon in engine.
Restricted exhaust.

FUEL

Fuel pump faulty.
Carburetor faulty.

IGNITION

Spark plugs faulty.

Coil wire or distributor cap faulty.

Distributor rotor faulty.

Defective electronic module.

Defective pole piece and plate assembly.

MECHANICAL

Faulty rings.
Faulty valve train.

ENGINE HESITATES OR STALLS DURING ACCELERATION (SPIT BACK THROUGH CARBURETOR)

GENERAL

Vapor lock.
Carburetor icing.
Restricted exhaust.
Compression low.
Intake manifold leaking (carburetor attaching bolts loose).
Partly blocked or dragging brake shoes (refer to "Brake" chart).
Air cleaner dirty.
Engine timing incorrect.
Excessive carbon in engine.
Heavy oil in engine.
Wrong or poor grade fuel.
Excessive rolling resistance from low air in tires, applied brakes, wheel alignment, overloading etc.

IGNITION

Distributor faulty.
Wiring oily or faulty.
Coil defective.
Faulty plugs.
Vacuum advance faulty.
Defective pole piece and plate assembly.

MECHANICAL

Accelerator pump stroke or throttle linkage improperly adjusted.
Stuck hydraulic lifters.
Intake manifold loose or leaking.
Carburetor mounting loose or leaking.
Valve train damaged or faulty.

ENGINE SURGES

GENERAL

Exhaust system restricted or faulty.
Cylinder(s) not firing properly.
TVS switch(s) faulty.
Vacuum leaks.

IGNITION

Check out complete ignition system.
Faulty spark plug wires.

FUEL

Fuel pump faulty.

Faulty needle valve and seat.

Float level setting wrong.

Defective parts in carburetor.

Restrictions in fuel lines or filter.

LACK OF POWER OR HIGH SPEED PERFORMANCE

NOTE: It should be noted that the altitude of operation has a decided effect on performance. An engine adjusted for sea level altitudes will lack performance at high altitudes; an engine operating normally at high altitudes may have a lean carburetor adjustment and show signs of pre-ignition when operated at sea level.

IGNITION

Ignition timing incorrect.
Centrifugal advance not operating properly.
Vacuum advance not operating properly.
Defective electronic module.
Defective pole piece and plate assembly.
Faulty spark plugs.
Faulty ignition cables.
Faulty ignition coil.
Worn or burned distributor rotor.
Worn distributor shaft.
Poor ground.

GENERAL

Pre-ignition.
Engine overheating. (Refer to "Engine Overheats" in this section).
Sub-standard fuel.
Overloaded vehicle.
Excessive carbon in engine.
Defective torque converter.
Excessive rolling resistance (dragging brakes, tight wheel bearings, underinflated tires).
Restricted exhaust.
Dirty air cleaner.
Transmission or power steering faulty.

MECHANICAL

Choke mechanism faulty.
Lack of engine compression.
Incorrect valve timing.
Inaccurate speedometer (gives impression of lack of performance).
Valve spring weak, broken valves or valves sticking when hot.
Valve timing incorrect.
Worn camshaft lobes.
Blown cylinder head gasket.
Burned, warped or pitted valves.

ENGINE FAILS TO REACH OPERATING TEMPERATURE

GENERAL

Thermostat removed.

COOLING

Defective thermostat (stuck open).
Faulty temperature sending unit or dash unit.

ENGINE OVERHEATS

NOTE: Coolant is used to cool the engine and air is used to cool the coolant. Anything which prevents the coolant air system from working properly will cause engine to overheat. (Air, oil or grease in the coolant will reduce the ability of the coolant to absorb the heat from the block and to transfer heat to the coolant in the radiator.)

GENERAL

Scale or rust deposits.
Slipping fan belt.
Low coolant. (Leaky system—internal or external.)
Pre-Ignition.
Detonation.
Excessive friction in engine or elsewhere in power transmitting units. (Brakes dragging, etc.)
Excessive back pressure in exhaust system.
Overloading vehicle.
High altitude.
Hot climate operation.
Insufficient oil in crankcase.

ENGINE OVERHEATS (CONT'D)

FUEL

Carburetor mixture too lean.

MECHANICAL

Valve timing incorrect.
Cylinder head bolts loose.
Warped or damaged head or block.
Wrong head gasket.

IGNITION

Timing late.
Distributor advance faulty.

COOLING

Restricted flow of coolant. (Defective components—dirt, rust and scale.)

Leaking head gasket. (Permits air in cooling system and coolant in engine.)

Thermostat fails or wrong thermostat.

Hoses defective.

Exterior of radiator clogged with dirt, leaves, or insects.

Water pump defective or loose.

Wrong type of coolant.

Wrong fan or hydraulic fan inoperative, or defective.

Wrong pressure cap or faulty cap.

Radiator fins bent or mutilated.

SPARK KNOCK, PING, OR DETONATION

NOTE: A sharp metallic knock due to instantaneous abnormal combustion.

GENERAL

Low octane fuel.
Too high compression.
Timing advanced too far.
Heavy carbon deposits.
Manifold heat control valve faulty.
Faulty distributor advance mechanism.

COOLING

Overheated engine. (See "Engine Overheats" in this section.)

Hot weather.

High altitude.

ENGINE CONTINUES TO RUN AFTER IGNITION IS TURNED OFF (DIESELING)

NOTE: When the engine won't stop as the ignition is turned off, the cause is often due to red hot carbon particles resting on heavy carbon deposit in a very hot engine.

GENERAL

Improper idle speed (too high).
High engine temperature.
Poor grade fuel (octane too low).
Improper ignition timing.
Defective electronic module (ignition).
Quick shut-down of hot engine.

MECHANICAL

Improper valve timing.

IGNITION

Advanced timing.

Improper heat range or improperly installed spark plugs.

Electrical feed through ignition system (faulty switch).

FUEL

Carburetor too lean.
Throttle plates misaligned.

PRE-IGNITION

NOTE: Hot spot in combustion chamber ignites fuel before spark occurs. May not be noticed unless severe.

GENERAL

Overheated engine.
Carbon deposits.
Spark plugs not tight.
Spark plugs with wrong heat range.
Ignition timing and dwell improperly set.

MECHANICAL

Leak at valve due to clearance, valve sticking, weak or broken spring.

Valve timing.

FLAT SPOT (SAG, STRETCHINESS)

NOTE: Does not respond promptly when throttle is opened quickly.

GENERAL

Poor fuel quality.
Vapor lock.
Late ignition timing.

MECHANICAL

Accelator pump linkage adjustment incorrect.
Accelerator linkage faulty or improperly adjusted.

FUEL

Low fuel pump pressure.
Accelerator pump piston or diaphragm leaks.
Accelerator pump valves leak or passages restricted.
Float level incorrect.
Defective fuel pump.
Carburetor defective or improperly set.
Fuel filter plugged.
Dirt in carburetor jets.

BACKFIRES, POPPING BACK OR SPITBACK THROUGH CARBURETOR (SUBDUED EXPLOSION IN INTAKE MANIFOLD)

GENERAL

Cold engine and choke too lean.
Loose carburetor mounting bolts.
Loose intake manifold bolts.
Incorrect ignition timing.
Vacuum leaks (hoses etc.).
Defective electrical module (ignition).

IGNITION

Leaking distributor cap may cause backfire to occur in cylinder on intake stroke.
Two crossed spark plug wires may also cause backfire through carburetor.

FUEL

Lean mixture.
Dirt or water in fuel.
Faulty accelerator pump.

MECHANICAL

Leaky or sticky intake valve.
Weak or broken intake valve spring.
Faulty heat valve.
Plugged heat crossover passage.
Improper camshaft timing.
Improper valve lash.

AFTER-BURNING OR MUFFLER EXPLOSION (BACKFIRE)

NOTE: A subdued put-putting at the exhaust tailpipe may be due to leaky exhaust valves which permit the mixture to finish combustion in the muffler. If exhaust pipe or muffler is red hot, it is important to let it cool, as there is some danger of setting the vehicle on fire. Most likely to occur when mixture is lean.

GENERAL

Late timing.
Burnt exhaust valve.
Air cleaner restricted.
Air leak in exhaust manifold or pipe.

MECHANICAL

Late valve timing.
Worn or broken exhaust valve spring.
Tight exhaust valve.
Choke stuck closed.

IGNITION

Intermittent open circuit in primary. (Ammeter needle swings further away from zero when generator is charging.)

Intermittent short in primary. (Ammeter swings toward zero when generator is charging.)

Short in coil or secondary coil wire.

FUEL

Carburetor flooding.

SMOKE

WHITE

Condensing water vapor which is a normal product of combustion—no problem—usually seen on cold days.

BLACK

Excessively rich fuel mixture. (See "Excessive Fuel Consumption, covered later in this section.)

BLUE
(OR BLUISH WHITE)

Excessive oil consumption (see "Excessive Oil Consumption" covered later in this section.)

EXCESSIVE FUEL CONSUMPTION

GENERAL

"Jack Rabbit" starts.
High speed.
Short drives.
Restricted Choke (partly closed).
Clogged air cleaner.
Loss of compression.
Excessive rolling resistance from low tires, dragging brakes, wheel misalignment, etc.
Restricted exhaust.
Engine overheating.
Crankcase ventilating system faulty.
Trailer towing.
Worn-out or badly tuned engine.

IGNITION

Faulty ignition system.

FUEL

Excessive fuel pump pressure.
Float level high.
Faulty carburetor.
Leakage or loose fittings.
Idle speed settings incorrect.
Accelerator pump improperly adjusted.

MECHANICAL

Faulty valves or valve train.
Faulty rings.
Choke mechanism binding or improperly adjusted.
Accelerator linkage binding or improperly adjusted.
Fuel tank cap missing.

LOW OIL PRESSURE

GENERAL

Low oil level.

Clogged oil filter.

Thin or diluted oil (frequent stops in cold weather).

Viscosity (too light grade).

Oil has foam from water (condensation or leaking head gasket).

Overheating.

MECHANICAL

Faulty pressure sending unit, line, or gauge.

Worn oil pump.

Excessive bearing clearance.

Oil pump relief valve dirty, worn, spring weak or worn.

Oil pump suction tube loose or cracked.

Screen clogged (ice, gummy, sludge or dirt).

Air leak in oil pump (loose cover or too thick gasket).

Loose connections in oil lines.

HIGH OIL PRESSURE

GENERAL

Oil too heavy (viscosity).

Main oil passage on pressure side of pump clogged.

MECHANICAL

Faulty gauge.

Oil pressure relief valve adjustment too heavy.

Relief valve spring too stiff.

Oil pressure passage clogged.

NO OIL PRESSURE WHILE IDLING

GENERAL

Faulty oil gauge sending unit.

Leakage at internal oil passage.

MECHANICAL

Oil pump nut functioning properly. (Valve stuck by foreign material.)

Excessive clearance at bearings (camshaft, rod or main).

NO OIL PRESSURE WHILE ACCELERATING

GENERAL

Low oil level in oil pan.

MECHANICAL

Leakage at internal oil passages.

NO OIL PRESSURE

GENERAL

Suction loss.

Oil pressure gauge faulty.

Not enough oil in pan.

Pipe to oil pressure gauge stopped up.

Oil passage on discharge side of pump stopped up.

Oil screen or passages on intake side of pump stopped up.

MECHANICAL

Oil pump inoperative.

Relief valve stuck open.

BURNED, STICKING OR BROKEN VALVES

GENERAL

Over-speeding engine.
Deposits on valve seats and/or gum formation on stems or guides.
Warped valves or faulty valve forgings.
Exhaust back pressure.
Improper ignition timing.

MECHANICAL

Weak valve springs.
Improper valve clearance.
Improper valve guide clearance and/or worn valve guides.
Out-of-round valve seats or incorrect valve seat width.

EXCESSIVE OIL CONSUMPTION

NOTE: Check the PCV valve for proper operation before checking causes of leak. A clogged crankcase vent valve can build up pressure in the crankcase which will cause seals and gaskets to leak.

EXTERNAL LEAKAGE

Oil pan drain plug loose or gasket missing.
Crack or hole in oil pan.

Oil pan gasket leaks due to:
a. Loose screws;
b. Damaged gasket;
c. Improperly installed gasket;
d. Bent oil pan flange.

Timing case cover gasket leaks due to:
a. Loose screws;
b. Damaged gasket;
c. Improperly installed gasket;
d. Bent cover flange;

Front crankshaft oil seal leaks due to:
a. Worn oil seal;
b. Seal not properly installed;
c. Rough surface on crankshaft, or fan pulley or damper;
d. Damper or pulley loose;
e. Seal or cover not centered on crankshaft;
f. Oil return passage to crankcase clogged up.

Rear main bearing oil seal leaks due to:
a. Worn oil seal;
b. Improper oil seal installation;
c. Worn rear main bearing;
d. Rough crankshaft. Oil passage to crankcase clogged.

Expansion plug in block at rear of camshaft leaks due to poor fit, careless installation, or corrosion.

Leakage at any external piping.
Plugs at ends of oil passages in cylinder block leak.
Oil filter leaks.
Leakage at distributor housing.
Valve cover leaks due to loose screws, defective gasket, improperly installed gasket or bent cover flange.
Rocker arm cover or push rod cover leaks due to loose screws, defective gasket, improper gasket installation or bent cover flange.
Pipe connections loose on oil gauge or oil filter lines.
Improperly seated or broken fuel pump gasket.
Broken push rod cover gasket, oil filter gasket, or timing chain cover gasket.
Worn timing chain cover oil seal.
Worn or improperly seated rear main bearing oil seal.
Loose oil line plugs.
Rear camshaft bearing drain hole plugged.
Loose rocker arm cover, gasket broken, or cover distorted or bent.
Rear main bearing side seal improperly installed.

INTERNAL LEAKAGE

Carbon in oil ring slot.
Rings fitted too tight in grooves.
Leaky piston rings due to wear, scuffs or broken.
Leaky piston rings due to sticking caused by gummy deposit. Try to free up with suitable

solvent poured in fuel tank. Blue smoke at tail pipe indicates badly leaking rings.

Worn pistons and cylinders.

Cylinder block distorted by tightening cylinder head bolts unevenly.

Excessive clearance between intake valve stems and guides allows oil mist to be sucked into cylinders.

Worn main or rod bearings allow excessive leakage from bearings.

Worn rings or worn valve seals, resulting in cylinder walls flooded with oil.

Result in cylinder walls are flooded with oil.

Oil pressure too high due to faulty action of oil pressure relief valve, or clogged relief passage.

If pressure lubricated, loose piston pins may permit excessive leakage to cylinder walls.

Grade of oil used is too light. A poor quality oil may become far too thin when engine is hot. Hard driving on hot days will also consume more oil.

Clogged crankcase ventilation system.

Intake valve seals damaged or missing.

Plugged drain back holes in head.

Intake manifold gasket leak in conjunction with rocker cover gasket leak.

Ring grooves or oil return slots clogged.

Rings sticking in ring grooves of piston.

Ring grooves worn excessively in piston.

Compression rings installed upside down.

Excessively worn or scored cylinder walls.

Cylinder walls not properly honed or finished.

Oil too thin (diluted).

Oil level too high.

Excessive main or connecting rod bearing clearance.

Piston ring gaps not staggered.

Incorrect size rings installed.

Piston rings out-of-round, broken or scored.

Insufficient piston ring tension due to engine overheating.

ENGINE NOISY

NOTE: When diagnosing engine noise problems, be careful that noises caused by accessories are not mistaken for engine noises. Removal of accessory drive belts will eliminate any noises caused by these units.

In general, engine noises are either synchronized to engine speed or one-half engine speed. Those that are timed to engine speed are sounds that have to do with the crankshaft, rods, pistons, and wrist pins. The sounds emitted at one-half engine speed are valve train noises.

The use of a stethoscope will often aid in locating an engine noise. Caution must be exercised, however, because noise will travel to other metal parts not involved in the problem. A timing light will aid in determining if the noise is synchronized with engine speed or at one-half engine speed.

Engine noise sometimes may be isolated by grounding the spark plug leads one at a time. If the noise lessens appreciably or disappears, it is confined to that particular cylinder.

No definite rule or test can be listed that will positively determine the source of a noise complaint.

Fuel pumps, distributors, flywheels, water pumps, drive belts, or carbon buildup in the combustion chamber may contribute to noisy engine operation. The following information can therefore be used only as a general guide to noise diagnosis. There is no substitute for experience.

A. NOISY MAIN BEARINGS

NOTE: A loose main bearing is indicated by a powerful, but dull, thud or knock when the engine is pulling. If all main bearings are loose a noticeable clatter will be audible.

The thud occurs regularly every other revolution. The noise is loudest when the engine is "lugging" or under heavy load. The sound is heavier and duller than a connecting rod noise. Low oil pressure also accompanies this condition. The knock can be confirmed by shorting spark plugs on cylinders adjacent to the bearing. Knock will disappear or be less when plugs are shorted. This test should be made at a fast idle equivalent to 15 mph. If bearing is not quite loose enough to produce a knock by itself, the bearing may knock if oil is too thin or if there is no oil at the bearing.

Regular noise: worn main bearings; irregular; worn end-thrust bearings.

GENERAL

Insufficient oil supply.

Low oil pump pressure.

Thin or diluted oil.

MECHANICAL

Excessive bearing clearance.
Excessive crankshaft end play.
Eccentric or out-of-round crankshaft journals.
Sprung crankshaft.
Excessive belt tension.
Loose harmonic balancer.
Loose flywheel or torque converter.

NOTE: Crankshaft End Play—Intermittent rap or knock that is sharper than a loose main bearing. Repeated disengagements of the transmission may cause a change in the rap.

B. NOISY ROD BEARINGS

NOTE: Rods with excessive clearance knock under all speeds and under both idle and load conditions. At the early stage of looseness, rod noise may easily be confused with piston slap or loose pins. Rod knock noise increases in intensity with engine speed. Low oil pressure also accompanies this condition.

GENERAL

Excessive bearing clearance.
Worn crankpin.
Lack of oil (thin or diluted).
Low oil pressure.
Journals out-of-round.
(A metallic knock which is usally loudest at about 30 mph with throttle closed. Knock can be reduced or even eliminated by shorting spark plug. If bearing is not loose enough to produce a knock by itself, the bearing may knock if oil is too thin or if there is no oil at the bearing.)

MECHANICAL

Misaligned rod.
Connecting rod bolts not tightened correctly. (Should connecting rod misalignment be suspected, check for a diagonal wear pattern on the piston skirt, and for excessive wear on the opposite edges of the connecting rod bearings.)

NOTE: Automatic transmission coupling noise caused by loose transmission-to-engine bolts sounds like rod bearing noise.

C. NOISY TIMING GEARS

NOTE: A high frequency light knock difficult to isolate without a sound detecting device. It is about the same intensity whether the engine is idling or at high speeds or under load.

GENERAL

Gears misaligned.

Excessive backlash.

Chipped—usually camshaft gear.

MECHANICAL

Gears loose on hubs or shafts.
Eccentric gear, usually due to high keys.
Teeth meshed too tight (new oversize gear).
Too much end play in camshaft or crankshaft.
Front camshaft bearing clearance excessive.

D. NOISY TIMING CHAIN

GENERAL

Chain loose due to wear.
Sprocket teeth worn.
Sprockets misaligned.
Loose vibration damper or drive pulley.

MECHANICAL

Sprocket loose on hubs or shaft.
Front camshaft bearing clearance excessive.
Front main bearing clearance excessive.

E. NOISY PISTONS

NOTE: Piston pin, piston and connecting rod noises are difficult to tell apart. A loose piston pin causes a shaft double knock which is usually heard when engine is idling. Severity of knock should increase when spark plug to this cylinder is short-circuited. However, on some engines the knock becomes more noticeable at 25 to 35 mph on the rod.

GENERAL

Worn or loose piston pin or bushing.
Improper fit of pin.
(Listen for a light ticking or tapping noise. More noticeable with no load on engine. May disappear completely under load. Generally, piston pin noise can be noticed on deceleration of the engine.)
Piston-to-cylinder bore clearance excessive.
(Sounds very similar to tappet or lifter noise. Removing one spark plug wire at a time may be helpful in determining which cylinder is noisy. One indication of piston slap is a decrease in noise as the engine warms up. Piston slap is always louder when the engine is cold. Retard timing slightly, noise should decrease.)
Lack of lubrication.
Carbon deposits on top of piston strikes cylinder head.
Worn or broken piston ring land. (Most noticeable during acceleration.)
Broken or cracked piston.
Engine overheating.
Fuel of too low octane rating.
Operating without air cleaner.

MECHANICAL

Excessive rod bearing clearance.
Misaligned connecting rods.
Worn rings, cylinder walls, low ring tension, broken rings, out-of-round or tapered bores.
Top of piston strikes ridge at top of cylinder bore.
Piston rubs against cylinder head gasket.
Excessive side clearance of rings in groove, clearance between ring and groove and/or ring gap.
Undersize pistons installed.
Wrong type and/or size rings installed.
Cylinder bores tapered or eccentric.
Pins improperly assembled.
Insufficient ring gap clearance.
Pistons 180° out of position.

F. NOISY VALVE MECHANISM

GENERAL

Sticking or warped valves.
Bent push rods.
Dirty, worn, or scored parts.
Broken or weak springs.
Damaged valve lifter and/or camshaft lobes.
Insufficient or poor oil to valve mechanism. (Thin, foaming, or diluted.)
Excessive valve stem-to-guide clearance.
Valve lifter incorrectly fitted to bore size.
Pulled or loose rocker arm bolts.

MECHANICAL

Hydraulic lifter not working properly or faulty. (Faulty lifter can usually be located with the aid of a stethoscope.)
Hydraulic lifter "pumped up" from excessive speed—temporary noise.

G. NOISY WATER PUMP

NOTE: Listen for a ratchety or grinding sound which increases with engine rpm. In the early stages, the grinding noise may disappear at higher engine rpm. Disconnect the fan belt, and run engine. If noise disappears, trouble most likely is the water pump bearing. Bearing failure or start of failure can be detected by grasping the water pump pulley with both hands and moving it in a sidewise motion. If sloppiness is present, the bearing is unserviceable.

GENERAL

Rough bearing.
Pump seal too hard.

MECHANICAL

Shaft pulley loose.
Impeller loose on shaft.
Too much end play in pump shaft.
Too much clearance between shaft and bearings.
Impeller blades rubbing against pump housing.
Impeller pin sheared off.
Impeller broken.

H. NOISY GENERATOR (REFER TO GENERATOR DIAGNOSIS CHARTS)

GENERAL

Brush squeal.
Bearings.
Faulty diode or stator.

MECHANICAL

Loose mounts.

Belt too tight.

I. NOISY FAN

GENERAL

Fan blades bent.
Fan out-of-balance when made.
Fan shaft end play excessive.

MECHANICAL

Fan blades loose on clutch.

Fan blades strike shroud.

J. NOISY FUEL PUMP

NOTE: Diagnosis of fuel pumps suspected as noisy requires that some form of sounding device be used. Judgement by ear alone is not sufficient, otherwise a fuel pump may be needlessly replaced in attempting to correct noise contributed by some other component. Use of a stethoscope, a long screwdriver, or a sounding rod is recommended to locate the area or component causing the noise. The sounding rod can easily be made from a length of copper tubing 1/4 to 3/16 inch in diameter. Dowel rods are also good.

If the noise has been isolated to the fuel pump, remove the pump and run the engine with the fuel remaining in the carburetor bowl. If the noise level does not change, the source of the noise is elsewhere and the original fuel pump should be reinstalled.

K. NOISY FAN BELT

GENERAL

Belt worn or burned.

Wrong belt. Does not fit pulley grooves properly.

Belt or pulley dirty or sticky with gummy oil.

Pulley bent, cracked or broken.

MECHANICAL

Belt too tight. Squeaks.

Belts pulleys misaligned.

Belt loose; squeaks when engine is accelerated.

L. MISCELLANEOUS NOISE

(RATTLES, SQUEAKS, ETC., FROM LOOSELY MOUNTED ACCESSORIES; GENERATOR, HORN, OIL PAN, ETC.)

LOOSE FLYWHEEL

A thud or click which is usually irregular. To test, idle the engine at about 20 mph and shut off the ignition. If thud is heard, the flywheel may be loose.

EXCESSIVE CRANKSHAFT END PLAY

A rather sharp rap which occurs at idling speed but may be heard at higher speeds also.

FAN SHROUD

Loose shroud or radiator.

ENGINE VIBRATION

Unequal compression in cylinders.

Missing at high speed.

Unbalances fan or loose fan blade.

Incorrect adjustment of engine mounts, or damaged mounts.

Loose engine mounts.

Engine support loose on frame or cylinder block.

Unbalanced or sprung crankshaft.

Excessive engine friction due to tight piston etc.

Defective vibration damper.

LOOSE ENGINE MOUNTINGS

Occasional thud with vehicle in operation. Most likely to be noticed at the moment the throttle is opened or closed.

M. PRE-IGNITION OR SPARK KNOCK

GENERAL

Low octane fuel being used.

Muffler or exhaust passage restricted.

Excessive carbon deposit in combustion chamber.

Hot spot in head—possibly caused by foreign matter clogging small water passages between head and block.

Engine lugging—produces unbalanced heat.

Compression too high for octane rating of fuel being used.

Overheated spark plug due to being too "hot" for the application, not seated properly, or not torqued to specifications.

IGNITION

Faulty ignition system or timing advanced beyond specifications.

Defective electronic module.

FUEL

Carburetor, mixture lean.

Operating with standard specifications at high altitudes allowing rich fuel mixture.

IN-VEHICLE SERVICE OPERATIONS

ENGINE OIL PRESSURE TEST
(FIGURE 5)

1. Remove oil pressure warning light switch from left front of engine.
2. Install oil pressure gauge in hole.
3. Set parking brake. Put transmission selector in "N" (neutral position).
4. Start engine and run until normal operating temperature is obtained.
5. Oil pressure should be 7 psi minimum at slow idle; 35 psi at 1500-3000 rpm.

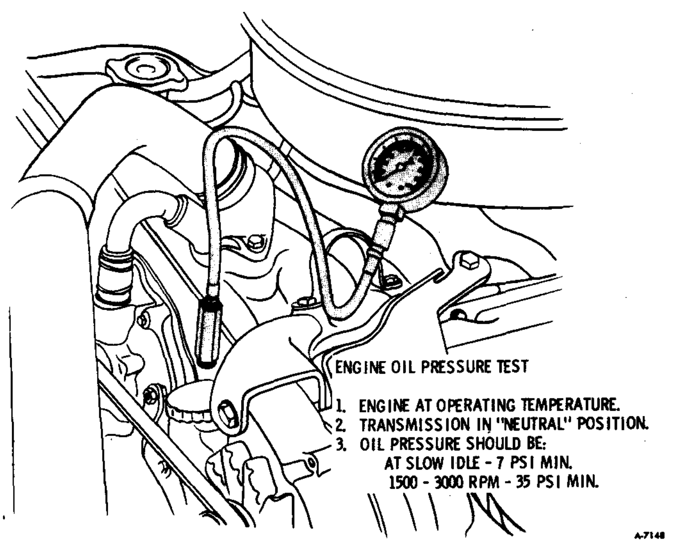


Figure 5—Checking Engine Oil Pressure

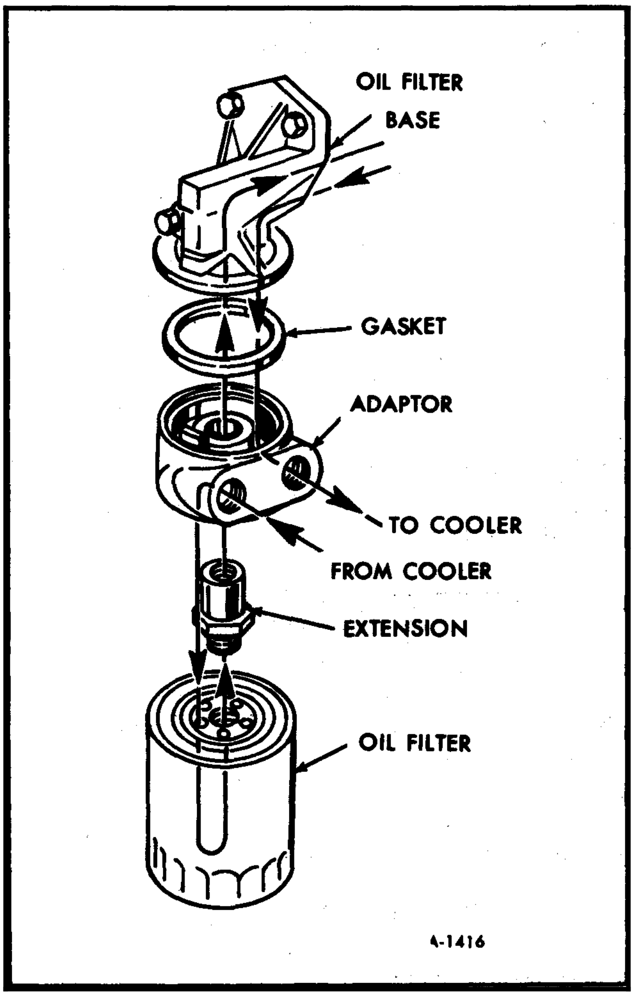


Figure 6—Oil Filter

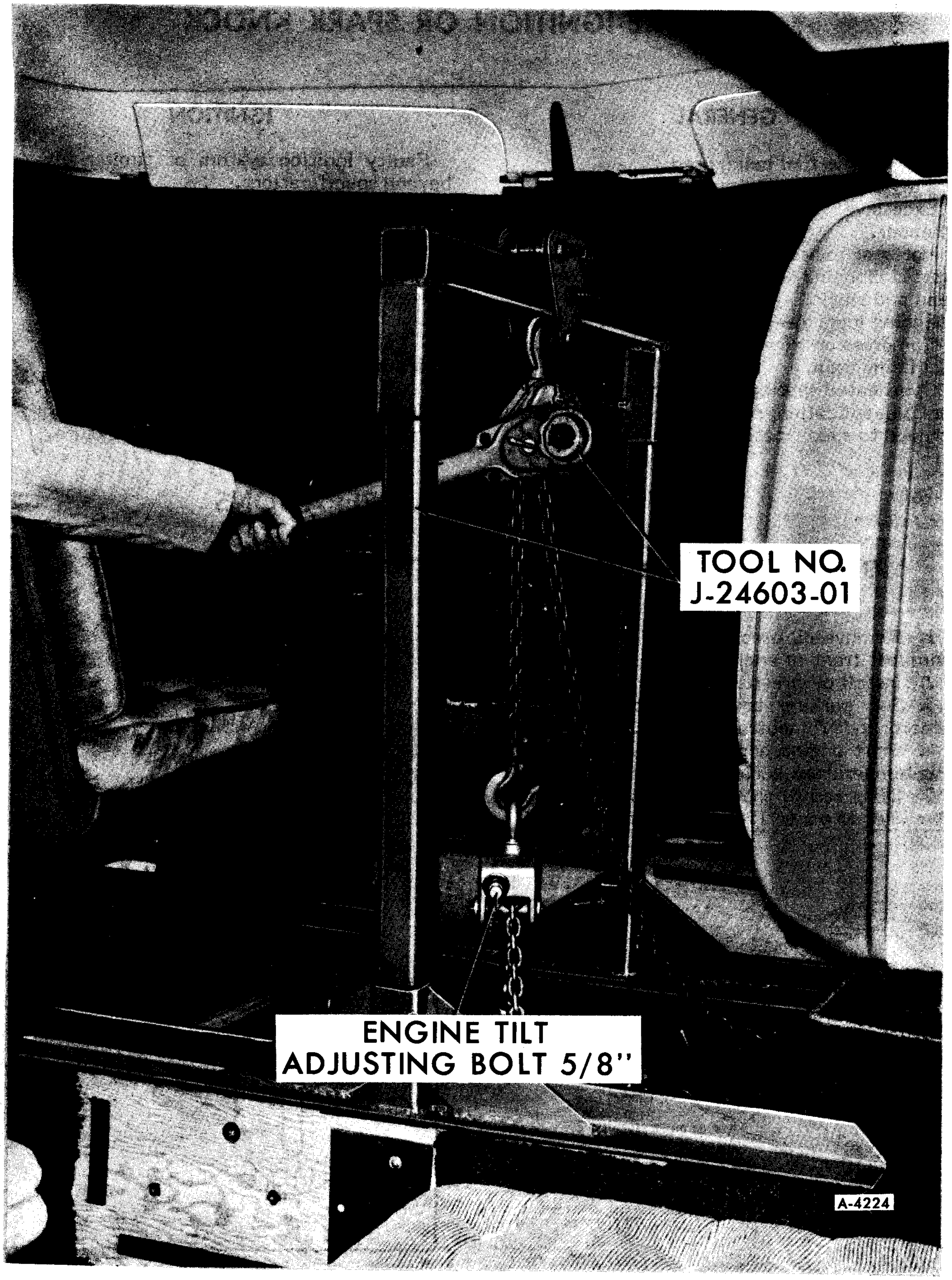


Figure 7—Attaching Engine Removal Tool

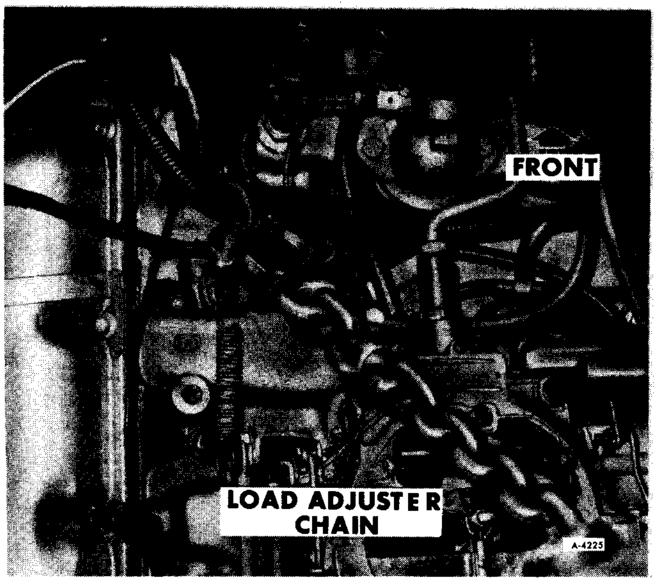


Figure 8—Engine Front Lift Location

OIL FILTER ASSEMBLY
(FIGURE 6)

REMOVAL

1. Hoist vehicle.
2. Remove oil filter.
3. Loosen oil cooler line fittings from the adapter.
4. Remove oil filter extension fitting and adapter.
5. Remove 3 bolts securing oil filter base to engine block.
6. Remove filter base and gasket.

INSTALLATION

1. Install gasket and filter base to engine block. Torque bolts to 35 ft. lbs.
2. Install adapter and oil filter extension fitting. Torque to 55 ft. lbs.
3. Reposition oil cooler lines and attach to adapter.
4. Apply a film of engine oil to the filter gasket and install. Torque by tightening 2/3 turn after gasket contacts adapter.

NOTE: If a new oil filter is being installed, add one quart of oil.

5. Start engine, check for possible leaks. Stop engine and after several minutes check for proper engine oil level.

ENGINE FRONT SUPPORT CUSHION

REMOVAL

1. Attach Engine Lift Tool J-24603-01 as shown in figure 7.

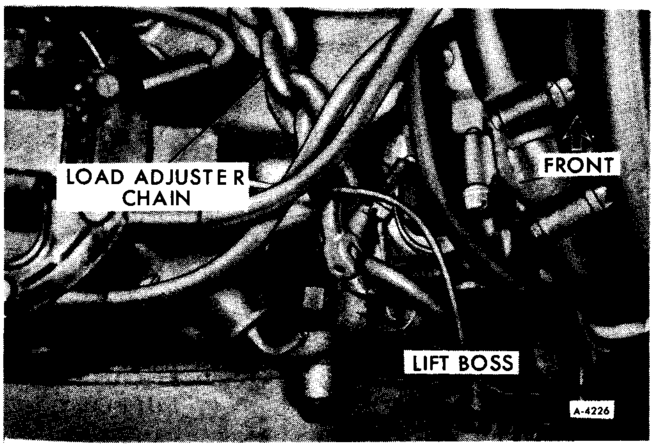


Figure 9—Engine Rear Lift Location

NOTE: To properly position engine removal tool, remove seat belt plate and anchor bolt assembly. Attach load adjuster chain to front and rear engine lift locations as shown in figures 8 and 9.

2. Referring to figure 10, remove bolts "A" and "B". Also remove nuts "C" and "D".
3. Adjust Tool No. J-24603-01 so that the front of the engine is raised just enough to enable removal of support cushion.
4. Remove engine support cushion.

INSTALLATION

1. Install new studs into engine support cushion and torque to 30 ft. lbs.
2. Install engine support cushion into place.
3. Lower engine, making sure holes in engine support line up with holes in engine support cushion.
4. Referring to figure 9, install bolts "A" and "B" with nuts and lock washers. Torque both nuts to 45 ft. lbs.
5. Install nuts "C" and "D" and torque to 30 ft. lbs. Note that these nuts are prevailing torque flange nuts; if replacements are used they must be the same type of fastener.
6. Remove tool No. J-24603-01. Install air cleaner and engine cover.

REAR ENGINE MOUNTS

REMOVAL

1. Lift engine cover and remove air cleaner assembly.
2. Attach Engine Lift Tool No. J-24603-01 as shown in figure 7.
3. Remove bolts "A", "B" and "C" on both sides of the engine/transmission rear support (figure 11).
4. Adjust tool, No. J-24603-01 so that the rear of the transmission is raised and there is enough clearance to remove the engine restrictor and transmission mount.

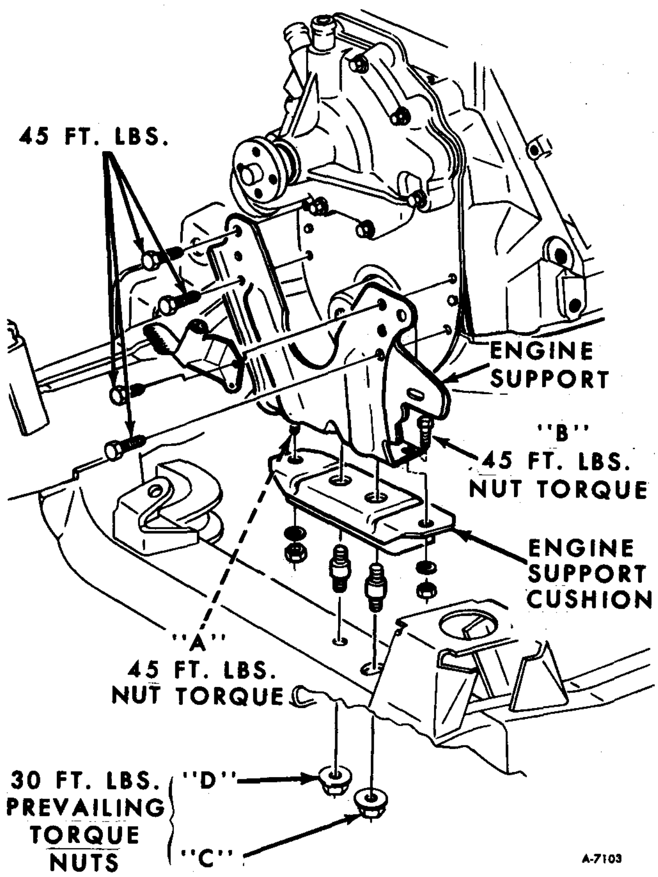


Figure 10—Engine Front Mounting

INSTALLATION

1. Install engine restrictor and transmisison mount. Lower engine.

2. Install all bolts and nuts finger tight to insure proper alignment. Torque bolts "A" and "B" on the transmisiosn support bracket to 50 ft. lbs. Torque bolt "C" to 55 ft. lbs.

NOTE: Observe placement of transmission mount before removal, and assemble mount with tab positioned as required by hole pattern.

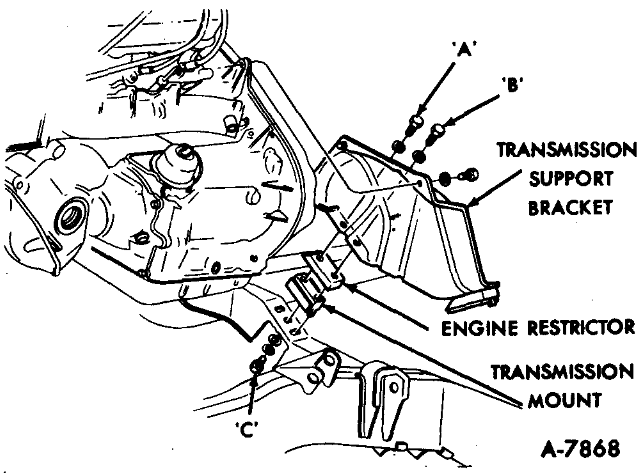


Figure 11—Engine Rear Mounting

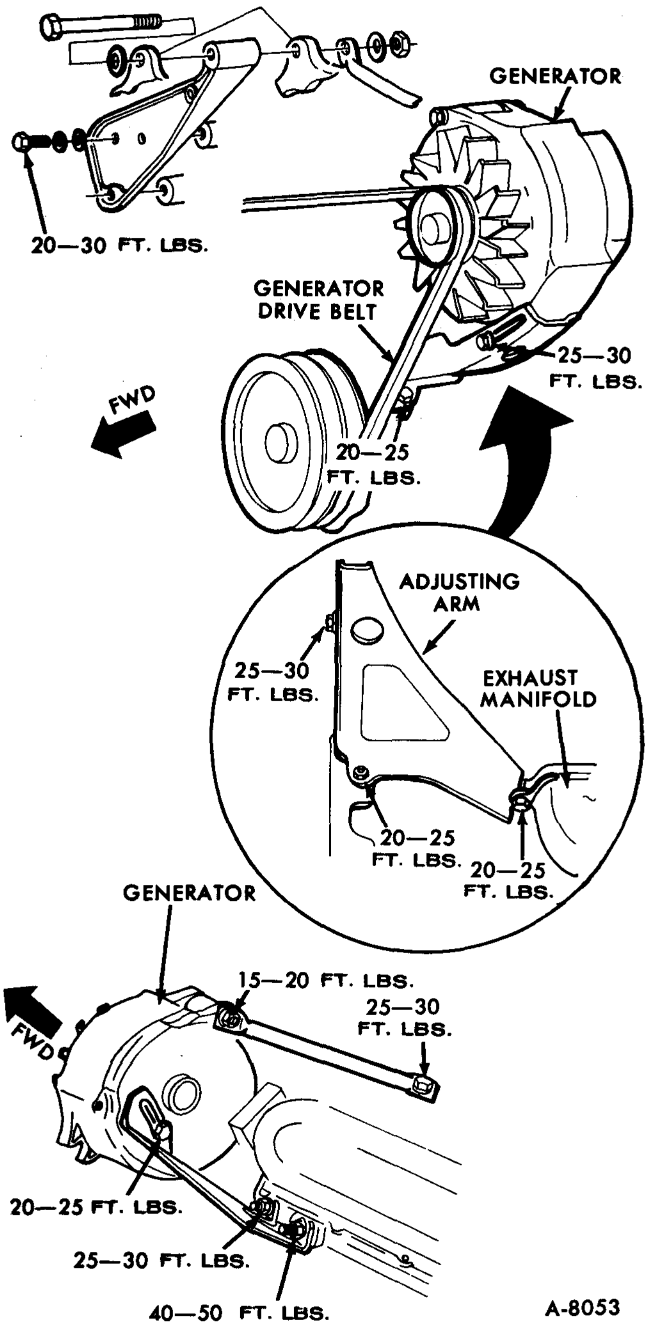


Figure 12—Generator Mounting

3. Remove tool J-24603-01 and replace air cleaner. Install engine cover.

INTAKE MANIFOLD

REMOVAL

1. Disconnect battery negative cables from both main and auxiliary batteries.

2. Remove air cleaner assembly.

3. Drain radiator, then disconnect upper radiator hose and thermostat by-pass hose from water outlet. Disconnect heater hose at rear of manifold.

4. Generator bracket removal is not required. However, upper brace from generator

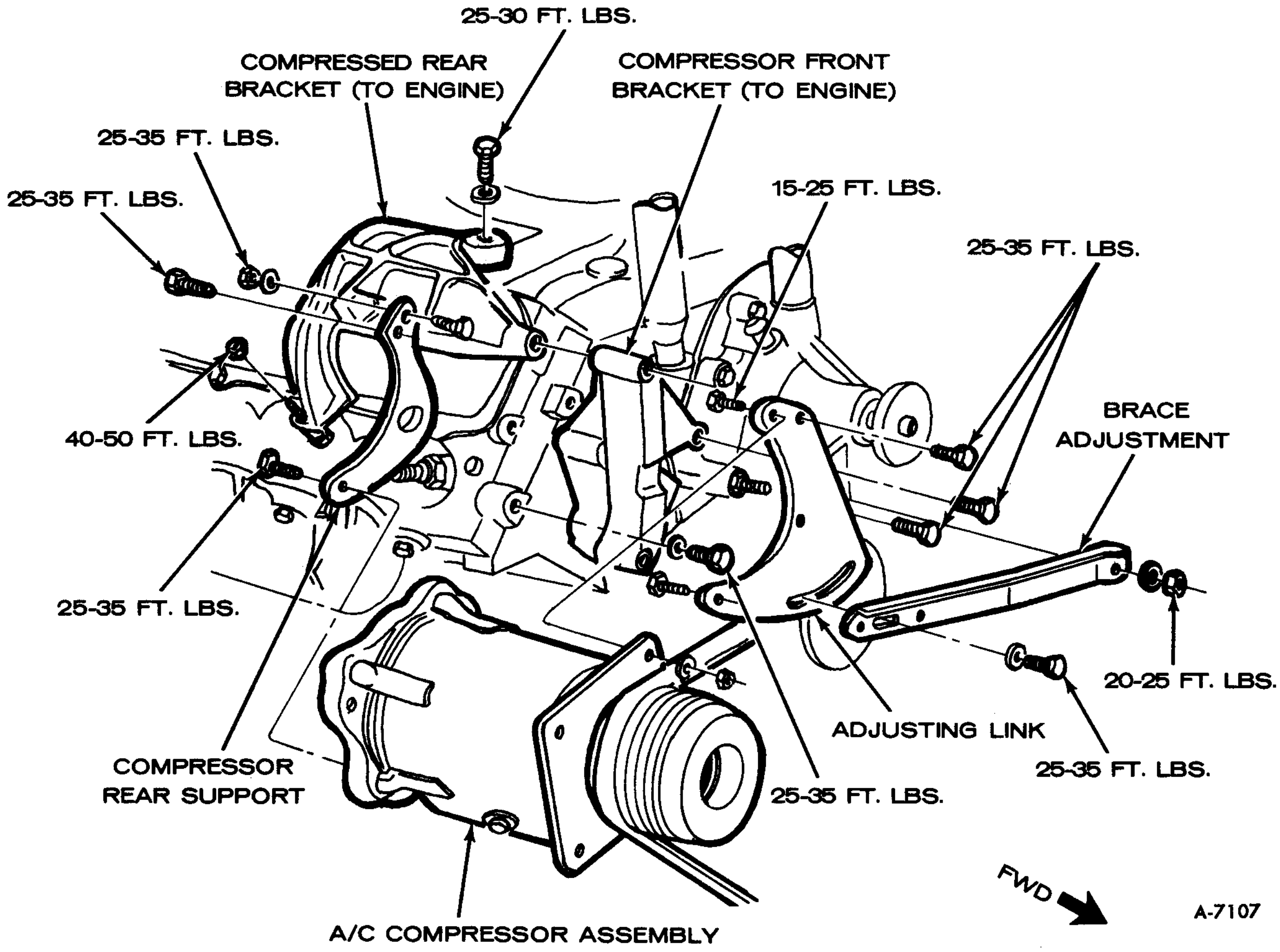


Figure 13—Air Conditioning Compressor Mounting

to intake manifold must be removed at both the generator and the intake manifold. Generator mounting is shown in figure 12.

5. Remove air conditioning compressor brackets and struts as necessary. See figure 13.

6. Remove engine oil filter lower tube and flexible elbow.

7. Disconnect temperature gauge wire.

8. Disconnect throttle cable, and cruise control (if so equipped) from carburetor throttle lever. Remove cruise control chain.

9. Remove fuel line from fuel pump to carburetor.

10. Disconnect vacuum hoses from distributor and tee, and also from the front of the carburetor which leads to the carbon cannister. Refer to Section 6T in this supplement for vacuum hose routings.

11. Disconnect vacuum hoses from intake manifold to brake booster, heater control, and cruise control (if so equipped).

12. Pull PCV valve from grommet in the right valve cover.

13. Disconnect spark plug cables from spark plugs on all cylinders. Disconnect distributor cap. and carefully remove distributor harness assembly.

14. Remove intake manifold bolts, then remove manifold with carburetor attached.

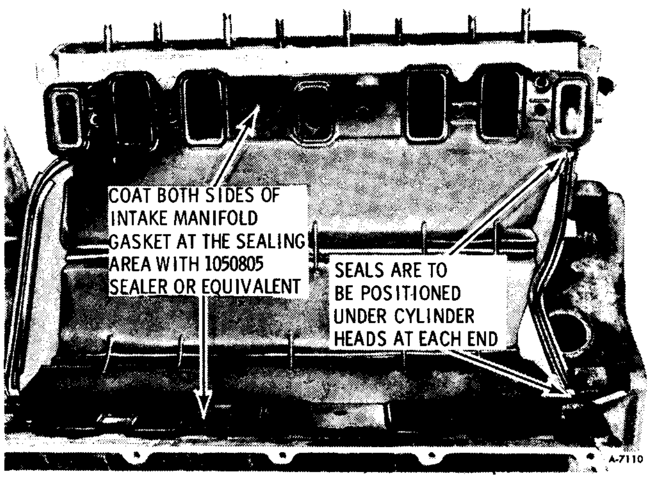


Figure 14—Intake Manifold Gasket

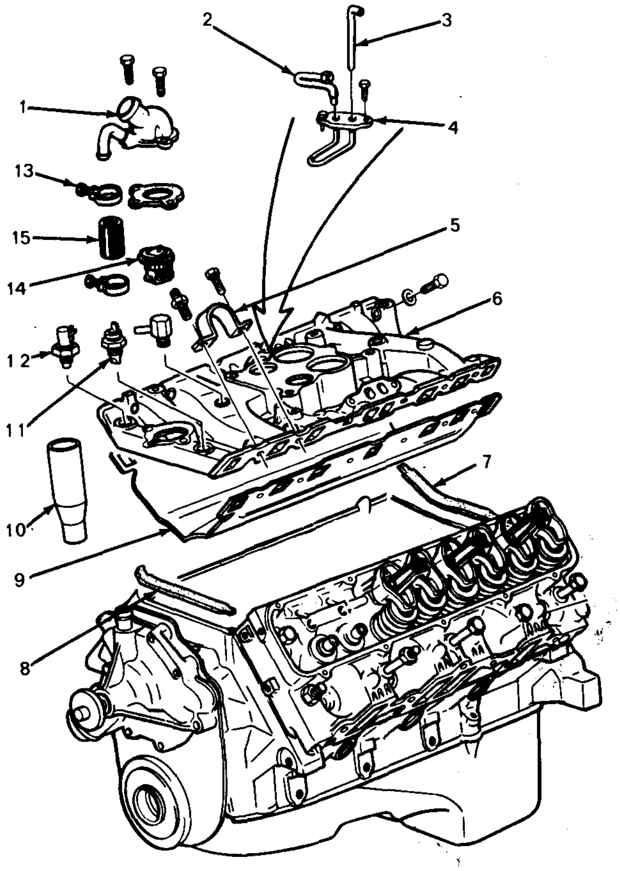


Figure 15—Intake Manifold and Gasket

15. Clean machined surfaces of cylinder head and intake manifold with a putty knife. Use care not to gouge or scratch machined surfaces.

INSTALLATION

1. Coat both sides of gasket sealing surface that seal the intake manifold to the head with Part No. 1050805 sealer or equivalent and

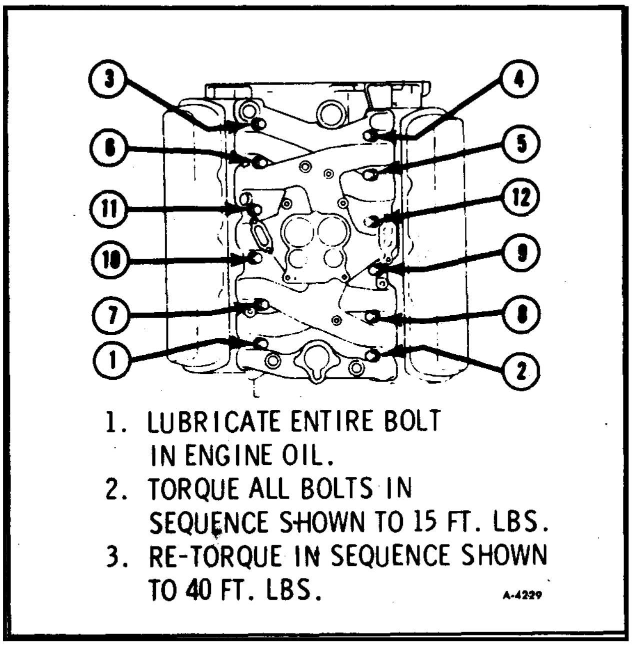


Figure 16—Intake Manifold Torque Sequence

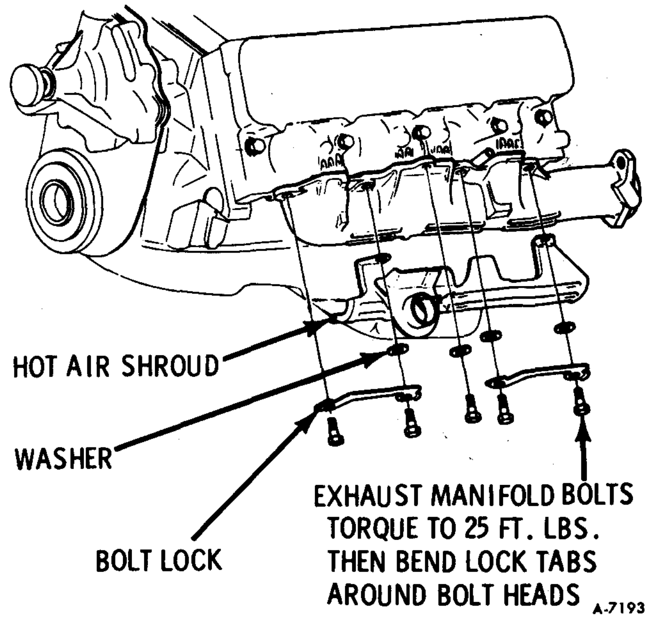


Figure 17—Hot Air Shroud

position intake manifold gasket. (See figure 14).

2. Install front and rear end seals, making sure that ends are positioned under cylinder heads as shown in figures 14 and 15.

3. Install intake manifold. Lubricate bolts entirely with engine oil, install and torque to 15 ft. lbs. in sequence (figure 16). Retorque in sequence to 40 ft. lbs.

4. Install distributor harness assembly and secure. Connect spark plug cables on the spark plugs (refer to figure 2 for proper spark plug cable connection).

5. Install PCV valve into grommet on R.H. valve cover.

6. Connect vacuum hoses to the distributor tee and to front of carburetor (from the carbon canister). Connect to the intake manifold vacuum hoses from the brake booster, heater control and cruise control (if equipped).

7. Connect throttle cable, and cruise control (if equipped).

8. Install fuel line from fuel pump to carburetor.

9. Connect temperature gauge wire.

10. Install air conditioning bracket(s) and any struts which were removed. (Refer to figure 13).

11. Install oil fill tube and flexible elbow.

12. Install generator brace (also mounting bracket, if removed).

13. Adjust belt tension. Refer to "Belt Tension" later in this section.

14. Connect upper radiator hose, thermostat and by-pass hose to the water outlet. Connect heater hose at rear of manifold.

15. Install air cleaner assembly.

16. Connect battery negative cable(s) to the batteries.

17. Fill radiator. Start engine and check for leaks.

L.H. EXHAUST MANIFOLD

REMOVAL

1. Remove air cleaner.
2. Remove hot air shroud as shown in figure 17.

NOTE: Shroud is attached to exhaust manifold by bolts No. 2 and 5.

3. Hoist vehicle.
4. Remove power steering or generator brackets and braces as required.
5. Disconnect exhaust pipe.
6. Remove exhaust manifold.

INSTALLATION

1. Position exhaust manifold on engine and install bolts No. 3 and 4 finger tight (figure 17).
2. Position hot air shroud, power steering and generator braces (as required). Torque braces (as required). Torque shroud bolts to 25 ft. lbs. and bend tabs around bolt heads.
3. Install power steering and generator brackets. Adjust belt tension. Refer to "Belt Tension" later in this section.
4. Connect exhaust pipe and tighten pipe to manifold bolts until they bottom on spacer.
5. Lower vehicle.
6. Install air cleaner.

R.H. EXHAUST MANIFOLD

REMOVAL

1. Hoist vehicle.
2. Disconnect exhaust pipe.
3. Remove exhaust manifold.

INSTALLATION

1. Install exhaust manifold and torque bolts to 25 ft. lbs. Bend tabs around bolt heads.
2. Connect exhaust pipe and tighten pipe to manifold bolts until they bottom on spacers.
3. Lower vehicle.

VALVE COVER

REMOVAL

1. Remove air cleaner.
2. Disconnect positive crankcase ventilation from valve cover.
3. Disconnect spark plug cables from spark plugs and move back and out of the way.
4. Loosen belts and remove accessories and mounting brackets. It will be necessary to wire the air conditioning compressor up for support after removing its brackets and support struts (figure 13).

NOTE: Refrigerant lines do not have to be disconnected from the compressor.

5. Remove valve cover to cylinder head attaching screws as shown in figure 18.
6. Clean gasket surfaces on cylinder head and valve cover.

INSTALLATION

1. Thoroughly clean the head and valve cover gasket surface. Then apply Part No.

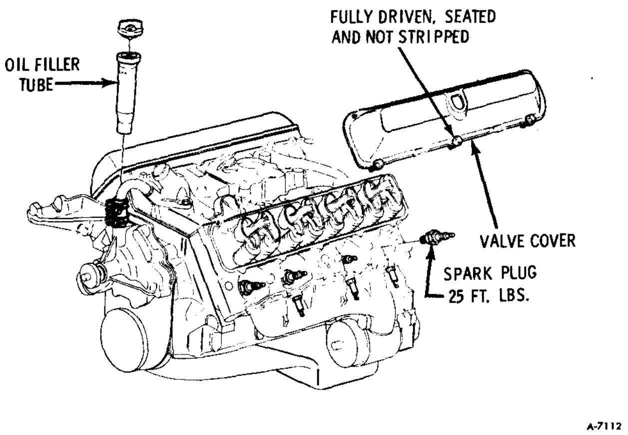


Figure 18—Valve Cover

1051435 RTV (Room Temperature Vulcanizing) sealer or equivalent to the valve cover (figure 19).

2. Replace valve cover and torque attaching screws so fully driven, seated and not stripped.
3. Install accessories and mounting brackets as necessary. Adjust belt tension. Refer to "Belt Tension" later in this section.
4. Connect spark plug cables, and connect PCV valve to valve cover.
5. Install air cleaner.

ROCKER ARM ASSEMBLIES
(FIGURE 20)

REMOVAL

1. Remove valve cover. Refer to "Valve Cover" earlier in this section.
2. Remove rocker arm flanged bolts, pivot and rocker arms (figure 21).

NOTE: Remove each set (one set per cylinder) as a unit.

INSTALLATION

1. Position a set of rocker arms (for one cylinder) in the proper location.

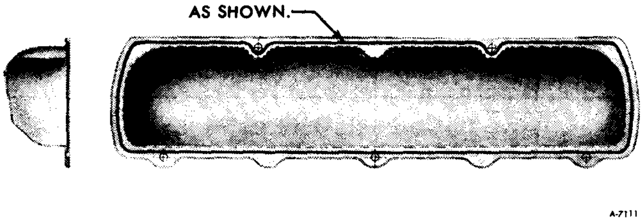


Figure 19—Sealer on Valve Cover

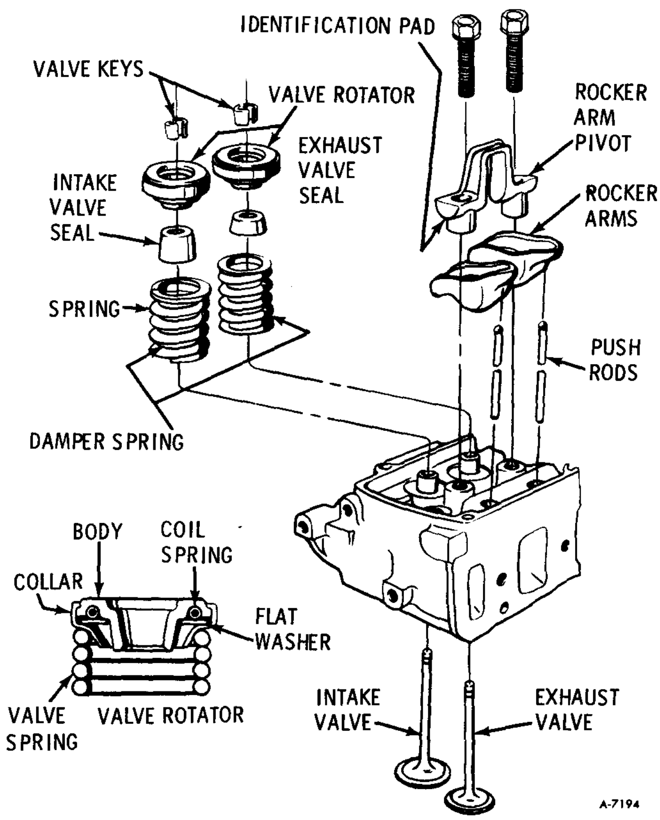


Figure 20—Cylinder Head Components

2. Lubricate wear points with Part No. 1050169 Lubricant or equivalent and install the pivots.
3. Install the hardened flanged bolts and tighten alternately. Torque bolts to 25 ft. lbs.

VALVE LIFTERS

OPERATION

Oil is supplied to the lifter through a hole in the side of the lifter body which indexes with a

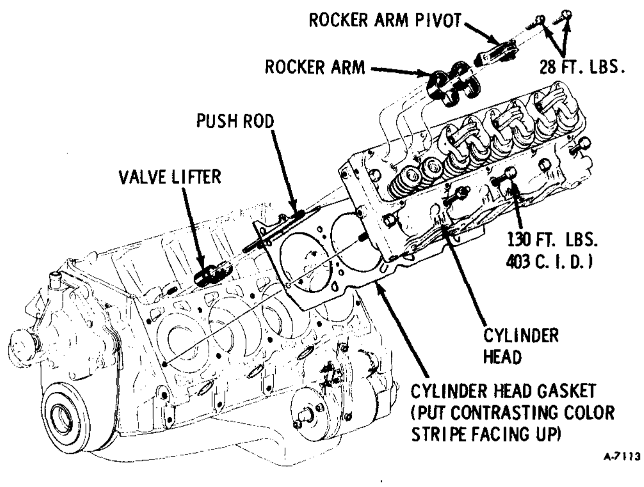


Figure 21—Removing Rocker Arms

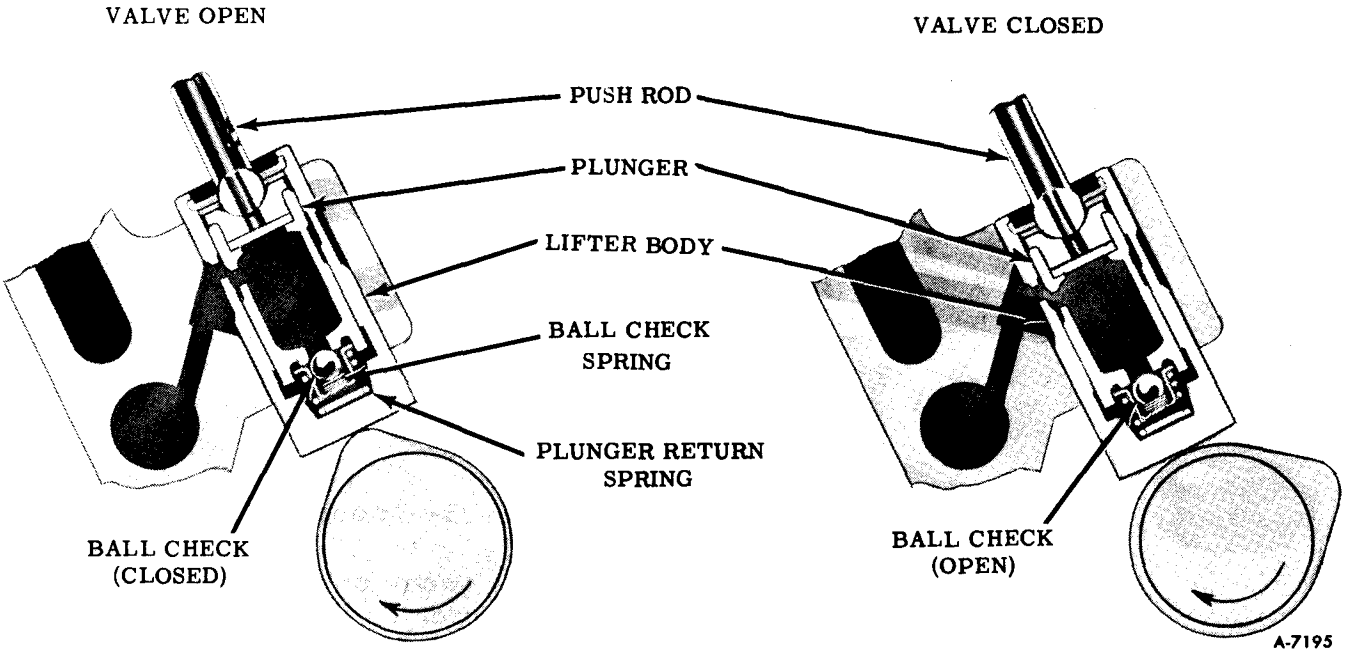


Figure 22—Valve Lifter (Cutaway View)

groove and hole in the lifter plunger. Oil is then metered past the oil metering valve in the lifter, through the pushrods to the rocker arms.

When the lifter begins to ride up the cam lobe, the ball check is held against its seat in the plunger by the ball check spring which traps the oil in the base of the lifter body below the plunger. The plunger and lifter body then raise as a unit, pushing up the push-rod to open the valve. The force of the valve spring which is exerted on the plunger through the rocker arm and push rod causes a slight amount of leakage between the plunger and lifter body. This "leak-down" allows a slow escape of trapped oil in the base of the lifter body. As the lifter rides down the other side of the cam lobe and reaches the base circle or "valve closed" position, the plunger spring quickly moves the plunger back (up) to its original position. This movement causes the ball check to open against the ball spring and oil from within the plunger is drawn into the base of the lifter. This restores the lifter to zero lash (figure 22).

VALVE LIFTER DIAGNOSIS

1. MOMENTARILY NOISY WHEN VEHICLE IS STARTED:

This condition is normal. Oil drains from the lifters which are holding the valves open when the engine is not running. It will take a few seconds for the lifter to fill after the engine is started.

2. INTERMITTENTLY NOISY ON IDLE ONLY, DISAPPEARING WHEN ENGINE SPEED IS INCREASED:

Intermittent clicking may be an indication of a flat or pitted ball, or it may be caused by dirt.

Correction: Clean the lifter and inspect. If ball is defective, replace lifter.

3. NOISY AT SLOW IDLE OR WITH HOT OIL, QUIET WITH COLD OIL OR AS ENGINE SPEED IS INCREASED:

Insert a .015" feeler gauge between the rocker arm and valve stem. If noise momentarily disappears and then reappears after a few seconds with the feeler still inserted, it is an indication that the lifter leakdown rate is too fast.

Correction: The lifter must be replaced.

4. NOISY AT HIGH VEHICLE SPEEDS AND QUIET AT LOW SPEEDS.

a. High oil level - Oil level above the "Full" mark allows crankshaft counterweights to churn the oil into foam. When foam is pumped into the lifters, they will become noisy since a solid column of oil is required for proper operation.

Correction: Drain oil until proper level is obtained. See Section 0 in Maintenance Manual X-7525.

b. Low oil level - Oil level below the "Add" mark allows the pump to pump air at high speeds which results in noisy lifters.

Correction: Fill until proper oil level is

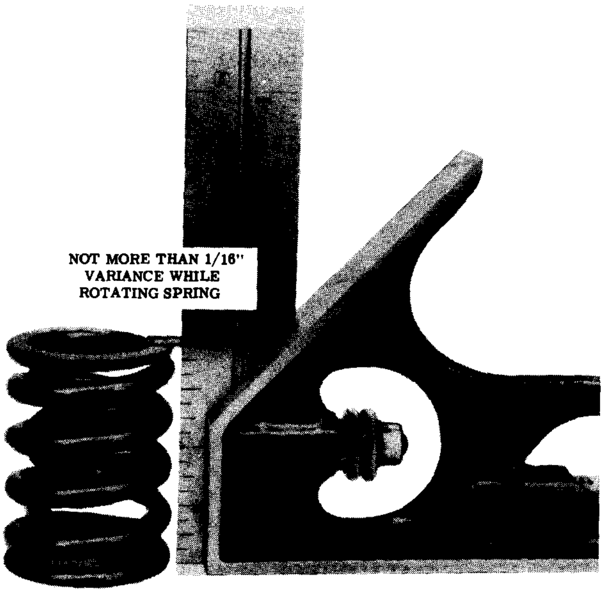


Figure 23—Checking Valve Spring

obtained. See Section 0 in Maintenance Manual X-7525.

5. NOISY AT IDLE BECOMING LOUDER AS ENGINE SPEED IS INCREASED TO 1500 RPM.

This noise is not connected with lifter malfunction. It becomes most noticeable in the vehicle at 10 to 15 mph "L" range, or 30 to 35 mph "D" range and is best described as a hashy sound. At slow idle, it may be entirely gone or appear as a light ticking noise in one or more valves. It is caused by one or more of the following:

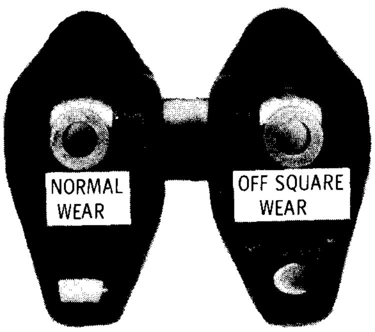


Figure 24—Rocker Arm Wear

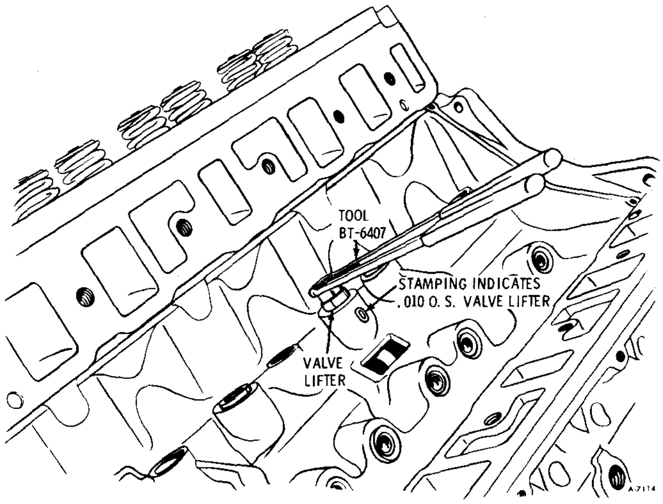


Figure 25—Removing Valve Lifter

1. Badly worn or scuffed valve tip and rocker arm pad.
2. Excessive valve stem to guide clearance.
3. Excessive valve seat runout.
4. Off square valve spring.
5. Off square rocker arm pad.
6. Excessive valve face runout.
7. Valve spring damper clicking on rotator.

Correction: Remove valve covers and while listening with a stethoscope, locate noisy valves by increasing engine speed slightly above idle, about 1500 rpm. With gloved hand, push side-ways on valve spring. Noise will change, either becoming louder or disappearing completely. Some noise will be present in all valve locations. It is necessary to determine which are actually responsible for the noise.

a. Occasionally this noise can be eliminated by rotating the valve spring and valve. Crank engine until noisy valve is off its seat. Rotate spring. This will also rotate valve. Repeat until valve becomes quiet. If correction is obtained, check for an off square valve spring. If spring is off square more than 1/16" in free position, replace spring (figure 23).

b. Observe rocker arm pad for excessive wear or excessive off square. Replace as required (figure 24).

c. Check for excessive valve stem to guide clearance. If necessary, correct as required.

6. VALVES NOISY REGARDLESS OF ENGINE SPEED

This condition can be caused by foreign particles or excessive valve lash.

Correction: With transmission in "Park" and parking brake on, run the engine at a moderate speed.

If this method does not quiet the lifter, strike the rocker arm above the push rod with a mallet while the engine is idling. This method of correction has proven successful for dislodging a foreign particle which is preventing the ball from seating properly.

b. Check for valve lash by turning engine so the piston in that cylinder is on top dead center of firing stroke. If valve lash is present, the push rod can be freely moved up and down a certain amount with rocker arm held against valve.

Valve lash indicates one of the following:

1. Worn push rod.
2. Worn rocker arm.
3. Lifter plunger stuck in down position due to dirt or varnish.
4. Defective lifter.

Checking of the above four items:

1. Observe upper end of push rod. Excessive wear of the spherical surface indicates one of the following conditions.

a. Improper hardness of the push rod ball. The push rod and rocker arm must be replaced.

b. Improper lubrication of the push rod. The push rod and rocker arm must be replaced. The oiling system to the push rod should be checked.

2. If push rod appears in good condition and has been properly lubricated, replace rocker arm and recheck valve lash.

3. If valve lash exists and push rod and rocker arm are okay, trouble is in the lifter. Lifter should be replaced.

REMOVAL (FIGURE 25)

NOTE: Valve lifters and push rods should be kept in order so they can be reinstalled in their original position. Some engines will have both standard and .010" oversize valve lifters, the .010" oversize lifter is etched "0" on the side of the lifter. The cylinder block will also be marked if the oversize lifter is used.

1. Remove intake manifold and gasket. Refer to "Intake Manifold" earlier in this section.

2. Remove valve covers, rocker arm assemblies and push rods. Refer to those areas earlier in this section.

3. If lifters are varnished, apply carburetor cleaning solution to lifter body. Allow five minutes for solution to remove varnish. Remove valve lifters.

CAUTION: *Carburetor cleaning solvent should be used in a well ventilated room. Avoid contact with skin and prolonged breathing of fumes.*

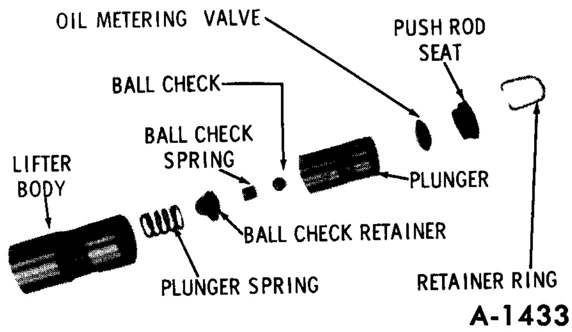


Figure 26—Valve Lifter Components

DISASSEMBLY

1. Remove retainer ring with a small screwdriver.

2. Remove push rod seat and oil metering valve.

3. Remove plunger and plunger spring. If plunger is stuck tight, allow lifter to soak in carburetor cleaning solvent for approximately five minutes, then remove.

4. Remove ball check retainer from plunger, then remove ball and spring.

CLEANING AND INSPECTION

After lifters are disassembled, all parts (figure 26) should be cleaned in clean solvent. A small particle of foreign material under the ball check valve will cause malfunctioning of the lifter. Close inspection should be made for nicks, burrs or scoring of parts. If either the body or plunger is defective, replace with a new lifter assembly.

NOTE: Do not condemn valve lifters that have a slight gap or show evidence of leakage where the lifter foot is welded to the lifter body.

Whenever lifters are removed, check the lifter foot for abnormal wear as follows:

1. Place a straight edge across the lifter foot.

NOTE: Lifter foot must be clean and dry.

2. While holding the lifter at eye level check for light between the straight edge and lifter foot.

3. If light indicates a concave surface of the lifter foot, the lifter should be replaced and the camshaft inspected for wear. Wear at the CENTER of the cam base circle is NORMAL. The camshaft should be replaced ONLY when wear is present across FULL

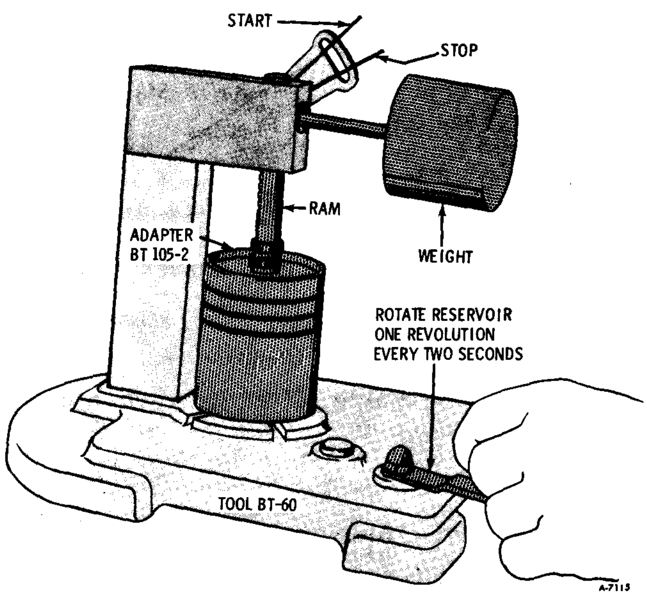


Figure 27—Valve Lifter Testing

WIDTH of cam base circle. Full wear across the nose of the cam is normal.

ASSEMBLY

1. Assemble ball check, spring and retainer into plunger (figure 25). Make sure retainer flange is pressed tight against bottom of recess in plunger.
2. Install plunger spring over ball check retainer.
3. Hold plunger with spring up and insert into lifter body. Hold plunger vertically to prevent cocking spring.
4. Assemble oil metering valve and push rod seat and seat retaining ring in groove.

NOTE: Lifters must be assembled while submerged in Hydraulic Lifter Test Fluid J-5268 or equivalent, and leak-down tested before placing into service.

5. Install Tester J-5790, then fill reservoir with hydraulic lifter test fluid J-5268 to ½" below top of reservoir.
6. Assemble ball check and retainer into plunger (figure 26).

Make sure retainer flange is pressed tight against bottom of recess in plunger.

7. Install plunger spring over ball check retainer.
8. Hold plunger with spring up and insert into lifter body. Hold plunger vertically to prevent cocking spring.
9. Place assembly into the tester cup, then position oil control valve and push rod seat onto plunger.
10. Position the ¼" steel ball on the push rod seat. Lower tester ram until it contacts the steel ball.
11. Allow ram to move downward by its own weight until air bubbles disappear.
12. Raise ram, then allow to lower as in Step 4. Repeat this procedure several times or until all air is expelled from lifter.

DO NOT ATTEMPT to expel air from lifter by pumping on ram.

13. After all air is expelled, allow ram to bleed down lifter until retaining groove is exposed.
14. Install retaining ring.
15. Adjust ram screw so that it contacts the steel ball in the push rod seat when the pointer is at the start line.
16. Raise arm, then start test by resting ram on steel ball. Rotate reservoir one revolution every two seconds and time the indicator from the start to the stop line (figure 27). Allowable leak down rate is six seconds minimum for used lifters and 9 to 60 seconds for new lifters.
17. If leak-down tolerance is within specifications, the lifter can be placed in service without removing test fluid.

INSTALLATION

NOTE: Prime new lifters by working lifter plunger while submerged in new engine oil. Lifter could be damaged when starting engine if dry.

1. Install lifters and push rods into original position in cylinder block. See note under "Removal".
2. Install manifold gaskets and manifold. Refer to "Intake Manifold" earlier in this section.
3. Position rocker arms, pivots and bolts on cylinder head as shown in figure 20.
4. Install valve covers. Refer to "Valve Cover" earlier in this section.

CYLINDER HEAD AND GASKET

REMOVAL

1. Drain radiator. Drain cock located at lower left side of radiator. By raising the rear wheels approximately 2-1/2 feet, enough engine coolant will drain from the engine block to allow removal of the heads.

NOTE: To avoid overloading the front suspension raise front of the vehicle enough so front wheels are just off the ground.

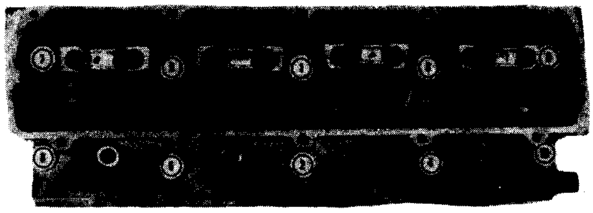


Figure 28—Cylinder Head Torque Sequence

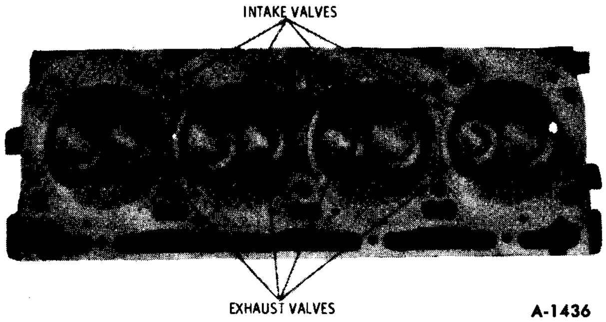


Figure 29—Valve Location

2. Remove intake manifold. Refer to "Intake Manifold" earlier in this section.
3. Remove exhaust manifold, see "L.H. and R.H. Exhaust Manifold Removal" earlier in this section.
4. Loosen or remove any accessory brackets which interfere with head removal.
5. Remove valve cover. Refer to "Valve Cover" earlier in this section.
6. Remove rocker arm bolts, pivots, rocker arms and push rods as shown in figure 20.

NOTE: Scribe pivots and keep rocker arms separated so they can be installed in their original locations.

7. Remove cylinder head bolts, then remove cylinder head.

NOTE: If a clearance problem is encountered for number 7 or 8 cylinder head bolts (figure 28) or push rods, pull these out far enough to clear the block, secure with rubberbands, and remove or install with the cylinder heads.

CAUTION: *Gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. The cylinder head bolt threads into the block and threads on cylinder head bolt must be cleaned. Dirt will affect bolt torque.*

INSTALLATION

Head gaskets are a special composition gasket that must be used WITHOUT a sealer. These gaskets are to be installed with the contrasting color stripe facing "up". Use a new head gasket.

1. Clean and dip cylinder head bolts in engine oil.
2. Install cylinder head and torque bolts to 100 ft. lbs. in sequence as shown in figure 28. Then retorque in sequence to 130 ft. lbs.

NOTE: Torque head bolts before installing rocker arms and pivots if a clearance problem is encountered.

3. Install push rods, pivots, rocker arms and bolts. Torque rocker arm pivot bolts to 25 ft. lbs., tighten by alternating from side to side.

NOTE: Be sure to place rocker arms and pivots in their original locations.

4. Install valve cover. Refer to "Valve Cover" earlier in this section.
5. Install intake manifold. Refer to "Intake Manifold" earlier in this section.
6. Install any accessory brackets that were removed previously.
7. Install exhaust manifold. Refer to "L.H. and R.H. Exhaust Manifold Installation" earlier in this section. Torque bolts to 25 ft. lbs. Bend tabs around bolt heads.
8. Add engine coolant.
9. Start engine and check for leaks.

VALVES AND SPRINGS WITH HEAD REMOVED

REMOVAL

1. Remove spark plugs.
2. Remove valve keys by compressing valve spring with a tool J-5892-1 or equivalent.
3. Remove valve spring rotators or retainers and springs.
4. Remove oil seals from valve stems.
5. Remove valves. Keep valves separated so they can be installed in their original locations (figure 29).

RECONDITIONING VALVES

When reconditioning valves and valve seats, clean carbon from cylinder heads and valves using care not to gouge or scratch machined surfaces. A soft wire brush is suitable for this purpose. Whenever valves are replaced or new

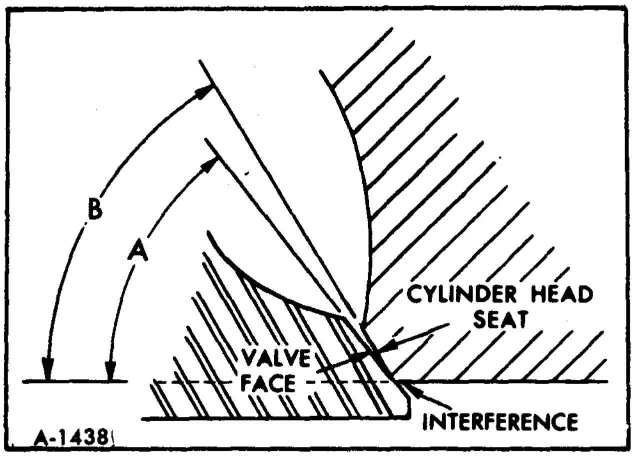


Figure 30—Relation of Valve and Seat Angles

valves installed, the valve seats must be reconditioned.

Figure 30 shows the relation of valve angle and valve seat angle.

Narrow the valve seats to the specified width.

NOTE: This operation is done by grinding the portside with a 30° stone to lower the seat and a 60° stone to raise the seat.

See "Engine Specification" Chart for valve seat width.

NOTE: Exhaust valve seats are induction hardened and must be ground, not cut.

If valve guide bores are worn excessively, they can be reamed oversize. This will require replacement of the valves with oversize valves (stems). The guide bores should be reamed

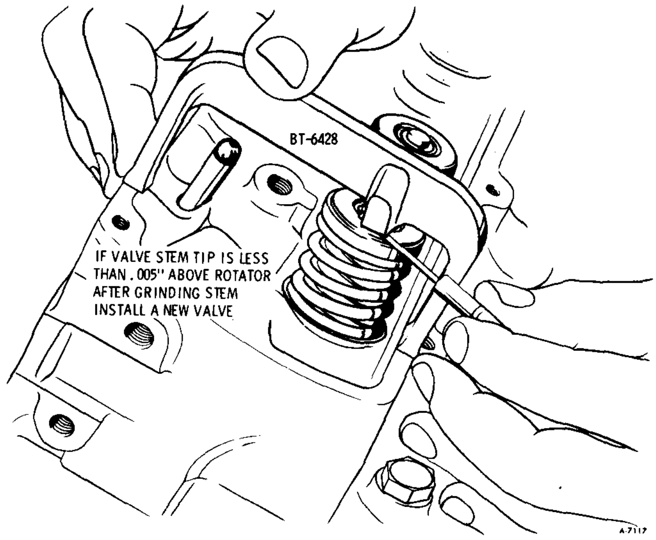


Figure 32—Measuring Rotator Height

before grinding the valve seats. Valve clearance in guide bore should be .0015" to .0032" (exhaust) or .002" to .0027" for the intake valve.

MEASURING VALVE STEM HEIGHT (FIGURE 31)

Whenever a new valve is installed, or after grinding valves, it will be necessary to measure valve stem height. Install Gauge BT-6428. There should be at least .015" clearance on all valves between gauge surface and end of valve stem. (Valve stem can be gauged with or without the valve rotator on the valve). If clearance is less than .015", remove valve and grind tip of valve stems as required on a valve refacing machine using the "Vee" block attachment to insure a smooth 90° end. Also be

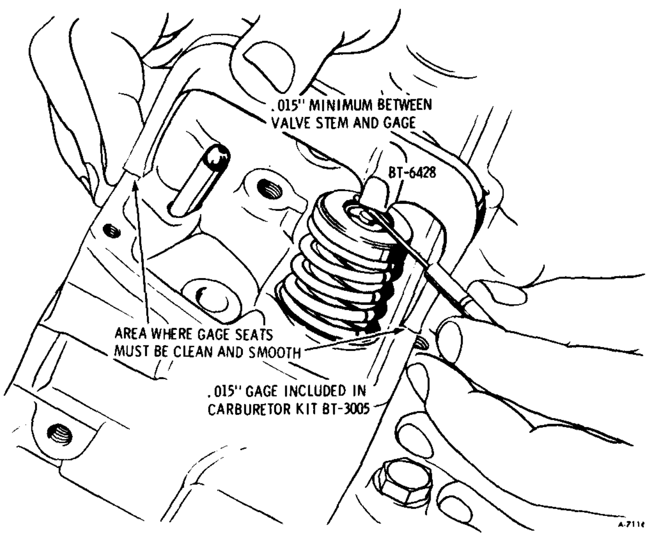


Figure 31—Measuring Valve Stem Height

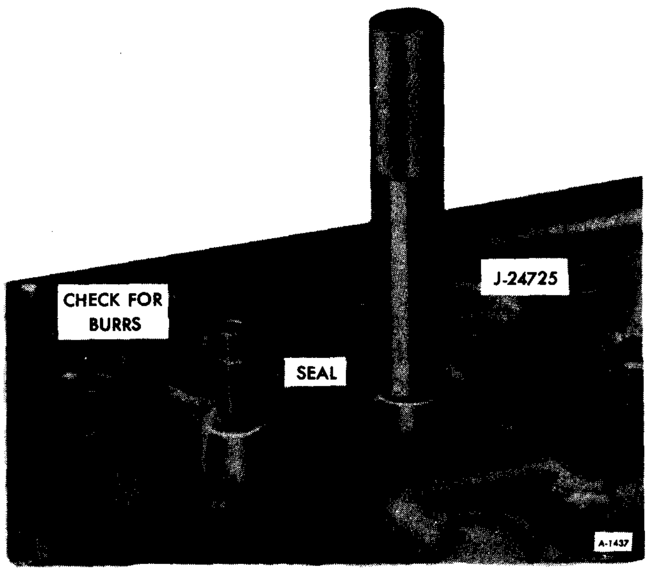


Figure 33—Valve Seal Installation

certain to break sharp edge on ground valve tip. Observe an original valve to determine chamfer.

After all valve keys have been installed on valves, tap each valve stem end with a hammer to seat valve rotators and keys. Re-gauge all valves between valve stem and gauge (.015" minimum) and valve rotator and gauge (.030" minimum) (figures 31 and 32). If any valve stem end is less than .005" above rotator, the valve is too short and a new valve must be installed.

NOTE: There must be a minimum of .030" clearance between valve rotator and gauge. Failure to maintain this clearance will cause rocker arm and valve rotator interference. Example:

Valve Rotator to Gauge Clearance . .	0.38"
Minus Valve Stem to Gauge Clearance .	-0.35"
	.003"

This is less than .005" and a new valve should be installed.

INSTALLATION

1. Install valves in their respective guides.
2. Install new oil seals over valve stem, using Tool J-24725 (figure 33).

Position seals down as far as possible on valve stem. The seals will correctly position themselves when the engine is started.

NOTE: Inspect seal for cracks after installation.

3. Position valve springs over valve stems.
4. Install valve rotators, then compress springs with a tool such as J-5892-1 and install valve stem keys.
5. Check valve springs and keys to be sure they are properly seated.
6. Torque spark plugs to 25 ft. lbs.

VALVE GUIDE BORES

As previously stated, if the valve guide bores are worn excessively, they can be reamed oversize. The following reamers are available:

.003" Oversize Valve Guide Reamer (BT-6414-1)

.005" Oversize Reamer (BT-6414-4)

.013" Oversize Valve Guide Reamer (BT-6414-3)

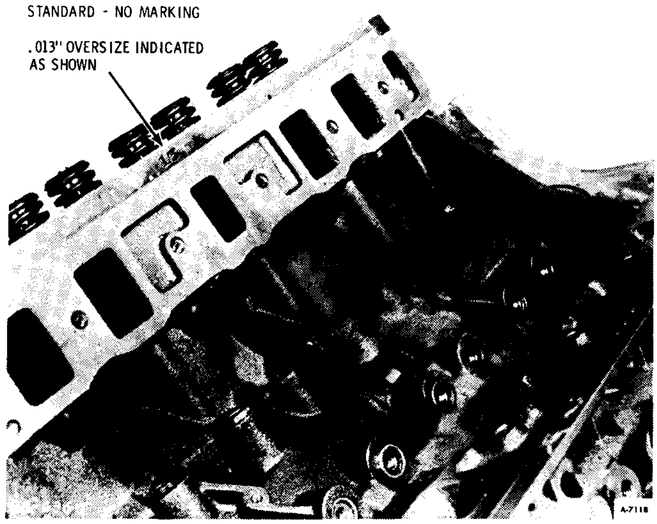


Figure 34—Valve Guide Bore Marking

If a standard valve guide bore is being reamed, use the .003" oversize reamer. For the .005" oversize valve guide bore, use the .005" oversize reamer; use the .013" reamer for the .010" or .013" O.S. valve guide bore.

If too large a reamer is used and the spiraling is removed, it is probable that the valve will not receive the proper lubrication.

Occasionally a valve guide bore will be oversize as manufactured. These are marked on the inboard side of the cylinder heads on the machined surface just above the intake manifold surface (figure 34). These markings are visible without removing any parts other than the air cleaner assembly. Before removing the cylinder heads to perform service to either the valves or valve guide bores, the cylinder heads should be inspected to determine if these markings are present. If no

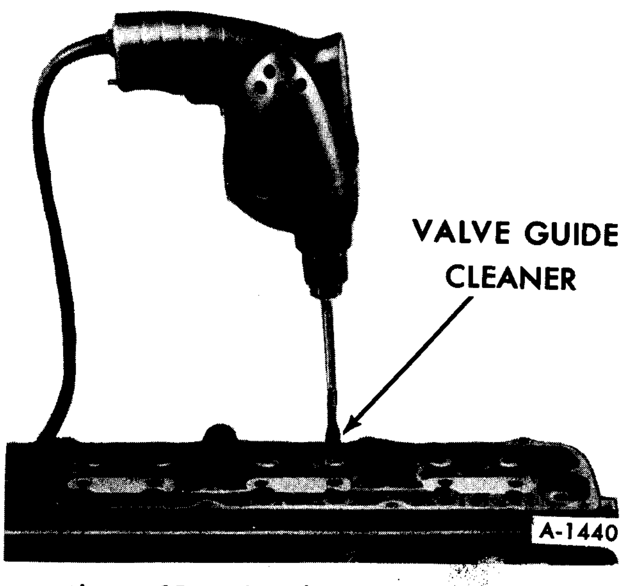


Figure 35—Cleaning Valve Guide Bores

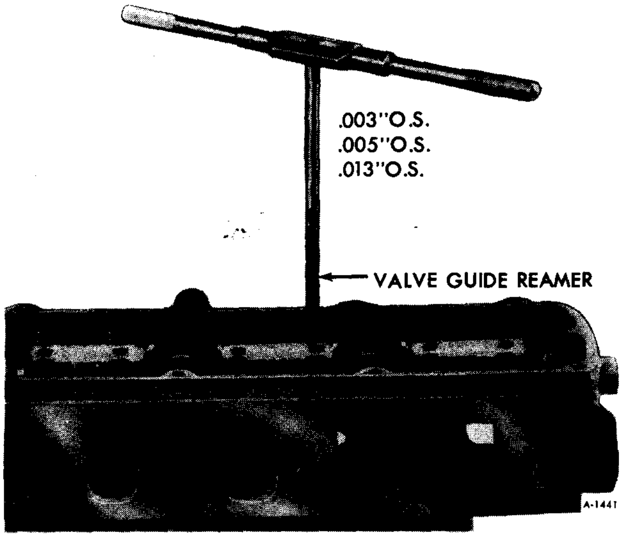


Figure 36—Reaming Valve Guide Bores

markings are present, the guide bores are standard. If oversize markings are present, any valve replacement will require an oversize valve. If the oversize marking is present, only that particular bore would be oversize, not all bores in that cylinder head. Service valves are available in five different stem diameters: Standard, .003" oversize, .005" oversize, .010" oversize, and .013" oversize.

REAMING PROCEDURE

Before attempting to ream the valve guide bores they should be cleaned using a tool as shown in figure 35.

This procedure to ream valve guide bores using a reamer is shown in figure 36. Use care to hold reamer straight in valve guide bore.

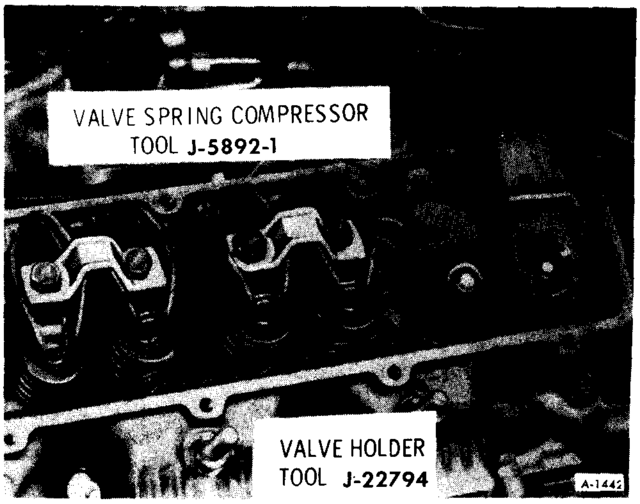


Figure 37—Removing Valve Spring

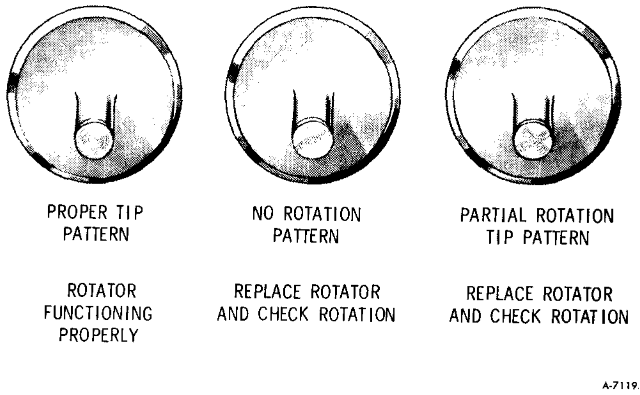


Figure 38—Valve Stem Wear

REPLACING VALVE SPRING (HEAD ON ENGINE)

To replace a worn or broken valve spring without removing the cylinder head proceed as follows:

REMOVAL

1. Remove valve covers. Refer to "Valve Cover" earlier in this section.
2. Remove rocker arm assemblies.
3. Remove spark plug and install Tool J-22794 into spark plug hole and attach to an air hose to hold the valve against its seat (figure 37).
4. Install Tool J-5892-1 (figure 37). Compress the valve spring until valve keys are accessible, then remove keys, valve rotators and springs.

NOTE: If valve spring does not compress, tap tool with a hammer to break bind at rotator and keys.

CHECKING ROTATORS

The rotators cannot be disassembled and require replacement only when they fail to rotate the valve.

Rotator action can be checked by applying a daub of paint across the top of the body and down the collar. Run engine approximately 1500 rpm; there should appear to be motion between the body and collar, the body will appear to "walk" around the collar. Rotator action can be either clockwise or counter-clockwise, sometimes on removal and reinstallation; the direction of rotation will change but this does not matter so long as it rotates.

Anytime the valves are removed for service the tips should be inspected for improper pattern which could indicate valve rotator malfunction (figure 38).

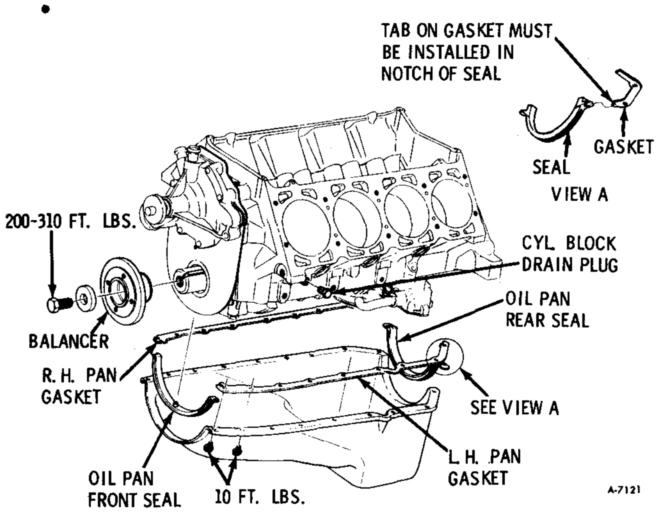


Figure 39—Oil Pan Assembly

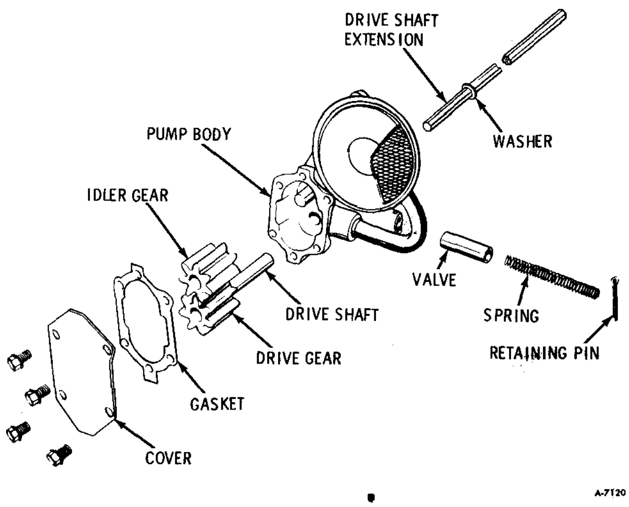


Figure 40—Oil Pump Components

INSTALLATION

1. Install valve spring and rotator. Using Tool J-5892-1, compress the valve spring until the valve keys can be installed.
2. Remove tool No. J-22794 and install spark plugs. Torque to 25 ft. lbs.
3. Install rocker arm assemblies.
4. Install valve covers. Refer to "Valve Cover" earlier in this section.

OIL PAN

REMOVAL

1. Remove transmission and final drive. Refer to "Engine Removal" later in this section.
2. Remove oil pan drain plug and drain oil.
3. Disconnect relay tie rod from the idler arm and the relay lever. Also disconnect steering shock absorber from crossmember bracket.
4. Remove fan and clutch assembly (4 bolts). Removal of these components will allow the engine to be raised slightly for oil pan removal.
5. Disconnect power steering pump.
6. Install engine removal tool (see figures 7, 8 and 9). Remove 4 front support bolts and front motor mount bolts.
7. Remove flywheel.
8. Remove oil pan attaching bolts.
9. Raise front of engine enough so the oil pan can be removed (approximately one inch). Remove oil pan.
10. Clean gasket surfaces on the engine block and the oil pan.

INSTALLATION

1. Apply sealer Part No. 1050805 or equivalent to both sides of gaskets. Position all gaskets on engine block (figure 39).
2. Position oil pan on engine. Start all bolts and install until finger tight. Torque oil pan bolts to 10 ft. lbs.
3. Install flywheel and torque bolts to 60 ft. lbs.
4. Lower engine to position. Install four (4) front support bolts and torque to 50 ft. lbs. (figure 10).
5. Torque engine mount support bracket to front cover bolts to 50 ft. lbs. (figure 10).
6. Install power steering pump.
7. Attach fan shroud to radiator support (4 bolts). Install fan and clutch assembly to pulley. Torque nuts to 10-15 ft. lbs.
8. Connect relay tie rod and torque nuts to 50 ft. lbs., then insert cotter pin. Connect steering shock absorber to bracket at cross-member, torque nut to 40 ft. lbs.
9. Install oil pan drain plug. Torque to 30 ft. lbs.
10. Install transmission and final drive. Refer to "Engine Replacement" later in this section.
11. Lower vehicle.
12. Add engine oil. Refer to Section "0" Maintenance Manual X-7525 for proper viscosity and quanity information.
13. Start engine and check for leaks.

OIL PUMP

REMOVAL

1. Remove oil pan. Refer to "Oil Pan" earlier in this section.
2. Remove the oil pump to rear main bearing cap attaching bolts, then remove pump and drive shaft extension.

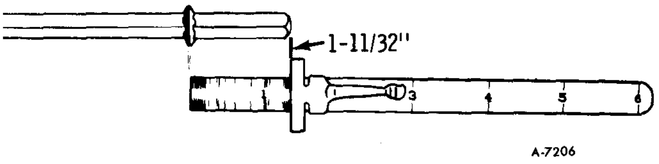


Figure 41—Oil Pump Driveshaft Extension

DISASSEMBLY (FIGURE 40)

1. Remove the oil pump drive shaft extension.

NOTE: Do not attempt to remove the washers from the drive shaft extension. The drive shaft extension and washers must be serviced as an assembly (figure 41).

2. Remove the cotter pin, spring and the pressure regulator valve.

NOTE: Position thumb over pressure regulator bore before removing cotter pin, as the spring is under pressure.

3. Remove the oil pump cover attaching screws and remove the oil pump cover and gasket.
4. Remove the drive gear and idler gear from the pump body.

INSPECTION

Check the gears for scoring or other damage. If they are damaged, new gears should be installed. During assembly, the gear end clearance should be gauged. Proper end clearance is .0015" to .0085". Also check the pressure regulator valve, valve spring and bore for damage. Proper valve to bore clearance is .0025" to .0050". The checking of gear end clearance will be covered in "Assembly".

ASSEMBLY

1. Install the gears and shaft in the oil pump body and check the gear end clearance by placing a straight edge over the gears and measure the clearance between the straight edge and the gasket surface. The clearance should be between .0015" to .0085". If the end clearance is near the excessive reading check for scores in the cover that would bring the total clearance over the specified amount.
2. Position a new gasket on the pump body and install the oil pump cover. Install cover screws and tighten alternately and evenly. Torque to 8 ft. lbs.

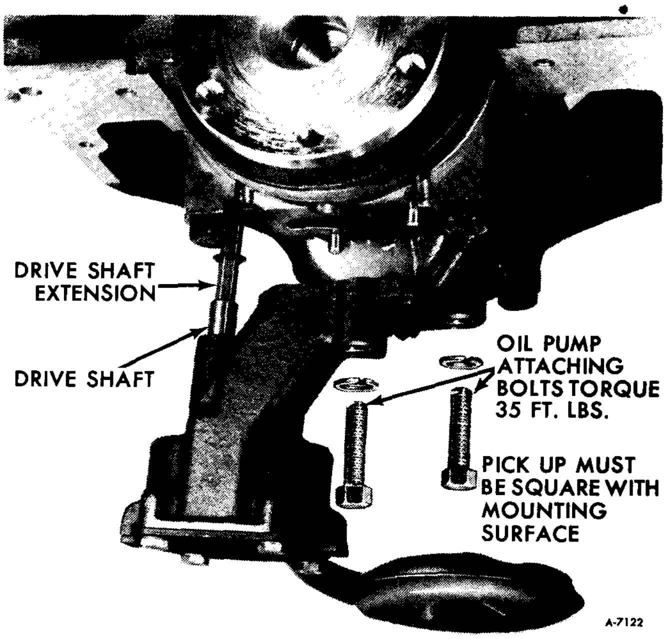


Figure 42—Oil Pump Installation

3. Position the pressure regulator valve into the pump cover, closed end first, then install the spring and cotter pin.

NOTE: When assembling the drive shaft extension to the drive shaft, the END OF THE EXTENSION NEAREST THE WASHERS MUST BE INSERTED INTO THE DRIVE SHAFT.

INSTALLATION

1. Insert the drive shaft extension through the opening in the main bearing cap and block until the shaft mates into the distributor drive gear.
2. Position pump onto the rear main bearing cap, and install attaching bolts. Torque bolts to 35 ft. lbs. (figure 42).
3. Install the oil pan. Refer to "Oil Pan" installation earlier in this section.

CONNECTING ROD AND PISTON ASSEMBLY

REMOVAL

1. Remove intake manifold. Refer to "Intake Manifold" earlier in this section.
2. Remove head or heads, oil pan and oil pan and oil pump assembly. Refer to those areas earlier in this section.

NOTE: Stamp cylinder number on the machined surfaces of the bolt bosses of the connecting rod and cap for identification when reinstalling. If the pistons are to be

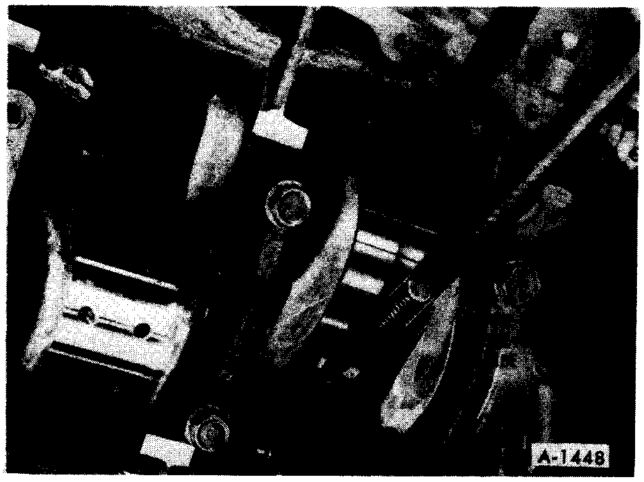


Figure 43—Connecting Rod Bolt Guide

removed from the connecting rod, mark cylinder number on piston with a silver pencil or quick drying paint for proper cylinder identification and cap to rod location. The right bank is numbered 2-4-7-8, left bank 1-3-5-7.

Examine the cylinder bore above ring travel. If ridge exists, remove ridge with ridge reamer before attempting to remove the piston and rod assembly.

3. Remove rod bearing cap and bearing.
4. Install guide hose over threads of rod bolts. This is to prevent damage to bearing journal and rod bolt threads (figure 43).
5. Remove rod and piston assembly through the top of the cylinder bore.
6. Remove other rod and piston assemblies in the same manner.

INSTALLATION

Refer to "Connecting Rod and Piston Assembly Installation" later in this section.

ROD BEARINGS

The connecting rod bearings are designed to have a slight projection above the rod and cap faces to insure a positive contact.

Connecting rod bearings can be replaced without removing the rod and piston assembly from the engine.

REMOVAL

1. Remove oil pan. Refer to "Oil Pan" earlier in this section.

NOTE: It may be necessary to remove oil pump to provide access to rear connecting rod bearings.

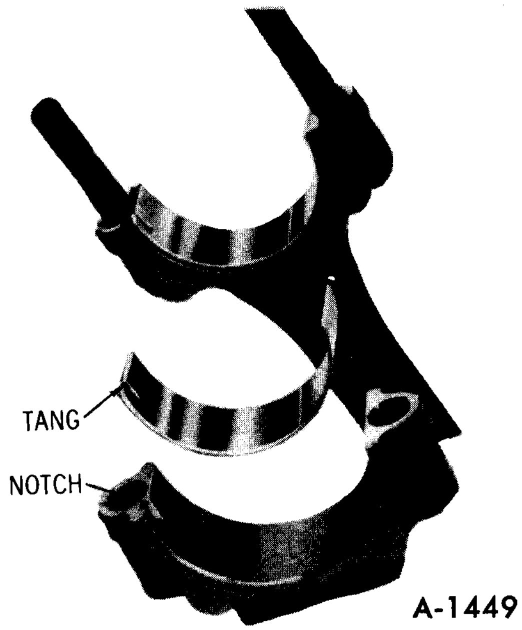


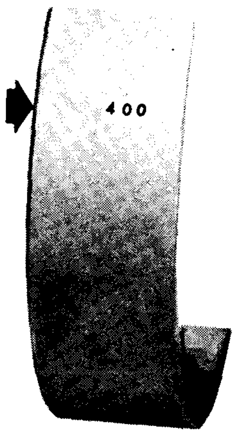
Figure 44—Bearing Tang and Notch

2. With connecting rod journal at the bottom, stamp cylinder number on machined surfaces of connecting rod and cap for identification when reinstalling, then remove caps.
3. Inspect journals for roughness and wear. Slight roughness may be removed with a fine grit polishing cloth saturated with engine oil. Burrs may be removed with a fine oil stone by moving the stone on the journal circumference. Do not move the stone back and forth across the journal. If the journals are scored or ridged, the crankshaft must be replaced.
4. The connecting rod journals should be checked for out-of-round and correct size with a micrometer. Maximum out-of-round must not exceed .0015".

NOTE: Refer to "Engine Specifications" later in this section.

NOTE: Crankshaft rod journals will normally be standard size; if any undersized crankshafts are used, all will be .010" U.S. and an "X" will be stamped on the pad at the L.F. upper corner of the block.

5. Clean oil from journal bearing cap, connecting rod and outer and inner surface of bearing inserts. Position insert so that tang is properly aligned with notch in rod and cap (figure 44).
6. Place a piece of plastic gauging material in the center of lower bearing shell.
7. Reinstall bearing cap and torque to 42 ft. lbs.
8. Remove bearing cap and determine bear-



403 C. I. D.

UNDERSIZE BEARINGS WILL ALSO BE STAMPED WITH .010" IN THIS LOCATION

A-7124

Figure 45—Bearing Identification

ing clearances by comparing the width of the flattened plastic gauging material at its widest point with the graduation on the plastic gaug-

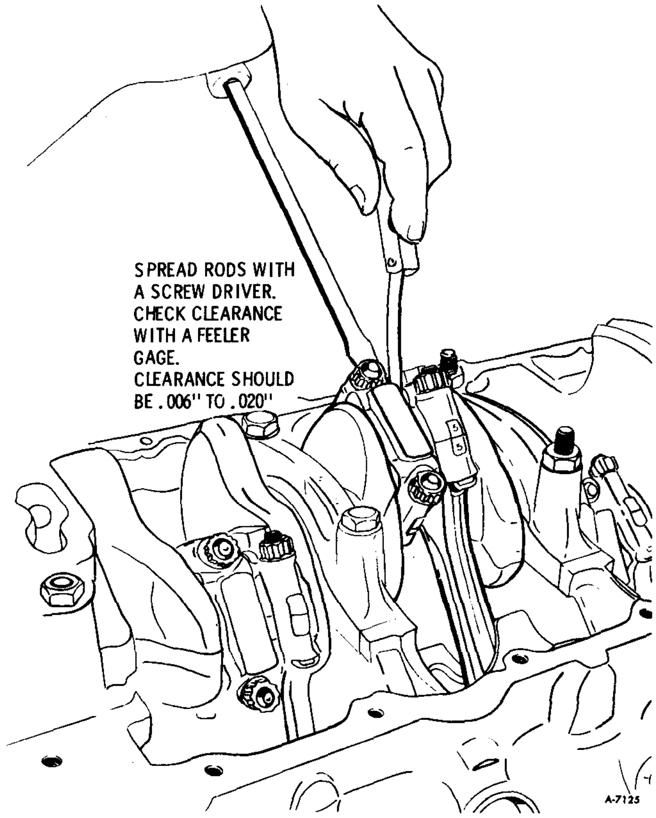


Figure 46—Connecting Rod Side Clearance

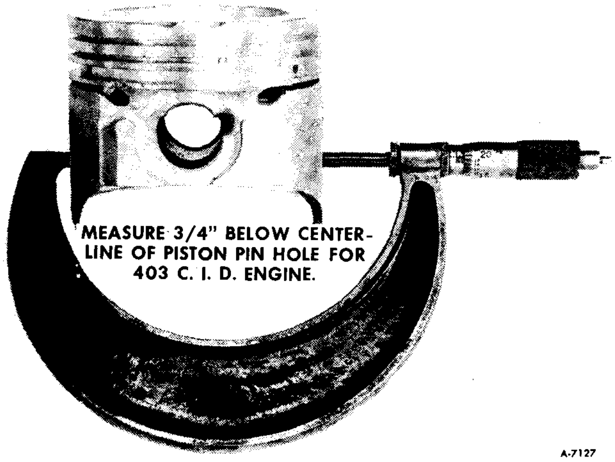


Figure 47—Measuring Piston

ing material container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch. If this clearance is greater than .0035", replace the bearing and recheck clearance with plastic gauging material.

NOTE: Lubricate bearing with engine oil before installation. Repeat Steps 2 through 8 on remaining connecting rod bearings. All rods must be connected to their journals when rotating the crankshaft to prevent engine damage.

NOTE: Bearings are identified as shown in figure 45.

9. Measure the rod side clearance as shown in figure 46. Clearance should be .006" to .020".

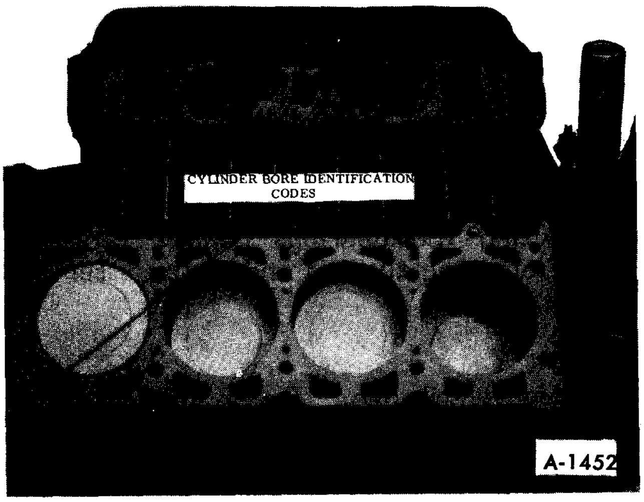


Figure 48—Cylinder Bore Marking

NOTE: If a rod is twisted or bent, a new rod must be installed. NO ATTEMPT SHOULD BE MADE TO STRAIGHTEN CONNECTING RODS.

PISTONS

MEASURING PISTON (FIGURE 47)

NOTE: Refer to PISTON INFORMATION CHART.

When replacing pistons, the original cylinder size is stamped with a letter code on the block near each cylinder on the cylinder head surface (figure 48) or on the oil pan rail.

When measuring piston for size or taper, measurement must be made on skirt 90° from piston pin hole (with the piston pin removed) (figure 47).

When measuring taper, measure at the center line of the piston pin hole and at the bottom of the skirt. The largest reading must be at the bottom of the skirt. Allowable taper is .000" to .0001".

NOTE: In some engines, oversize pistons may be found. These pistons will be .010" oversize.

Each piston should be fitted to its individual cylinder and marked for that cylinder.

CLEANING PISTON

Clean the pistons by scraping carbon off the top of the piston. Deposits in the ring grooves should be removed with a suitable ring groove cleaning tool. It is important that the ring grooves be completely free of deposits.

PISTON INFORMATION CHART —403 C.I.D. ENGINE

Bore Diameter	Cylinder Bore Selection	Bore Sizes	Piston Selection	Piston Size	Piston Diameter	Piston To Cyl. Bore Clearance	Ring Size
	A	4.3500-4.3505	A	4.3495-4.3490			
4.3500-	B	4.3505-4.3510	B	4.3500-4.3495	4.3510-		Std.
4.3520	C	4.3510-4.3515	C	4.3505-4.3500	4.3490		
Std.	D	4.3515-4.3520	D	4.3510-4.3505	Std.	.0005 to .0015	
4.3600-	J	4.3600-4.3605	J	4.3595-4.3590			
4.3620	K	4.3605-4.3610	K	4.3600-4.3595	4.3610-		.010" O.S.
	L	4.3610-4.3615	L	4.3605-4.3600	4.3590		
.010" O.S.	M	4.3615-4.3620	M	4.3610-4.3605	.010" O.S.		

CHECKING CYLINDER BORE

NOTE: Refer to PISTON INFORMATION CHART.

Cylinder bore size can be measured with inside micrometers or a cylinder gauge. Maximum allowable taper of the cylinder bore is .001". The most wear will occur at the top of the ring travel.

Reconditioned cylinder bores should be held to not more than .001" out-of-round and .001" taper.

If the cylinder bores are smooth, the cylinder walls should not be deglazed. If the cylinder walls are scored the walls may have to be honed before installing new rings. It is important that reconditioned cylinder bores be thoroughly washed with a soap and water solution to remove all traces of abrasive material to eliminate premature wear.

RINGS

(FIGURE 49)

The pistons have three rings (two compression rings and one oil ring). The oil ring consists of two rails and an expander.

RING TOLERANCES

When installing new rings, ring gap and side clearance should be checked as follows:

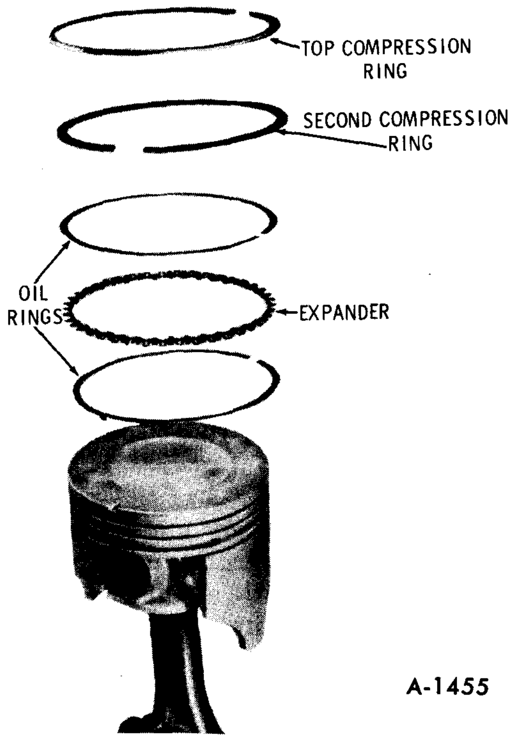


Figure 49—Piston Rings

PISTON RING AND RAIL GAP

Each ring and rail gap must be measured with the ring or rail positioned squarely and at the bottom of the ring-travel area of the bore (figure 50).

The gap measurement should be .013" to .023" for compression rings and .015" to .055" for oil rings.

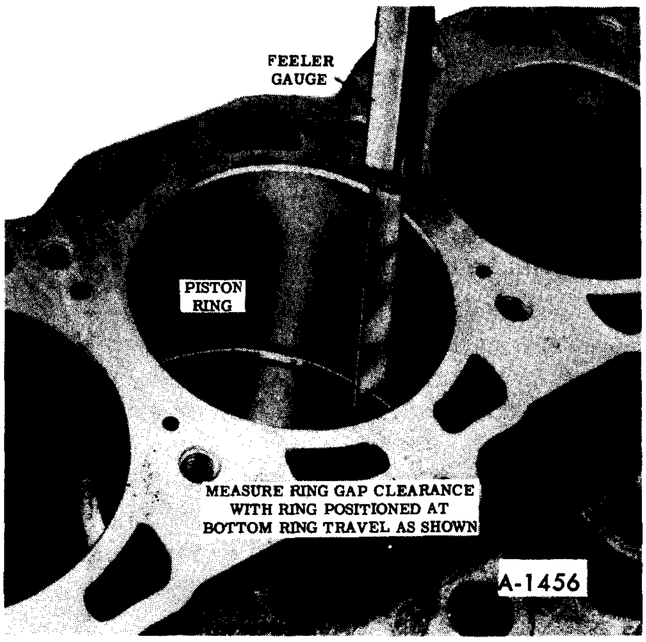


Figure 50—Measuring Piston Ring Gap

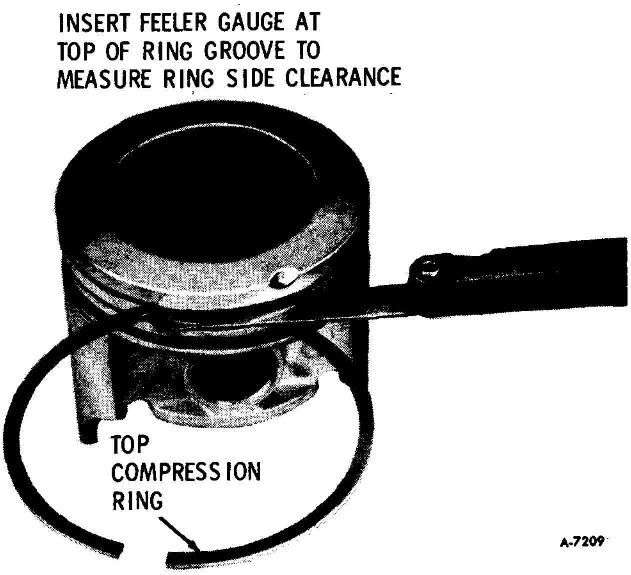


Figure 51—Piston Ring Side Clearance

SIDE CLEARANCE

Each ring must be checked for side clearance (see chart) in its respective piston groove by inserting a feeler gauge between the ring and its upper land (figure 51). The Piston grooves must be cleaned before checking ring for side clearance.

NOTE: To check oil ring side clearance, the oil rings must be installed on the piston.

ALLOWABLE SIDE CLEARANCE:

Compression Rings	.002" to .004"
Oil Ring	.015" to .055"

RING IDENTIFICATION AND INSTALLATION

For service ring specifications and detailed installation instructions, refer to the instructions furnished with the parts package.

CONNECTING ROD AND PISTON ASSEMBLY

(FIGURE 52)

INSTALLATION

1. Install connecting rod bolt guide hose over rod bolt threads (figure 43).
2. Apply engine oil to rings and piston, then install piston ring compressing tool on piston (figure 53).
3. Install assembly in its respective cylinder bore so notch cast in top of piston is towards the front of engine.

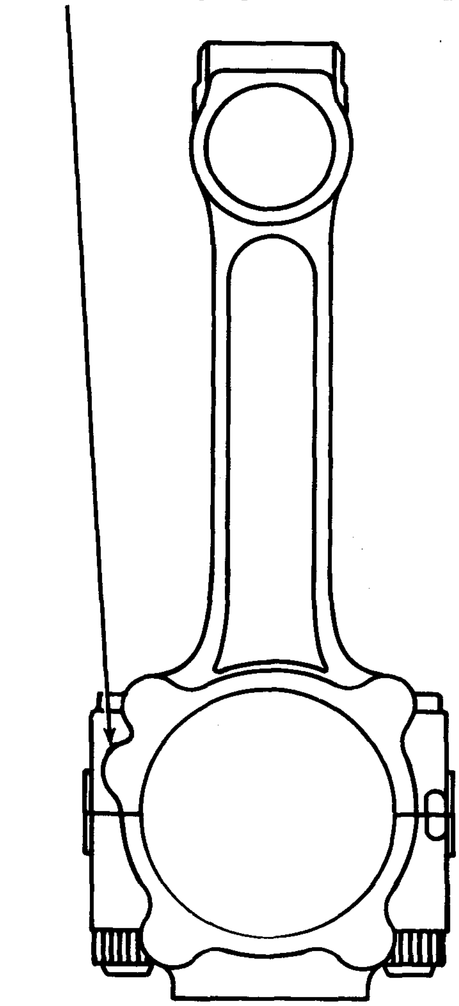


Figure 52—Connecting Rod Identification

4. Lubricate the crankshaft journal with engine oil and install connecting rod bearing and cap, with bearing index tang in rod and cap on same side.

NOTE: When more than one rod and piston assembly is being installed, the connecting rod cap attaching nuts should only be tightened enough to keep each rod in position until all have been installed. This will facilitate installation of remaining piston assemblies.

The clearance between the adjacent rods, when checked with a feeler gauge on each crankpin, should be from .006 " to .020" (figure 46).

5. Torque rod bolt nuts to 42 ft. lbs.

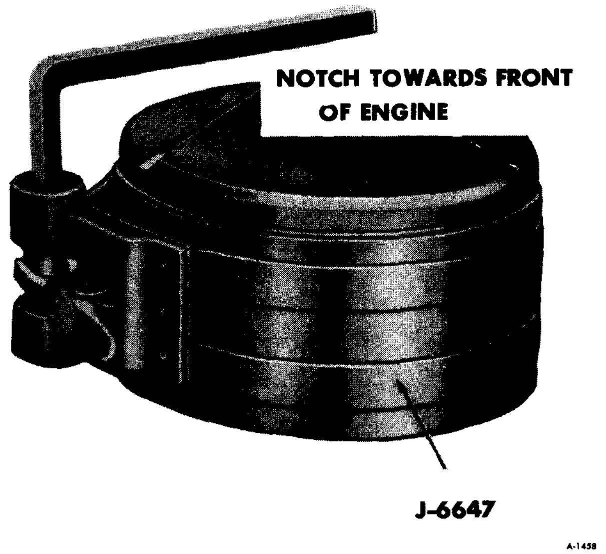


Figure 53—Piston Ring Compressor

PISTON PINS

The correct piston pin fit in the piston is .0003" to .0005" loose. If the pin to piston clearance is to the high limit (.0005"), the pin can be inserted in the piston with very little hand pressure and will fall through the piston by its own weight. If the clearance is .0003", the pin will not fall through. It is important that the piston pin hole be clean and free of oil when checking pin fit. The pin is a press fit in the connecting rod.

When replacement of a piston pin is necessary, use Piston Pin Tool Set J-24086 (figure 54). The 403 cubic inch engine (with a piston pin diameter of .9803" - .9807") has a narrow connecting rod pin boss. Use Pin Guide J-24086-2 (GREEN) for this engine application. The Piston Pin Installer — J-24086-9 — is a variable insertion length tool. The insertion

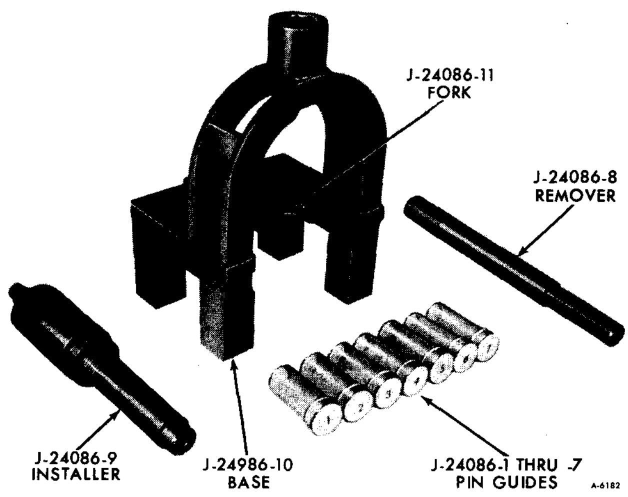


Figure 54—Piston Pin Tool Set J-24086

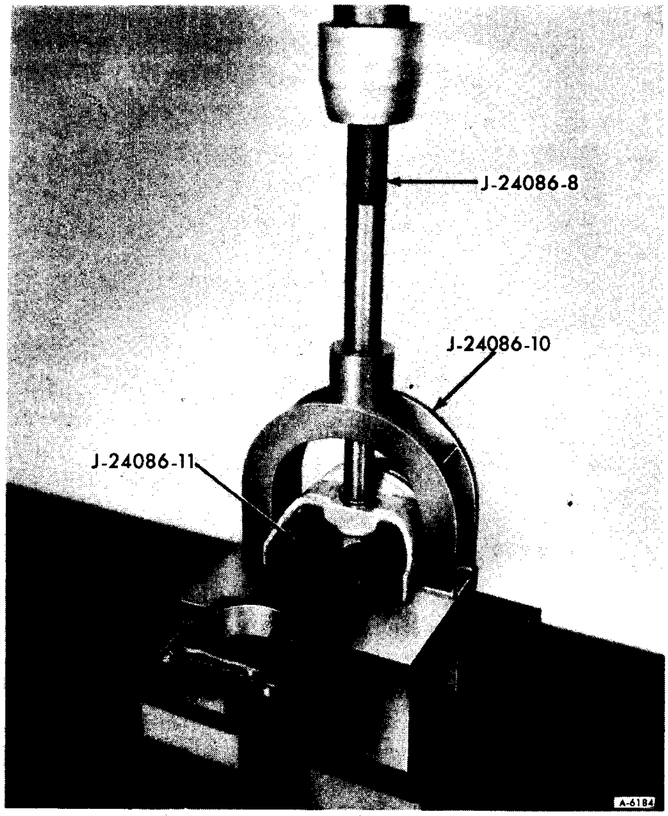


Figure 55—Removing Piston Pin with J-24086-8

length is varied by rotating the hub on the shaft much like adjusting a micrometer. An alpha-numeric scale is used to determine the desired length for a given piston pin assembly. The correct setting for installation of new piston pins in the 403 cubic inch engine is H-4.

REMOVAL

1. Position Tool J-24086-11, the Support Fork of the piston pin tool set, between the connecting rod and piston (figure 55).
2. Install the J-24086-8 Removal Arbor through the alignment hole in the tool base.

NOTE: It is important that the piston, rod and pin assembly be centered with the removal arbor.

3. Press the piston pin out of the connecting rod.

INSTALLATION

1. Install proper pin guide (J-24086-2, Green) through piston and into connecting rod. Hand tap pin guide into piston for proper retention. Drop piston pin into the other side of the piston.

NOTE: The pin guide centers the connecting rod in the piston. When the piston, connecting rod, piston pin and pin guide assembly are positioned on the fork of the tool, the pin guide will also center this assembly in the tool. If a pin guide that is too small is used, the piston assembly will not be located centrally in the tool, and damage may occur to the fork of the tool.

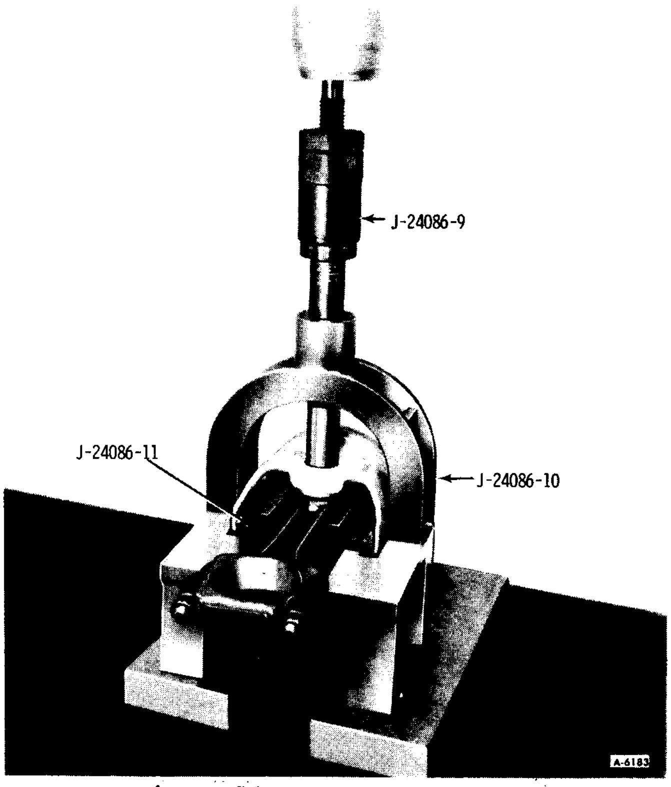


Figure 56—Installing Piston Pin with J-24086-9

2. Install piston assembly onto fork assembly of tool. Tool will support connecting rod at the piston pin. Be sure piston assembly is slid onto the fork until the pin guide contacts the fork.
3. Adjust the Installing Arbor, J-24086-9, to the proper length by turning the numbered sleeve on the lettered shaft until the specified alphanumeric setting (H-4 for 403 cubic inch engine) is obtained. Turn knurled nut to lock numbered sleeve on shaft.
4. Insert the installing arbor through the hole in the arch of the tool (figure 56). Press piston pin into the connecting rod until the sleeve on the installing arbor contacts the top of the tool arch. The pin guide will fall out of the connecting rod as the piston pin is pressed in.

CAUTION: *Do not exceed 5000 lbs. of force when stopping the installing arbor sleeve against the arch.*

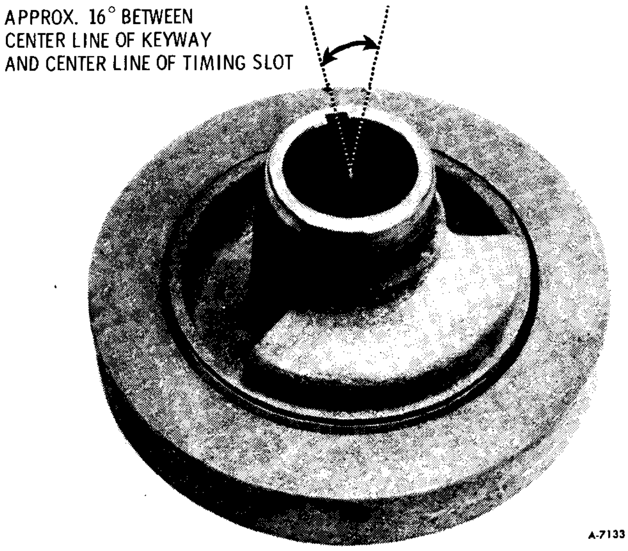


Figure 57—Harmonic Balancer

CRANKSHAFT PULLEY

REMOVAL

1. Loosen all belts enough so they may be slipped off crankshaft pulley.
2. Hoist vehicle.
3. Remove 4 pulley bolts and pulley.

INSTALLATION

1. Install pulley and 4 bolts. Torque bolts to 10 ft. lbs.
2. Install belts. Refer to "Belt Tension" next in this section.

BELT TENSION

NOTE: All belt tension checks must be taken at center of greatest span of the belt.

1. Using Belt Tension Gauge J-23573 (BT-33-73-F), check power steering belt. If necessary, adjust power steering belt FIRST before other belt adjustment is made. A "used" power steering belt (in operation more than one hour) should be adjusted to 70-80 lbs. A new power steering belt should be adjusted to 110-140 lbs.
2. Check and adjust (as required) the generator and air conditioning compressor belts. Belt tension should be the same as above.

HARMONIC BALANCER
(FIGURE 57)

REMOVAL

1. Remove engine cover.
2. Loosen all accessory drive belts.

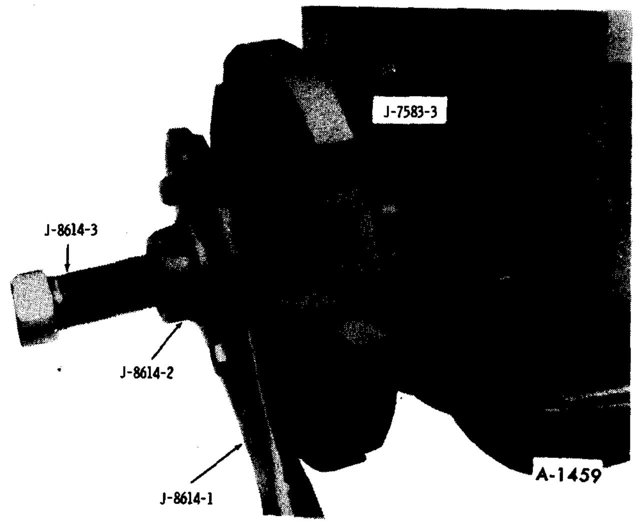


Figure 58—Removing Harmonic Balancer

3. Raise vehicle.
4. Remove fan and fan clutch assembly. Refer to ENGINE COOLING (SEC. 6K) in this supplement. Then remove bolts attaching fan shroud to radiator support. Remove shroud.
5. Slip belts off crankshaft pulley.
6. Remove 4 crankshaft pulley bolts and remove pulley.
7. Remove harmonic balancer hub bolt and washer.
8. Using balancer puller, remove balancer as shown in figure 58.

CAUTION: *Use of any other type puller such as a universal claw type which pulls on the outside of the hub can destroy the balancer. The outisde ring of the balancer is bonded in rubber to the hub; by pulling on the outside rather than the hub, it is possible to break the bond. The timing mark is on the outside ring of the balancer; if the bond between the hub and the outside ring is broken, the outside ring could slip which would change the location of the timing mark.*

If it is suspected that the bond between the sections of the harmonic balancer has been broken and the timing mark changed, it can be visually checked as shown in figure 57. The center of the keyway should be approximately 16^{o} from timing slot. In addition there are chisel aligning markers between the weight and hub. These marks should be aligned.

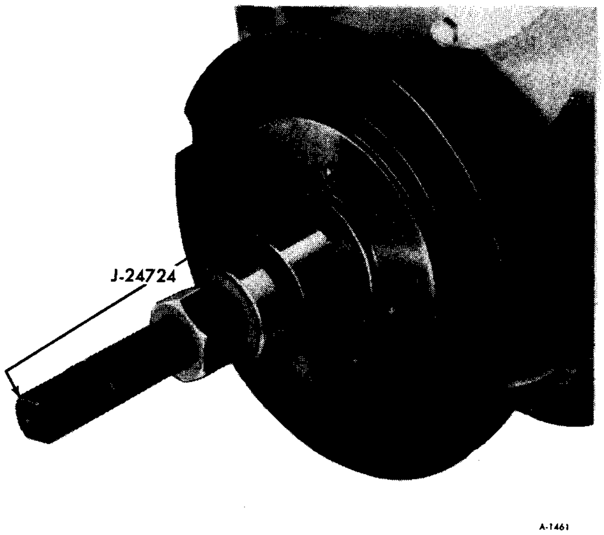


Figure 59—Installing Harmonic Balancer

INSTALLATION

1. Apply sealer Part No. 1050805 or equivalent, to inside diameter of pulley hub and to crankshaft key to prevent possible oil leakage. Coat outside area of crankshaft pulley hub which enters seal with Special Seal Lubricant No. 1050169 or equivalent.

1. Install harmonic balancer on crankshaft (figure 59). Use tool J-24724.

NOTE: Balancer to crankshaft fit is .001" tight to .0007" loose.

3. Install washer and bolt. Torque bolt to 200-310 ft. lbs.
4. Install pulley and position belts over pulley.
5. Install fan shroud to radiator support. Replace fan and clutch assembly. Refer to ENGINE COOLING (SEC. 6K) for installation procedures.
6. Lower vehicle.
7. Tension drive belts. Refer to "Belt Tension" earlier in this section.
8. Install engine cover.

OIL SEAL—FRONT COVER

REMOVAL (FRONT COVER INSTALLED)

1. Raise vehicle.
2. Loosen belts so they may be slipped off crankshaft pulley. Remove belts.
3. Remove crankshaft pulley and harmonic balancer. Refer to "Crankshaft Pulley" and "Harmonic Balancer" earlier in this section.
4. Using Front Cover Seal Removing Tool (such as BT-6406), remove oil seal.

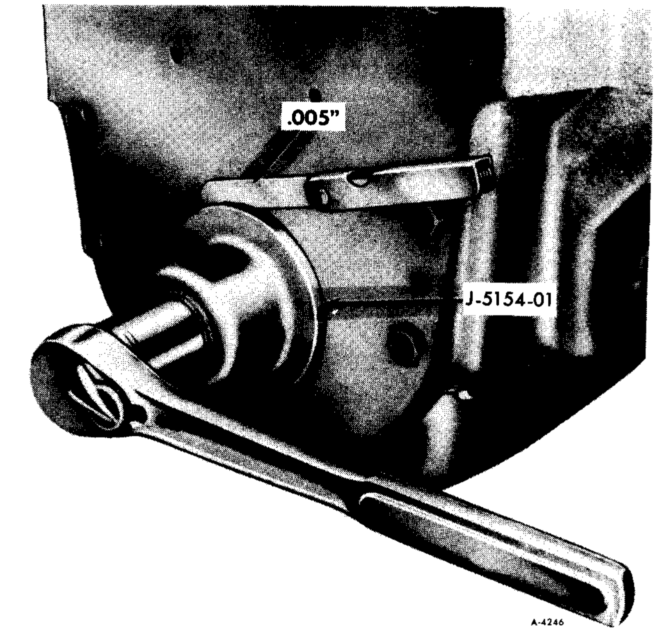


Figure 60—Front Cover Oil Seal Installation

INSTALLATION

1. Apply Part No. 1050805 sealer or equivalent to outside diameter of seal.
2. Using Tool J-5154-01, install oil seal as shown in figure 60.
3. Install crankshaft pulley and harmonic balancer. Refer to "Crankshaft Pulley" and "Harmonic Balancer" earlier in this section.
4. Install and adjust belts. Refer to "Belt Tension" earlier in this section.
5. Lower vehicle.

FRONT COVER
(FIGURE 61)

REMOVAL

1. Raise vehicle.
2. Drain cooling system. Disconnect radiator hoses, heater hoses, and bypass hose from the water pump and radiator.
3. Drain oil.
4. Remove all drive belts.
5. Remove fan and fan clutch assembly. Remove fan shroud from radiator support. (Refer to ENGINE COOLING (SEC. 6K) for procedure.)
6. Remove crankshaft pulley and harmonic balancer. See "Crankshaft Pulley" and 'Harmonic Balancer" earlier in this section.
7. Remove oil pan. Refer to "Oil Pan" earlier in this section.
8. Remove front cover to block attaching bolts.
9. Remove front cover, timing indicator and water pump assembly (figure 62).

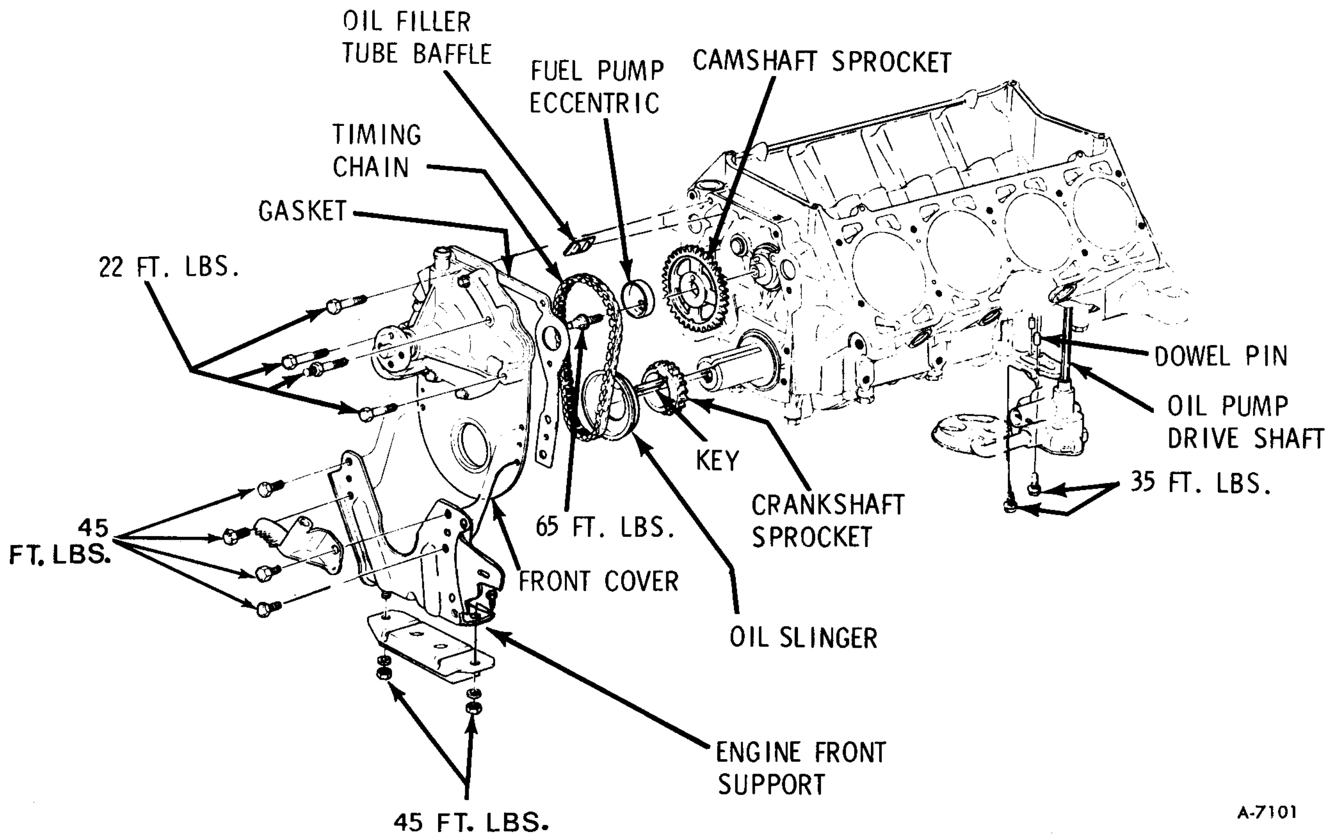


Figure 61—Engine Front Cover Components

Remove front cover and both dowel pins. It may be necessary to grind a flat on the pins to get a rough surface for gripping.

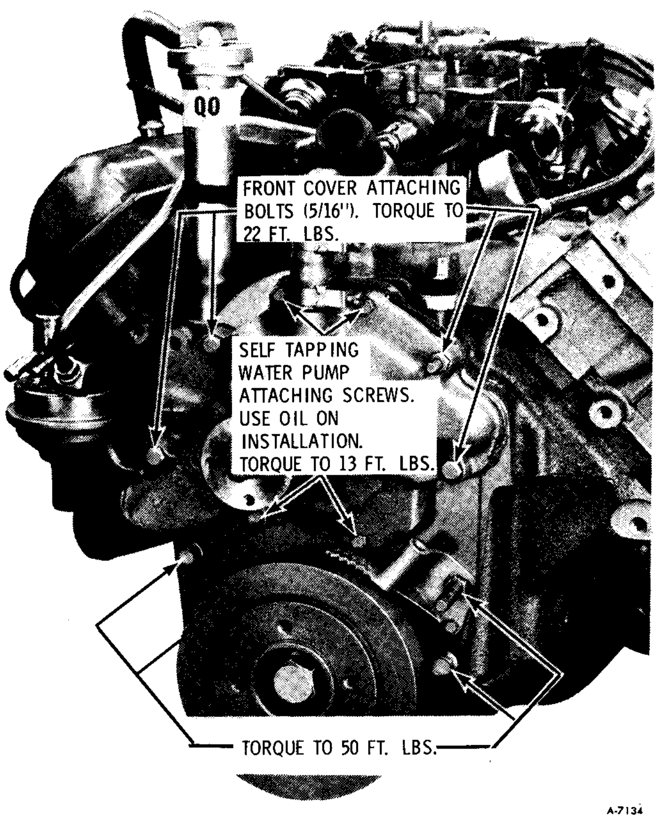


Figure 62—Engine Front Cover Bolts

INSTALLATION

1. Grind a chamfer on one end of each dowel pin as shown in figure 63.
2. Cut excess of material from front end of oil pan gasket on each side of engine block.
3. Clean block, oil pan and front cover mating surfaces with solvent.
4. Trim about 1/8" from each end of new front pan seal, using a sharp tool as shown in figure 64.
5. Install new front cover gasket on engine block and new front seal on front cover. Apply

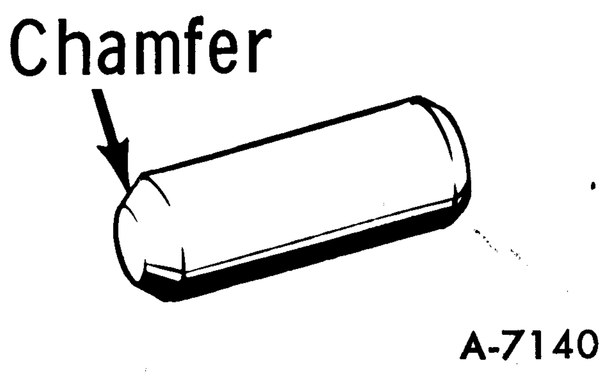


Figure 63—Dowel Pin Chamfer

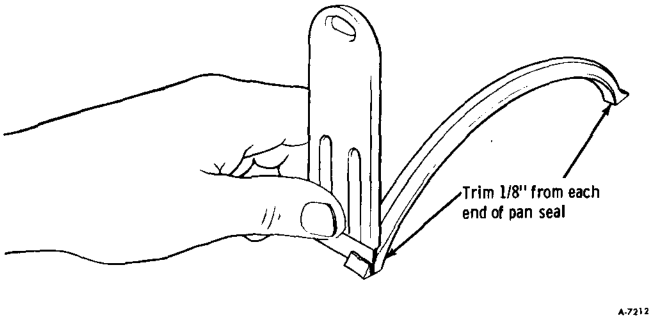


Figure 64—Trimming Pan Seals

sealer Part No. 1050805 or equivalent sealer to gasket around coolant holes and place on block.

6. Apply R.T.V. sealer at junction of block, pan and front cover as shown in figure 65.

7. Place cover on front of block and press downward to compress seal. Rotate cover left into cavity using a small screwdriver as shown in figure 66.

8. Apply engine oil to bolts (threads and heads).

9. Install 2 bolts finger tight to hold cover in place.

10. Install 2 dowel pins (chamfered end first).

11. Install remaining front cover bolts. Install timing indicator and water pump assembly. Then torque all fasteners evenly, to specification, as shown in figure 62.

12. Apply lubricant Part No. 1050169 or equivalent on balancer seal surface.

13. Install oil pan. Refer to "Oil Pan" earlier in this section.

14. Install balancer and balancer bolt. Refer to "Harmonic Balancer" earlier in this section. Torque balancer bolt from 200-310 ft. lbs.

15. Connect radiator hoses, bypass hose and heater hoses.

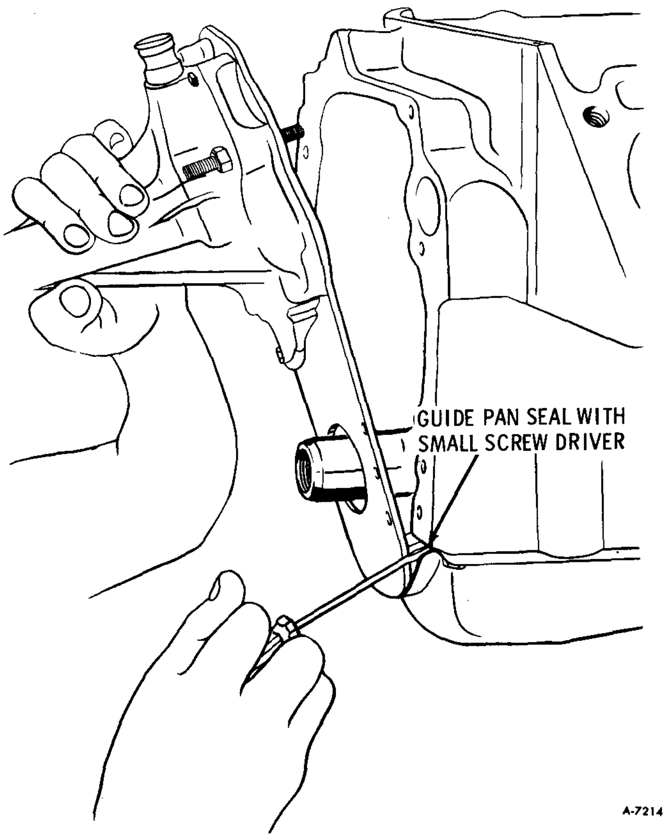


Figure 66—Guide Seal in Pan While Pushing Downward

16. Install crankshaft pulley and four attaching bolts. Torque to 10 ft. lbs. Refer to "Crankshaft Pulley" earlier in this section.

17. Install fan and clutch assembly. Torque clutch to hub bolts to 10-15 ft. lbs. Install radiator fan shroud and attaching bolts (4).

18. Install all drive belts, and adjust. Refer to "Belt Tension" earlier in this section.

19. Replace oil drain plug and shut radiator drain cock.

20. Lower vehicle.

21. Fill radiator and crankcase. Start engine

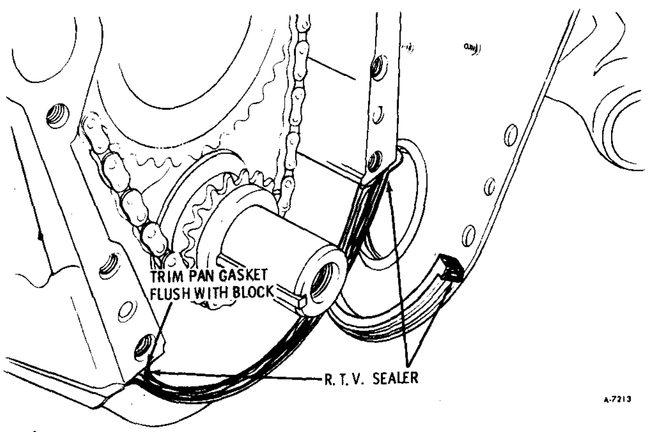


Figure 65—Applying R.T.V. Sealer and Trimming Pan Gasket

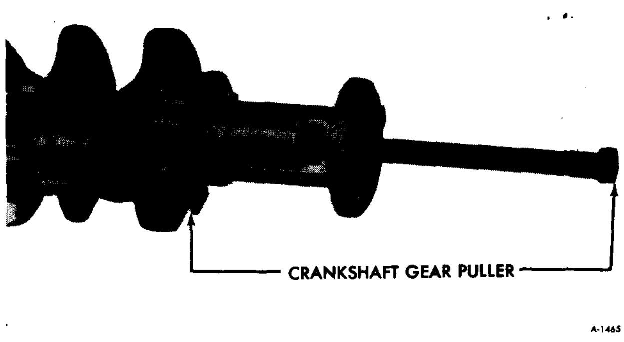


Figure 67—Crankshaft Gear Removal

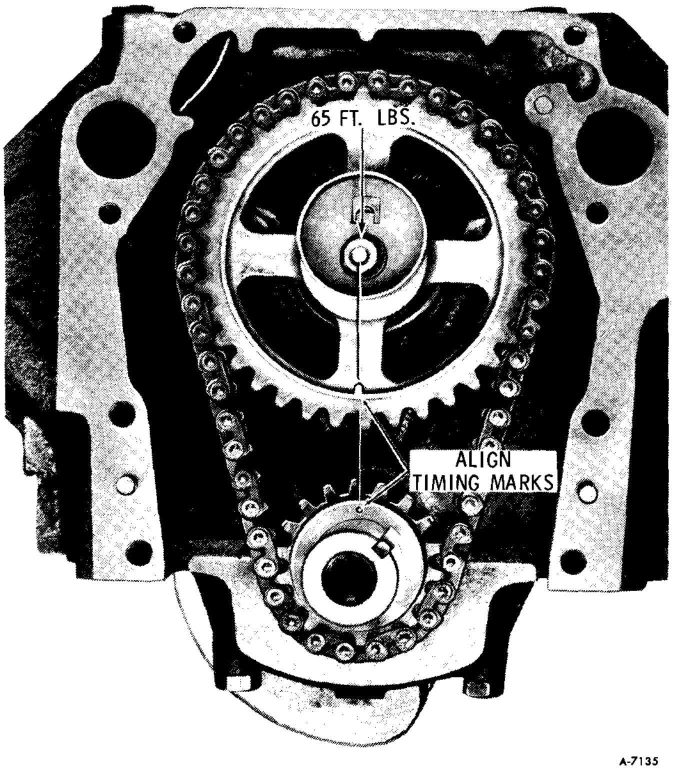


Figure 68—Timing Gear Position

and check for leaks. (Use of spray foot powder or equivalent may aid in detecting leaks.)

TIMING CHAIN AND GEARS

REMOVAL

1. Raise vehicle.

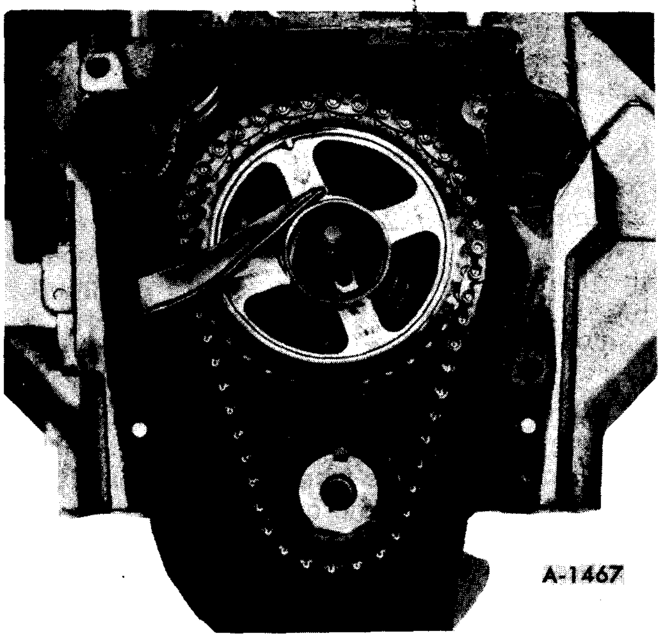


Figure 69—Fuel Pump Eccentric

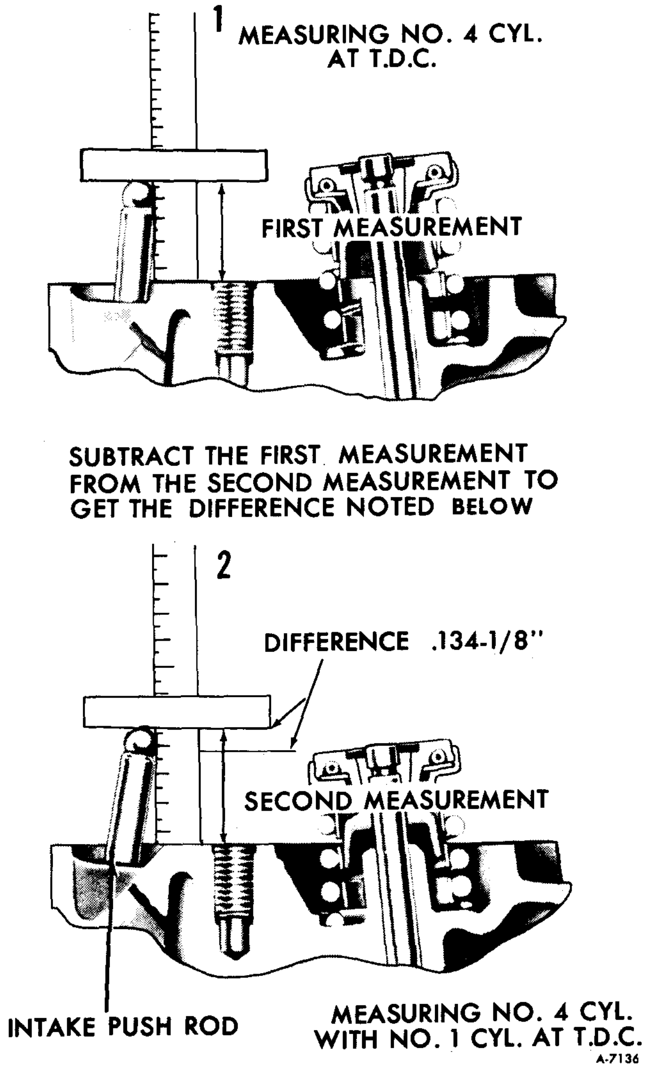


Figure 70—Checking Valve Timing

2. Remove front cover. See "Front Cover" earlier in this section.
3. Remove fuel pump eccentric.
4. Remove oil slinger, cam gear and timing chain.
5. Remove key, then crankshaft gear.

NOTE: Gear to crankshaft fit tolerances may be such that a puller is necessary (figure 67).

CAUTION: *Remove crankshaft key, if possible, before using puller; if not, align puller so that it does not overlap end of key when using puller. Keyway is machined only part way in crankshaft gear and breakage would occur.*

INSTALLATION

1. Install camshaft gear, crankshaft gear and timing chain together, and then align timing marks as shown in figure 68.

NOTE: When the timing marks are in alignment (figure 68), number six cylinder is at T.D.C. To obtain T.D.C. for number one cylinder, slowly rotate crankshaft one rotation. This will bring the cam mark to the top, number one will then be in the firing position.

2. Install fuel pump eccentric with flat side rearward (figure 69).
3. Drive crankshaft gear key in with a brass hammer until it bottoms in gear.
4. Install oil slinger.
5. Install front cover. See "Front Cover" earlier in this section.
6. Lower vehicle.

CHECKING VALVE TIMING WITHOUT REMOVING FRONT COVER

1. Remove distributor cap, right valve cover, No. 4 cylinder intake and exhaust rocker arms and pivot.
2. Remove wire from "BAT" terminal of HEI distributor.
3. Turn ignition switch on. Crank engine until rotor is in line with No. 4 spark plug wire position. No. 4 piston will be approximately at the top of the cylinder.
4. Measure from pivot boss on head surface to top of No. 4 intake push rod. Record measurement (figure 70).
5. Slowly turn engine 1-1/2 revolutions until rotor approaches No. 1 spark plug wire position. Continue to turn engine until timing mark on crank pulley is aligned with 0 on indicator. This is top dead center of No. 1 piston.
6. Again measure from pivot boss surface to top of No. 4 cylinder intake push rod (figure 70).
7. Measurement should increase over the first measurement as shown in figure 70.
8. If measurement increase is not within 1/32" of that shown on chart, camshaft is advanced or retarded.

ENGINE REPLACEMENT

The engine assembly may be removed with or without the transmission and final drive attached.

NOTE: It is recommended that transmission and final drive be removed from the vehicle before the engine.

In some situations repair to the engine (ie. piston replacement, oil pan gasket replacement, oil pump repair etc.) requires removal of the engine oil pan. If this is the case, refer to "Oil Pan" earlier in this section.

Refer to steps 1 through 19 for removal of transmission and final drive with engine remaining in vehicle.

Refer to steps 20 through 42 for removal of engine after the transmission and final drive have been removed.

WARNING: A VEHICLE OF THIS SIZE AND WEIGHT COMBINED WITH THE WEIGHT AND BULKINESS OF THE ENGINE AND/OR TRANSMISSION AND FINAL DRIVE DURING REMOVAL PRESENTS A POTENTIALLY DANGEROUS SITUATION TO PERSONNEL. ENGINE, TRANSMISSION AND FINAL DRIVE REMOVAL EITHER AS A UNIT OR SEPARATE COMPONENTS SHOULD BE PERFORMED WHILE USING A "TWIN POST" HOIST.

REMOVAL

1. Disconnect negative (—) battery cables from both the automotive and living area batteries.

NOTE: Drain radiator before raising vehicle.

2. Remove engine cover, remove air cleaner assembly and position engine removal tool No. J-24603-01 to the engine. Adjust lift mechanism until all slack is removed from the cable. (See figure 7).

NOTE: To properly position engine removal tool, remove seat belt plate and anchor bolt assembly. Attach load adjustor chain to front and rear engine lift locations as shown in figures 8 and 9. Then install support braces and chain fall as shown in figures 7, 8 and 9.

3. Raise vehicle. See WARNING at the beginning of "Engine Replacement".
4. Disconnect wires from starter solenoid.
5. Remove starter motor.
6. Referring to figure 71, remove flywheel cover bolts "B", "C" and "D". Loosen bolt "A" and pivot cover out of the upper L.H. bolt "A" slot.
7. Disconnect transmission shift linkage and

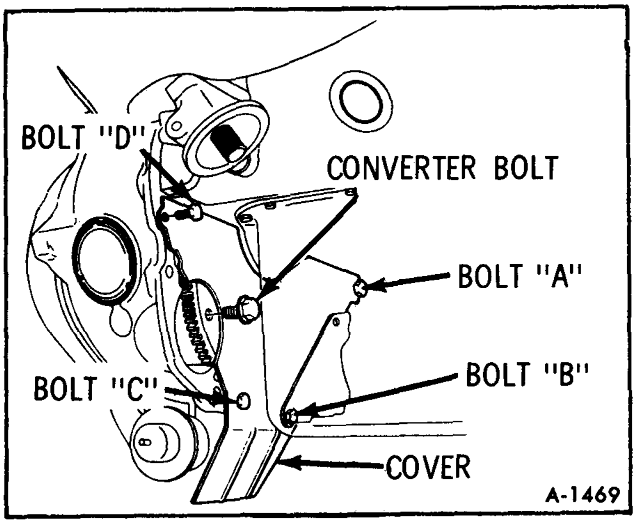


Figure 71—Flywheel Cover Removal

speedometer cable from transmission and position to one side. Remove bracket from frame.

8. Disconnect transmission oil cooler lines, detent solenoid wire and modulator tube from the transmission. Position all to the side.

9. Disconnect R.H. drive axle from the final drive output shaft. (Refer to Section 3B, Maintenance Manual X-7525.) Move drive axle rearward.

10. Remove output shaft bracket from engine and remove R.H. output shaft assembly from final drive.

11. Disconnect L.H. drive axle from flange at final drive and reposition axle forward and clear of the flange.

12. Remove bolt "X". (See figure 72).

13. Remove three (3) bolts that secure the converter to the flywheel.

NOTE: Rotate flywheel to gain access. Mark or scribe converter to flywheel for reassembly.

14. Remove three (3) transmission to support bracket bolts (figure 11).

15. Remove support bracket to crossmember bolts.

16. Position transmission jack under transmission as shown in figure 73.

17. Remove six (6) bolts that attach the flywheel housing to the engine.

18. Slide transmission rearward.

NOTE: Reposition transmission support bracket upward as required to obtain clearance between transmission and floor.

19. Remove transmission and final drive.

20. Lower vehicle.

21. Remove engine oil dipstick.

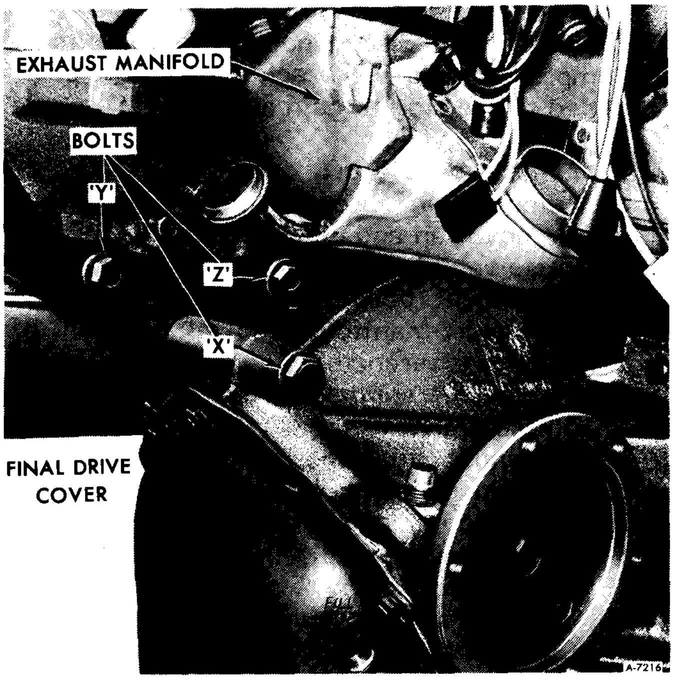


Figure 72—Disconnecting Final Drive from Engine

22. Disconnect vacuum hoses to the brake booster and heater controls from the intake manifold. Disconnect the vacuum hose to the carbon canister from the front of the carburetor.

23. Disconnect throttle linkage.

24. Disconnect heater hoses.

25. Disconnect wire from brake combination valve.

26. Disconnect engine harness.

27. Remove engine oil filler upper tube.

28. Remove engine oil dipstick tube.

29. Disconnect upper radiator hose from engine.

30. Remove necessary support struts and remove air conditioning compressor from bracket(s). Support compressor up and out of way with wire.

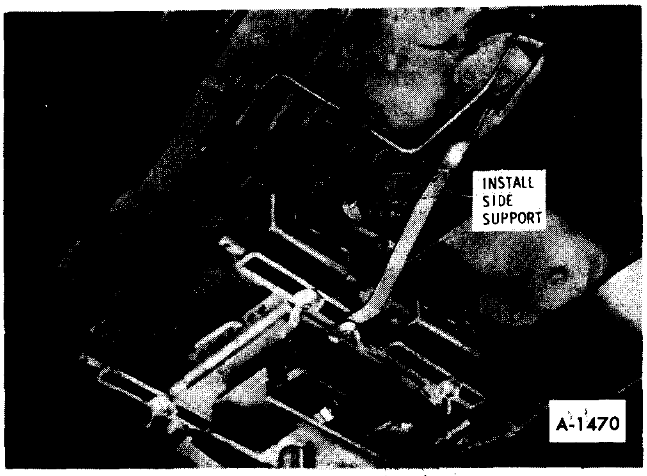


Figure 73—Transmission Jack Installation

NOTE: Do not disconnect refrigerant lines. Compressor and its brackets can be positioned to the side to gain access.

31. Remove generator.
32. Remove fan shroud from radiator support. Remove fan and clutch assembly.
33. Raise vehicle.
34. Disconnect both R.H. and L.H. exhaust pipes at exhaust manifolds. Move up and out of way for more clearance.
35. Disconnect engine oil cooler tubes from tube to hose union.
36. Disconnect fuel line from fuel pump.
37. Disconnect lower radiator hose.
38. Disconnect power steering hoses from the power steering pump.
39. Remove engine front mounting bolts.
40. Remove hub cap from L.H. hub. Remove cotter pin and axle nut. Tap lightly on outboard end of L.H. axle until splines are free. Remove L.H. drive assembly.
41. Raise engine assembly using engine removal tool J-24603-01 (figure 7).
42. Gradually remove engine assembly by alternately raising, tilting and lowering the engine assembly. Use care when supporting engine on dolly to prevent damage to oil pan.

INSTALLATION

INSTALLATION CAUTION

CAUTION: *When installing new or repaired engine and its attachments, correct routing of the power steering hoses is very important. Although sequence of assembly is not vital, the power steering hoses, when installed, must not be twisted, kinked, or tightly bent. The hoses should have sufficient natural curvature in the routing to absorb movement and hose shortening in operation under pressure. They should also be free of twist under strain. All fittings must be held while tightening or loosening nuts.*

1. Using tool J-24603-01 as shown in figures 7, 8, and 9, raise engine assembly adjusting and tilting until engine front mount lines up so bolts may be installed. Install nuts finger tight.
2. Install L.H. drive axle into knuckle and torque axle nut to 110 ft. lbs. Advance nut to next castellation if necessary and install cotter pin.

NOTE: Do not allow drive axle to hang unsupported. Use a piece of wire to support drive axle.

3. Raise transmission and final drive using the transmission jack. Position transmission support bracket while raising the transmission.
4. Position transmission and install six (6) bolts that attach flywheel housing to engine. Torque bolts to 25 ft. lbs.
5. Position transmission support bracket and referring to figure 11, torque bolts "A", "B" and "C" to 55 ft. lbs. Torque bolts "D" and "E" to 55 ft. lbs.
6. Install three (3) converter to flywheel bolts. Torque to 30 ft. lbs.

NOTE: Rotate flywheel to gain access. Refer to figure 71.

7. Attach final drive to engine. Refer to figure 72, install bolt "X" and torque to 105 ft. lbs.
8. Properly position L.H. drive axle and torque NEW attaching bolts to 65 ft. lbs.
9. Install R.H. output shaft into final drive and attach support bolts to engine.

NOTE: When attaching the right hand output shaft to the engine bracket, do not let the shaft hang. Assemble bracket bolts loosely, and by moving the flange end of the shaft up and down, and back and forth, find the center location. Hold the shaft in this position and then torque the bolts to 55 ft. lbs. on support.

10. Position R.H. drive axle and torque NEW attaching bolts to 65 ft. lbs.
11. Connect transmission cooler lines and tighten fittings to 20 ft. lbs. Then connect detent solenoid wire and modulator tube.
12. Connect transmission shift linkage and speedometer cable.
13. Referring to figure 71, install flywheel cover and tighten bolts "A", "B", "C" and "D" to 5 ft. lbs. torque.
14. Install starter, hand start both bolts.

NOTE: Tighten lower bolt first. Then tighten upper bolt. Torque to 30 ft. lbs. Connect wires to starter.

15. Tighten engine front mounting nuts to 50 ft. lbs. torque.
16. Connect power steering lines to the power steering pump.
17. Install fan shroud and torque bolts to 15 ft. lbs.

18. Install engine fan and clutch assembly. Torque nuts to 15 ft. lbs.
19. Connect lower radiator hose. Torque clamp to 17 in. lbs.
20. Connect fuel line to fuel pump.
21. Connect engine oil cooler lines.
22. Connect R.H. and L.H. exhaust pipes. Tighten pipe to exhaust manifold bolts until they bottom on spacer.
23. Lower vehicle and remove engine removal tool J-24603-01.
24. Install generator and braces. See figure 12 for torque values. Refer to "Belt Tension" earlier in this section.
25. Install air conditioning compressor and support struts (figure 13). Refer to "Specifications" at the end of this section for torque values. Refer to "Belt Tension" earlier in this section also.
26. Connect upper radiator hose to engine. Torque clamp to 17 in. lbs.
27. Install engine oil dipstick tube.
28. Install engine oil filler upper tube.
29. Connect engine harness.
30. Connect wire to the brake combination valve.
31. Connect heater hoses.
32. Connect throttle linkage.
33. Connect vacuum hoses to the brake booster and heater controls to the intake manifold. Connect the vacuum hose from the carbon canister to the front of the carburetor.
34. Add engine oil and transmission fluid, as required. Add engine coolant. Refer to "Engine Cooling" (SEC. 6K) in Maintenance Manual X-7525. Also refer to SECTION 7, Maintenance Manual X-7525 for details on "Checking and Adding Transmission Fluid".
35. Connect battery negative (—) ground cables.
36. Check transmission shift linkage. Refer to SECTION 7 in Maintenance Manual X-7525, under "Linkage Adjustment".
37. Adjust all drive belts using tool J-23573 (BT-33-73-F). Refer to "Belt Tension" earlier in this section.
38. Shut engine off. After several minutes check engine oil level. Check also for possible fuel and coolant leaks.

CAUTION: *For step 39, see "Caution" on page one of this section."*

39. Install seat belt plate and anchor bolt assembly.
40. Install air cleaner assembly and engine cover.

OUT-OF-VEHICLE SERVICE OPERATIONS

CAMSHAFT

REMOVAL

1. Remove engine. Refer to "Engine Replacement" earlier in this section.
2. Remove oil pan. Refer to "Oil Pan" earlier in this section.
3. Remove crankshaft pulley and harmonic balancer. Refer to "Crankshaft Pulley" anc "Harmonic Balancer" earlier in this section.
5. Remove both valve covers. Refer to "Valve Covers" earlier in this section.
7. Remove intake manifold and gasket, front and rear seal. Refer to "Intake Manifold" earlier in this section.
8. Remove rocker arms, push rods and valve lifters. Refer to those items earlier in this section for removal.

NOTE: Parts position should be noted so they will be installed in their original location.

9. Remove bolt securing fuel pump eccentric, remove eccentric, camshaft gear, oil slinger and timing chain. Refer to "Timing Chain and Gears" in this section.
10. Remove camshaft by carefully sliding it out the front of the engine.

NOTE: Do not force shaft as damage can occur to camshaft bearings.

INSTALLATION

1. Coat camshaft and bearings liberally with Part No. 1051396 or equivalent before installing. Camshaft gear and crankshaft gear must be aligned as shown in figure 68.
2. Slide camshaft into block.

NOTE: Do not force shaft as damage may occur to camshaft bearings.

3. Install gears, timing chain, eccentric and oil slinger. Refer to "Timing Chain and Gears" earlier in this section.
4. Install valve lifters, push rods and rocker arms. Refer to "Rocker Arm Assemblies" earlier in this section.
5. Install intake manifold and gasket.

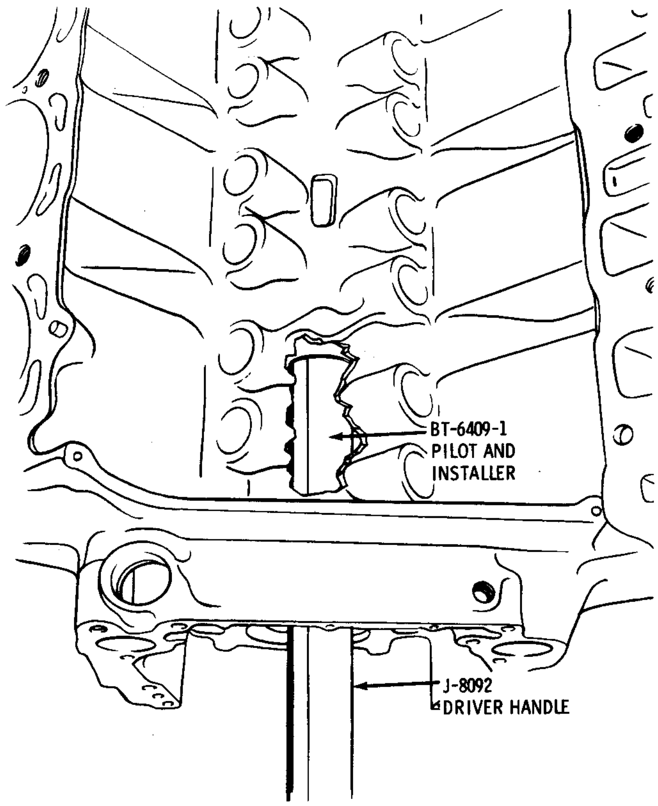


Figure 74—Installing No. 1 Cam Bearing

Refer to "Intake Manifold" earlier in this section. Install belts and adjust. Refer to "Belt Tension" as described earlier in this section.

6. Install distributor as described in SECTION 6Y of this supplement.
7. Install valve covers. Connect spark plug cables.
8. Install front cover. Refer to "Front Cover" earlier in this section.
9. Install crankshaft pulley and harmonic balancer. Refer to "Harmonic Balancer" and "Crankshaft Pulley" earlier in this section.
10. Install oil pan. Refer to "Oil Pan" as described earlier in this section.
11. Install engine. Refer to "Engine Replacement" earlier in this section.

CAMSHAFT BEARINGS

The camshaft bearings must be replaced in complete sets. All bearings must be removed before any can be installed. No. 1 bearing must be removed first, then No. 2, then 3, 4, and 5. When installing the bearings, No. 5 must be installed first, then, 4, 3, 2 and 1.

REMOVAL

1. Remove camshaft as described in "Camshaft" earlier in this section.

NOTE: Each cam bearing is different in diameter and the correct sequence must be used both for removal and installation.

2. Using a cam bearing remover set drive out No. 1 (front cam bearing).
3. Drive out No. 2 bearing. Remove No. 3 and 4 bearings in the same manner.
4. When removing No. 5 bearing drive out rear cup plug, located behind No. 5 camshaft bearing. See Figure 69.

INSTALLATION (FIGURE 74)

NOTE: To aid aligning bearings with oil passages, place each bearing in the front bore with tapered edge toward block and align the oil hole in the bearing with the center of the oil slot in the bore. Mark top of bearing. When installing the bearings the mark will act as a guide.

1. Install new cup plug in rear of No. 5 bearing bore and seal with a permanent type sealer.
2. Drive No. 5 camshaft bearing into place and check oil hole alignment as shown in figure 75.
3. Install remaining bearings in correct sequence. Check all oil hole openings for proper alignment. Wire must enter hole or the bearing will not receive sufficient lubrication.

CAMSHAFT AND OIL GALLERY PLUGS

(Figure 76)

The left hand rear oil gallery plug is not shown. It is a threaded plug in the end of the left gallery just rearward of the distributor. A small hole is provided in the plug for distributor lubrication. The cup plug shown provides access to the threaded plug.

The front oil gallery plugs (not shown) are threaded. The plug on the right side has a small hole which provides lubrication for the timing chain and gears.

To find out if the camshaft plug at the rear of the engine is properly installed: Place a straight edge across the machined surface of the rear of the block and measure from the straight edge to the lip of the plug. Dimension should be .250" maximum to .160" minimum.

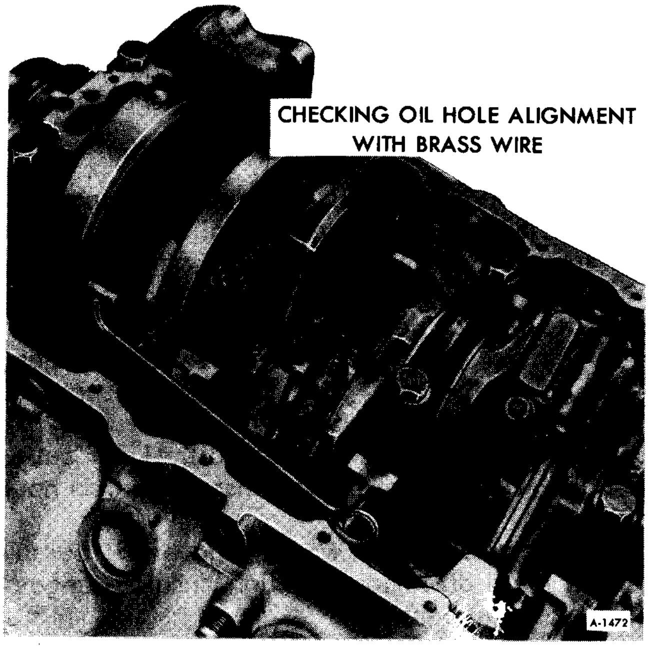


Figure 75—Checking Oil Hole Alignment

CRANKSHAFT (FIGURE 77)

REMOVAL (CYLINDER HEADS ON)

1. With engine on stand oil pan, oil pump and front cover removed, rotate crankshaft to the position where the connecting rod nuts are most accessible. Figure 78 shows No. 3 and No. 4 rods in the fully extended position.
2. Remove main bearing caps.
3. Remove connecting rod caps.
3. Remove connecting rod caps and install thread protectors.
4. Note position of keyway in crankshaft so it can be installed in the same position.
5. Lift crankshaft out of block. Rods will

Figure 76—Camshaft and Oil Gallery Plugs

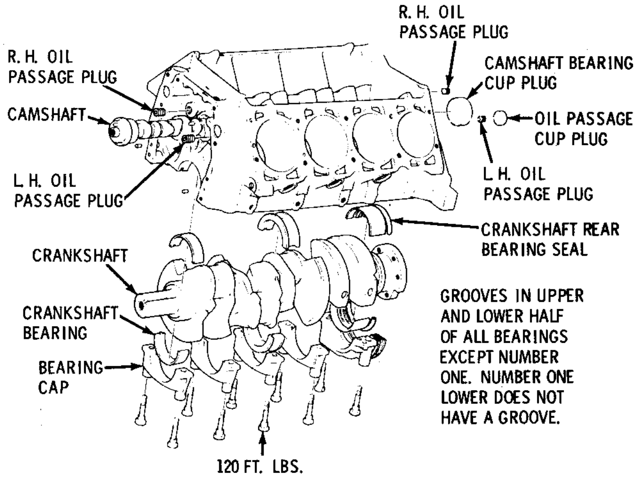


Figure 77—Crankshaft Components

pivot to the center of the engine when the crankshaft is removed.

Do not allow pistons to move in their bore during or after crankshaft removal.

INSTALLATION

1. Install sufficient oil pan bolts in pan rails to align rods with rubber bands as shown in figure 78.

Align rods so that the inner thread protectors of adjacent rods overlap approximately one inch as shown. Alignment can be adjusted by increasing tension on rubber bands with additional turns around the pan bolts or thread protectors.

2. Position crankshaft keyway in the same

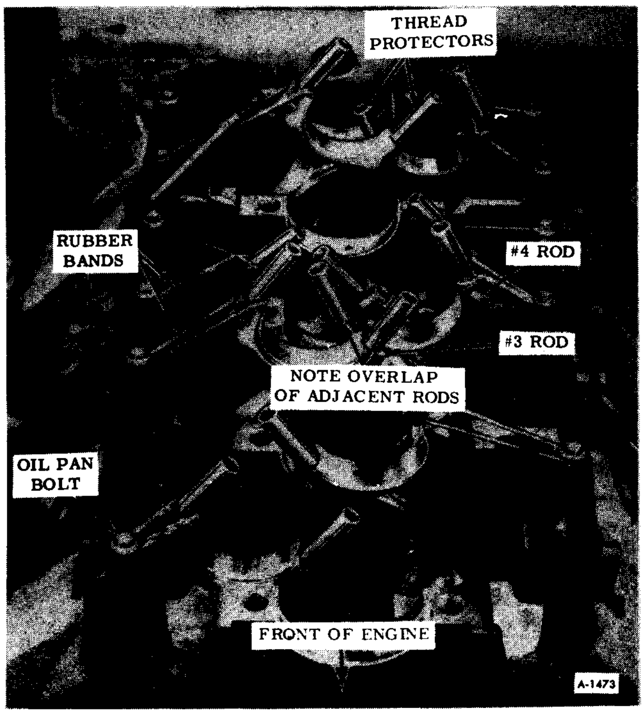


Figure 78—Crankshaft Removal

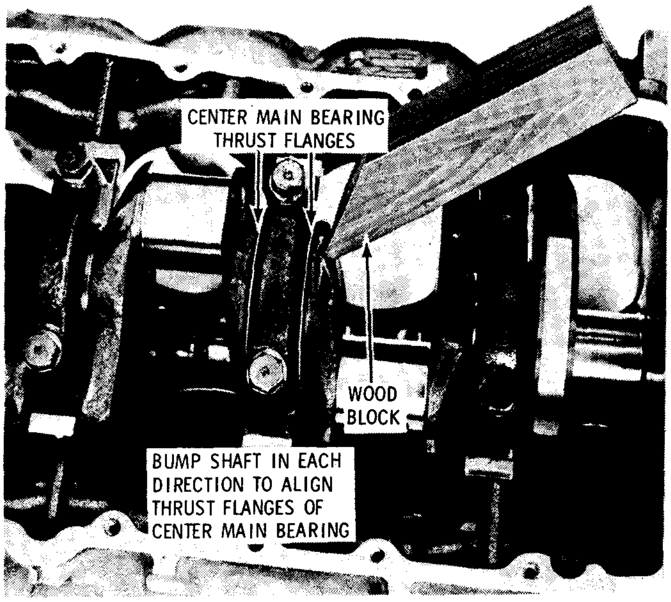


Figure 79—Aligning Center Main Bearing Flanges

position as removed and lower into block. The connecting rods will follow the crank pins into the correct position as the crankshaft is lowered.

3. Remove rubber bands, thread protectors and pans bolts and assemble engine.

REMOVAL (CYLINDER HEADS REMOVED)

1. With engine on stand, remove oil pan, front cover, connecting rods and oil pump.
2. Remove main bearing caps and lift crankshaft out of block.

INSTALLATION

1. Measure the crankshaft journals with a micrometer to determine the correct size rod and main bearings to be used.

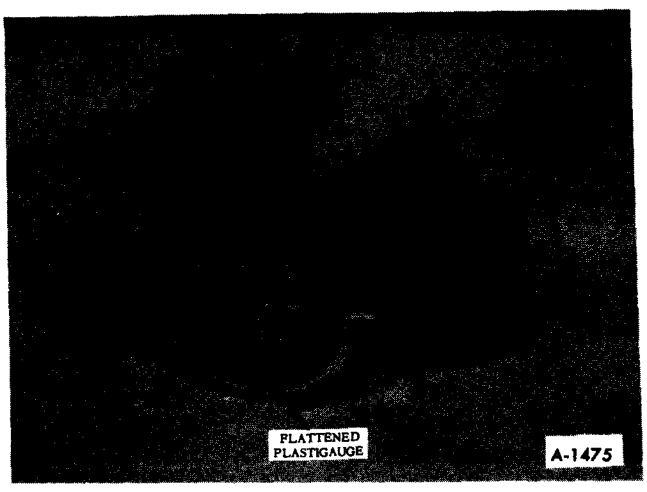


Figure 80—Checking Bearing Clearance

NOTE: Whenever a new or reconditioned crankshaft is installed, new connecting rod bearings and main bearings, should be installed.

2. Position upper half of main bearings in block and lubricate with engine oil.
3. Install a new rear main bearing seal.
4. After oil passages in crankshaft have been checked for being open and shaft is clean, place shaft in block. Lubricate thrust flanges of the center bearing with 1050169 Lubricant or equivalent. Install caps with lower half of bearing lubricated with engine oil. Lubricate cap bolts with engine oil and install, but do not tighten.
5. With a block of wood (figure 79) bump shaft in each direction to align thrust flanges of center main bearing.

NOTE: After bumping shaft in each direction, wedge the shaft to the front and hold it while torquing No. 3 cap bolts.

6. Torque No.'s 1, 2, 3 and 4 main bearing cap bolts to 80 ft. lbs. and No. 5 bolts to 120 ft. lbs.
7. Reassemble engine and install in vehicle.

MAIN BEARINGS

Main bearing clearance must not exceed .0035" on all bearings. The .0035" clearance is permissible only if the engine is disassembled for other than a bearing noise condition. If bearings are noisy or if a visual inspection indicates defective bearings, new bearings must be installed within the specifications outlined under "Main Bearings".

Bearings which fall within the .0035" specifications should not be rejected if the bearings show a normal wear pattern or slight radial grooves, unless they have been established to be defective.

CHECKING BEARING CLEARANCES

1. If not already removed, remove oil pan. Refer to "Oil Pan" earlier in this section.
2. Remove bearing cap and wipe oil from crankshaft journal and outer and inner surfaces of bearing shell.
3. Place a piece of plastic gauging material in the center of bearing.
4. Use a floor jack or other means to hold crankshaft against upper bearing shell. This is necessary to obtain accurate clearance readings when using plastic gauging material.
5. Reinstall bearing cap and bearing. Place engine oil on cap bolts and install.

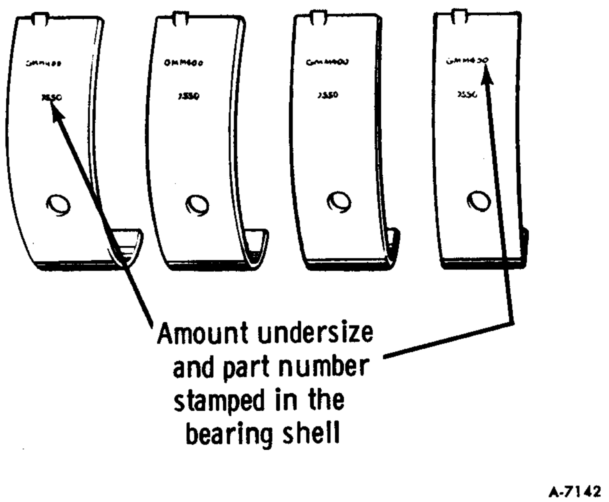


Figure 81—Main Bearing Identification

Torque Nos. 1, 2, 3, and 4 bolts to 80 ft. lbs. and No. 5 bolt to 120 ft. lbs.

6. Remove bearing cap and determine bearing clearance by comparing the width of the flattened plastic gauging material at its widest point with graduation on the plastigauge container. The number within the graduation on the envelope indicates the clearance in thousandths of an inch (figure 80). If this clearance is greater than .0035" REPLACE BOTH BEARING SHELLS AS A SET. Recheck clearance after replacing shells.

NOTE: Main bearing end thrust clearance should be .0035" to .0135" as checked with a dial indicator.

MAIN BEARING REPLACEMENT

Main bearing clearance must be corrected by the use of selective upper and lower shells. UNDER NO CIRCUMSTANCES should the use of shims behind the shells, to compensate for wear, be attempted.

NOTE: The upper and lower shells must be installed in pairs. Sizes of the bearings are located on the tang (figure 81). It is possible to have more than one bearing size in the same engine.

To install main bearing shells, proceed as follows:

1. Loosen all main bearing caps.
2. Remove bearing cap and remove lower shell.
3. Insert a flattened cotter pin or roll out pin (or tool J-8080 if available) in the oil passage hole in the crankshaft, then rotate the crankshaft in the direction opposite to cranking rotation. The pin will contact the upper shell and roll it out.

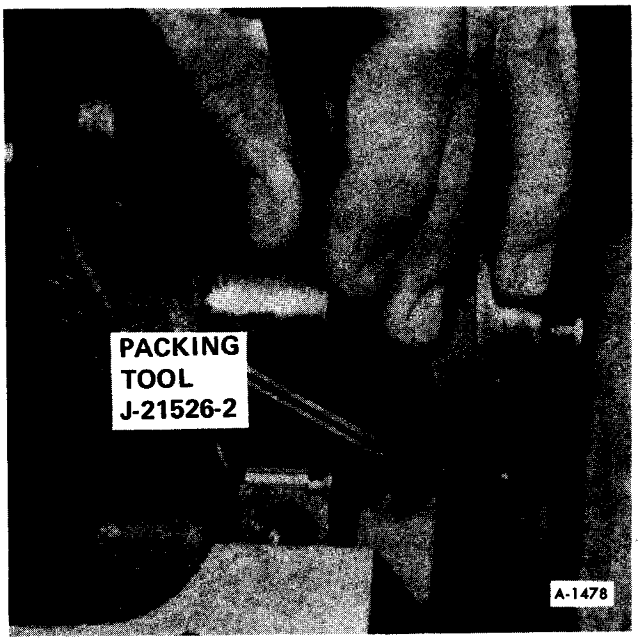


Figure 82—Packing Seal into Cylinder Block

4. The main bearing journals should be checked for roughness and wear. Slight roughness may be removed with a fine grit polishing cloth saturated with engine oil. Burrs may be removed with a fine oil stone. If the journals are scored or ridged, the crankshaft must be replaced.

NOTE: The journals can be measured for out-of-round with the crankshaft installed by using a crankshaft caliper and inside micrometer or a main bearing micrometer. The upper bearing shell must be removed when measuring the crankshaft journals. Maximum out-of-round of the crankshaft journals must not exceed .0015".

4. Clean crankshaft journals and bearing caps thoroughly before installing new main bearings.
5. Apply Special Lubricant, Part No. 1050169 or equivalent to the thrust flanges of bearing shells on No. 3 bearing.
6. Place new upper shell on crankshaft journal with locating tang in correct position and rotate shaft to turn it into place using cotter pin or roll out pins during removal.
7. Place new bearing shell in bearing cap.
8. No. 5 bearing-Install new asbestos oil seal in the rear main bearing cap as described later in this section. Install Part No. 1050805 or equivalent sealer on cap as shown.
9. Install bearing caps, lubricate bolt

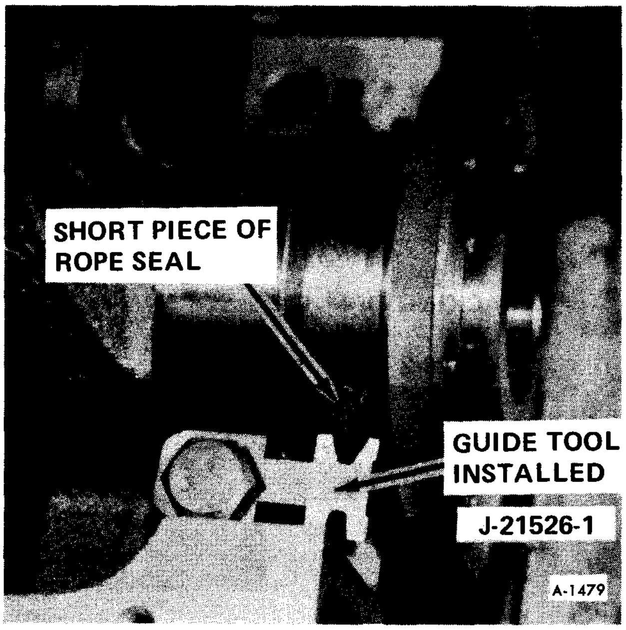


Figure 83—Guide Tool Installed

threads with engine oil, then install. Torque Nos. 1 through 4 to 80 ft. lbs. and No. 5 to 120 ft. lbs.

REAR MAIN BEARING UPPER OIL SEAL

REPAIR

Tool J-21526 is available to provide a means of CORRECTING engine rear main bearing upper seal leaks WITHOUT the necessity of removing the crankshaft. However, replacement of the rear main bearing upper oil seal requires crankshaft removal.

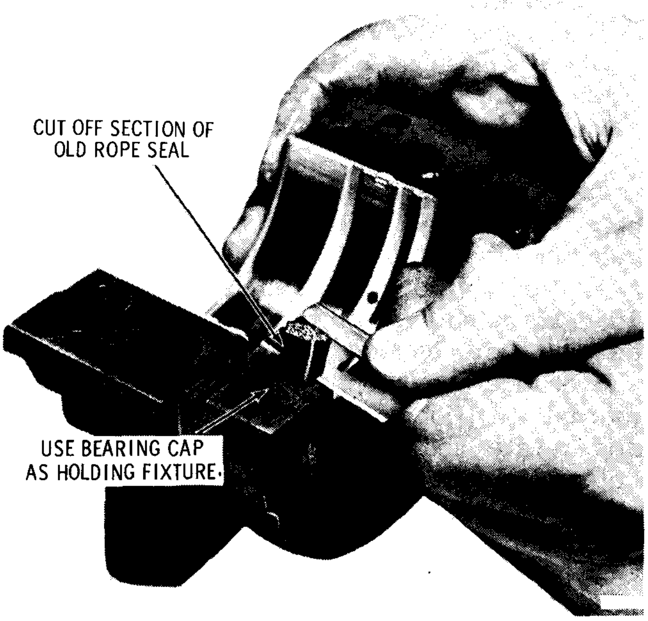


Figure 84—Cutting Off Lower Seal Ends

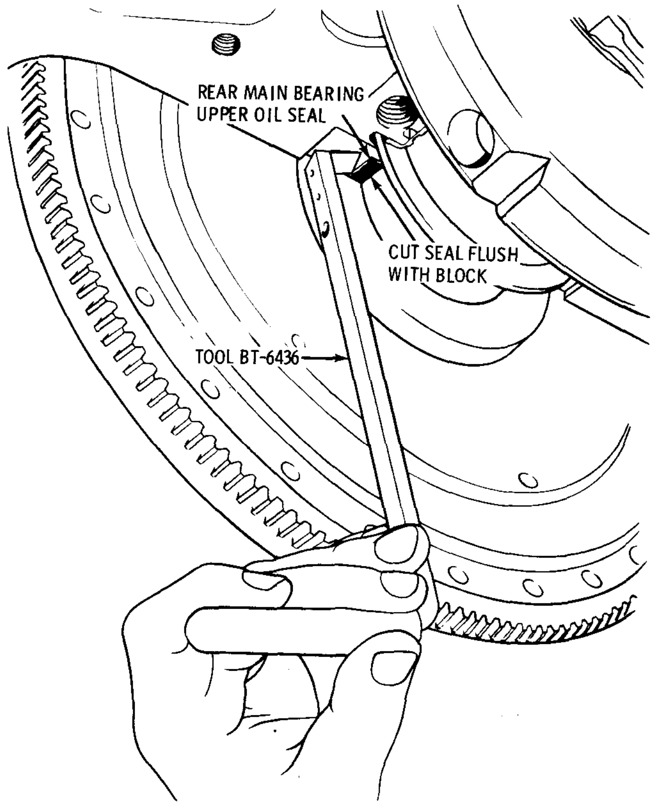


Figure 85—Cutting Off Upper Seal Ends

Listed below is a procedure for seal leak correction.

1. Drain oil and remove oil pan and rear main bearing cap.
2. Insert Packing Tool J-21526-2 against one end of seal in cylinder block and drive the old seal gently into the groove until it is

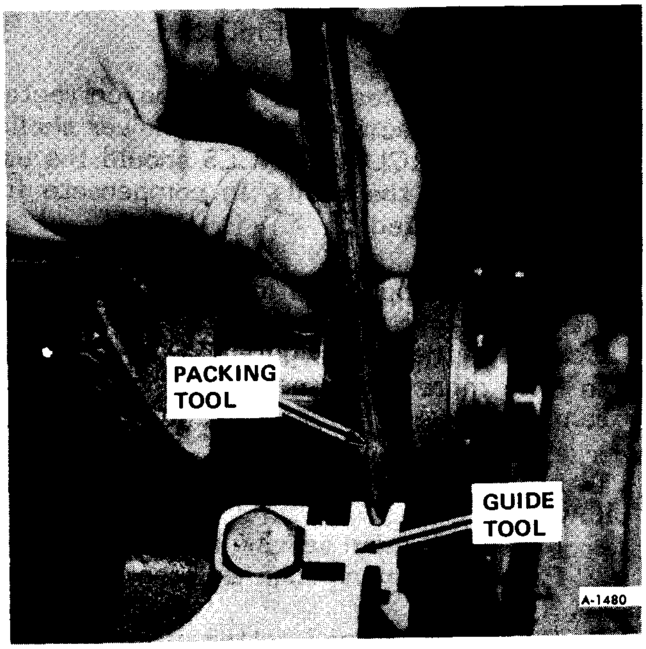


Figure 86—Packing Seal into Guide and Cylinder Block

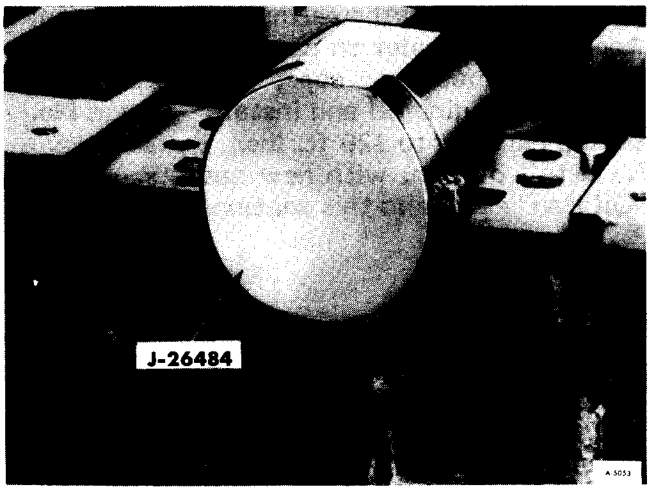


Figure 87—Installing Rear Main Seal - Upper Half

packed tight. Distance varies from 1/4" to 3/4" depending on the amount of pack required. See figures 82 and 83.

3. Repeat this on the other end of the seal in the cylinder block.

4. Measure the amount the seal was driven up on one side; add 1/16", then cut this length from the old seal removed from the main bearing cap with a single edge razor blade. Measure the amount the seal was driven up on the other side. Add 1/16" and cut another length from old seal. Use main bearing cap as a holding fixture when cutting seal as shown in figure 84.

5. Place a drop of Part No. 1050805 Sealer or equivalent, on each end of seal and cap as indicated.

6. Work these two pieces of seal into the cylinder block (one piece on each side) with two small screwdrivers. Use guide tool J-21526-1 as shown in figure 83. Using packing tool, pack these short pieces up into the block. Use a seal trimming tool to trim seal flush with block as shown in figure 85. Refer also to figure 86.

NOTE: Place a piece of shim stock between seal and crankshaft to protect bearing surface before trimming.

7. Form a new rope seal in the rear main bearing cap. Refer to "Rear Main Lower Oil Seal" next in this section.

8. Assemble the cap to the block and torque to specifications.

REPLACEMENT

1. Remove crankshaft. Refer to "Crankshaft" earlier in this section.

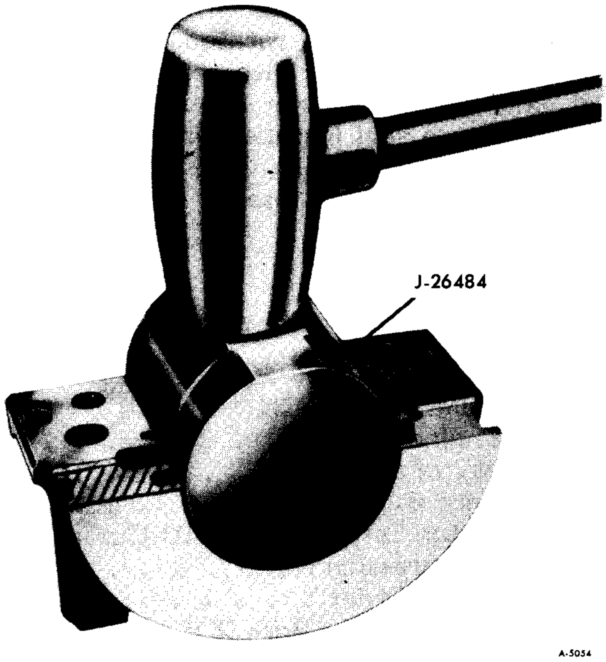


Figure 88—Installing Rear Main Seal - Lower Half

2. Remove upper oil seal.

3. Install a new rear main bearing upper seal. Use tool J-26484 as shown in figure 87.

4. After correctly positioning seal, rotate tool slightly and cut off each end of seal flush with block.

5. Install crankshaft as described earlier in this section under "Crankshaft".

REAR MAIN BEARING OIL SEAL

REMOVAL

1. Remove oil pan. Refer to "Oil Pan" earlier in this section.

2. Remove the rear main bearing cap.

3. Remove rear main bearing insert and old seals.

4. Clean bearing cap and seal grooves and inspect for cracks.

INSTALLATION

1. Install seal into bearing cap, packing by hand.

2. Using seal installer J-26484 hammer seal into groove (figure 88).

NOTE: To check if seal is fully seated in the bearing cap, slide the tool away from the seal. With tool fully seated in the bearing cap, slide tool against the seal. If undercut area of tool slides over the seal is fully seated. If tool butts against the seal, the seal must be driven further into the seal groove. Rotate tool before cutting off excess seal packing.

3. With tool slightly rotated, cut seal flush with mating surface. With screwdriver, pack seal end fibers towards center, away from edges. Rotate seal installer when cutting seal to avoid damage to tool.

4. Clean bearing insert and install in bearing cap.

5. Clean crankshaft bearing journal and seal contact. Install sealer on cap as shown.

6. Install bearing caps, lubricate bolt threads with engine oil and install. Torque No. 5 bearing cap bolt to 120 ft. lbs.

7. Install oil pan, with new gaskets. Refer to "Oil Pan" earlier in this section.

ENGINE SPECIFICATIONS

CYLINDER BLOCK	
Engine Type	90° V-type
No. of Cylinders	8
Bore and Stroke	4.351" X 3.385"
Piston Displacement 403 Cu. In.	
Compression Ratio	8.5:1
Firing Order	1-8-4-3-6-5-7-2
Main Bearing Bore (ID)	2.687" - 2.688"
CRANKSHAFT	
Diameter-Main Bearing Journal	2.4995" - 2.4985" (2,3,4,5)
	2.4998"-2.4988" (1)
Width-Main Bearing Journal (with fillets)	
No. 1	1.185"
No. 2 & 4	1.156" - 1.166"
No. 3	1.1985" - 2.0015"
No. 5	1.882"
Diameter-Connecting Rod Bearing Journal	2.1248" - 2.1238"
Width-Connecting Rod Bearing (with fillets)	1.877" - 1.887"
Length-Overall Crankshaft	26.470"
Diameter - Oil Holes in Crankshaft	1.250"
Clearance - Crankshaft End	.0035" - .0135"
MAIN BEARINGS	
Bearing Clearance - Crankshaft 1,2,3, & 4	.0005" - .0021"
Bearing Clearance (Vertical)	.0015" - .0031"
Width-Bearing Shell	
No. 1,2, and 4	.970" - .980"
No. 3	1.193" - 1.195"
No. 5	1.624"
CONNECTING RODS	
Length-Center to Center	5.998"-6.002"
Diameter-Connecting Rod Bore	2.2495" - 2.2500"
Diameter-Pin Bore	.9789" - .9795"
Bearing Clearance - (Vertical)	.0004" - .0033"
Side Clearance - Big End	.006" - .020"
PISTON	
Diameter Nominal Outside	4.351"
Top of Piston to Center of Pin	1.617"-1.613"
Clearance at Thrust Surface (selective)	.001" - .002"
Weight Less Pin & Rings (all)	700.23 $\pm$ 2 g.
Skirt Taper	.0003" - .0017" Larger at Bottom
Ring Width (2 compression)	.0798" - .0808"
Ring Width (1 oil)	.1881" - .1891"

ENGINE SPECIFICATIONS (CONT'D)

PISTON PINS

Diameter	.9803" - .9807"
Pin to Piston Clearance	.0003" - .0005"
Pin to Rod Fit	.0008" - .0018" Press

PISTON RINGS

No. of Compression Rings (per piston)	2
Width of Compression Rings (top & bottom)	.0780" - .0770"
Gap Clearance Compression Rings	.010" - .023"
Clearance in Groove Compression Rings-Upper	.0020" - .0040"
Clearance in Groove Compression Rings-Lower	.0020" - .0040"
No. of Oil Rings (per piston)	1
Gap Clearance, Oil Ring	.015" - .055"

CAMSHAFT

Bearing Journal Diameters	
No. 1	2.0365" - 2.0357"
No. 2	2.0165" - 2.0157"
No. 3	1.9965" - 1.9957"
No. 4	1.9765" - 1.9757"
No. 5	1.9565" - 1.9557"
Width (including chamfers)	
No. 1	.810"
No. 2, 3 and 4	.741"
No. 5	.788"
Journal Clearance in Bearing (all)	.0020" - .0058"
End Clearance	.011" - .077"
Push Rod - Length	8.265"

VALVE - INTAKE

Diameter Head	2.000" - 1.990"
Diameter - Stem	.3425" - .3432"
Angle - Valve (A^o) See Figure 30	44^o
Angle - Valve Seat (B^o) See Figure 30	45^o
Width - Valve Seat (Cylinder Head)	.037" - .075"
Overall Length	4.667"
Clearance in Guide	.0010" - .0027"
Lash	Hydraulic

VALVE EXHAUST

Diameter - Head	1.497" - 1.507"
Diameter - Stem	.3420" - .3427"
Angle - Valve (A^o) See Figure 30	30^o
Angle - Valve Seat (B^o) See Figure 30	31^o
Width - Valve Seat (Cylinder Head)	.050" - .090"
Overall Length	4.675"
Clearance in Guide	.0015" - .0032"
Lash	Hydraulic

VALVE SPRINGS

Length	1.96"
Diameter - Wire	.192"
Inside Diameter	.1065" - 1.041"
Load	76 - 84 lbs. @ 1.670"
Load @ 1.270"	180 - 194 lbs.

ENGINE SPECIFICATIONS (CONT'D)

VALVE LIFTERS

Diameter - Body*	.8422" - .8427"
Length - Overall	2.000"
Clearance in Boss	.0005" - .0020"

* Also available in .010" Over Size

CAMSHAFT SPROCKET

Width of Sprocket	.420" - .400"
Pitch	.500"
No. of Teeth	36

CRANKSHAFT SPROCKET

Width of Sprocket	.400" - .410"
Overall Width of Gear	.991" - 1.001"
Pitch	.500"
No. of Teeth	18

TIMING CHAIN

Width	Morse-.627, Linkbelt-.720" - .750"
No. of Links	48
Pitch	.500"

FLYWHEEL

No. of Teeth on Starter Gear	166
No. of Teeth on Starter Pinion	9

LUBRICATION SYSTEM

Crankcase Capacity Drain and Refill	5 Qts.
Drain & Refill with Filter Change	6 Qts.
Oil Pump	
Clearance Pressure Relief Valve in Bore	.0025" - .0050"
End Clearance-Gear	.0025" - .0065"

TORQUE SPECIFICATIONS

Specified torque is for installation of parts only. Checking of torque during inspection may be 10% below specification.

APPLICATION	FT. LBS.
FUEL PUMP	
Fuel Pump to Block Bolt and Nut	25
Fuel Pump Eccentric to Camshaft	65
EXHAUST SYSTEM	20
ENGINE	
Crankshaft Bearing Cap Bolts Nos. 1, 2, 3 & 4	80
Crankshaft Bearing No. 5	120
Flywheel to Crankshaft	60
Oil Pump to Bearing Cap Bolts	35
Oil Pump Cover to Pump Bolts	8
Rocker Arm Pivot Bolt to Head	25
Valve Cover Bolts	Fully driven, seated, not stripped
Oil Pan Bolts	10
Oil Pan Drain Plug	30
Crankshaft Balancer or Hub to Crankshaft Bolt	200-310

TORQUE SPECIFICATIONS (CONT'D)

APPLICATION	FT. LBS.
Oil Filter Element to Base	20
Oil Filter Assembly to Cylinder Block Bolts	35
Oil Filter Extension Fitting	55
Support/Front Cover Block	50
Fan Driven Pulley to Hub Bolts	20
Fan Driving Pulley to Balancer Bolts	20
Water Pump to Front Cover Bolts	13
Water Outlet to Manifold Bolts	20
Intake Manifold to Cylinder Head Bolts*	40
Exhaust Manifold to Cylinder Head Bolts	25
Carburetor to Intake Manifold Bolts	10
Choke Tube and Plate to Intake Manifold Bolts	15
Air Cleaner to Carburetor Stud	5
Engine Front Support Cushion Studs	30
Engine Support to Mount	45
Engine Mount to Crossmember Mount	30
Transmission Rear Mount to Crossmember	55
Transmission Rear Mount to Support	50
Starter to Cylinder Block Bolt	35
Starter Brace to Cylinder Block Bolts	25
Starter Brace to Starter	15
Starter Brace to Starter Stud	8
Distributor Clamp to Cylinder Block Bolt	17
Spark Plugs	25
Cylinder Head Bolts*	130
Connecting Rod Nuts	42

* Clean and dip entire bolt in engine oil before tightening to obtain a correct torque reading.

SPECIAL TOOLS

J-5154-01	Timing Cover Oil Seal Installer
J-5892-1	Valve Spring Compressor
J-6647	Piston Ring Compressor (3-7/8")
J-7583-3	Pilot (used with J-8614-01 Harmonic Balancer Remover)
J-8080	Main Bearing Shell Remover
J-21526-1	Rope Seal Repair Guide Tool
J-21526-2	Rope Seal Repair Packing Tool
J-22794	Valve Holder
J-24603-01	Engine Removal Fixture
J-24724	Crankshaft Harmonic Balancer Installer
J-24725	Valve Stem Seal Installer
J-26484	Rear Main Bearing Oil Seal Installer
BT-33-73F (J-23573)	Belt Tension Gauge
BT-6428	Valve Stem Height Gauge

SECTION 6K
ENGINE COOLING

The information described in Maintenance Manual X-7525 under the heading ENGINE COOLING (SEC. 6K) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

COOLING SYSTEM CHECKS

The procedure for checking the cooling system is outlined below. As with all service recommendations, these suggestions should be adjusted to vehicle usage.

DRAIN AND FILL SYSTEM

Always drain system coolant when the engine is hot. This is to hold in suspension fine particles that tend to settle in low places in the block when the engine is not operating. Refer to "Draining, Flushing and Refilling Cooling System" in Section 6K of Maintenance Manual X-7525.

CHECK THE COOLANT

While draining the engine, check the color and the "feel" of the coolant. If it shows an unusual amount of oil sediment or feels slippery, this indicates that engine oil may be leaking into the cooling system. A coating of lube oil on the insides of the coolant passages reduce's the system's efficiency. Engine overheating often results. Besides this, a leak in the cooling system may also permit coolant to flow into the lube oil passages. The contaminated lubricant which results can seriously damage the engine.

If engine oil if found in the coolant, examine the oil cooler core for cracks. Should a pressure check of the core show no leakage, replacement of head-to-block gaskets, coolant and oil seals is indicated. If this fails to solve the problem, the cause may be a damaged cylinder head or block.

PRESSURE CHECK SYSTEM

Pressure check on radiator and system determines ability of system to hold pressure and therefore is an indicator of cooling efficiency.

CHECK THE THERMOSTAT

If the engine operating temperature deviates from the normal range, remove the thermostat and check it. A thermostat which remains closed or only partially open restricts the flow of coolant. This can cause an engine to overheat. Serious damage to engine components may result. A thermostat which is stuck in the wide-open position does not allow the engine to reach its normal operating temperature. The incomplete combustion which results from cold engine operation promotes the build-up of excess carbon deposits on the pistons, rings, and valves. Replace any thermostat found to be defective. Refer to "Thermostat" in Section 6K, Maintenance Manual X-7525.

CHECK HOSES AND BRACKETS

Check the condition of hoses and clamps. Hoses should be pliable but show no signs of "ballooning". Look for cracks, cuts, and kinks - areas of potential leaks. If the lower radiator hose showed signs of collapsing when the engine was accelerated - an indication of weakness - replace it. Replace any hoses which feel unnusually hard or spongy.

Inspect hose brackets, supports, ties, and clamps to make sure they are secure, unbroken, and retain hoses properly. Retighten brackets and clamps as needed. Replace any components which are found to be split or badly corroded, broken, or deteriorated.

CHECK THE DRIVE BELTS

For efficient warm-weather operation, check the condition of the fan and water pump drive belts. Look especially for worn or frayed areas and for cracking and splitting on the underside of the belts. Worn belts can fail at any time and should be replaced.

Check the tension on serviceable belts and adjust as needed. Avoid over - or under-tightening fan and pulley belts. Remember - overtightening can lead to early belt and bearing failure. Undertightening results in slippage which can lead to belt and pulley "glazing", inefficient fan and water pump operation, and engine overheating. When replacing belts, don't guess at the tension required. Use belt tension gauge BT33-73F and adjust to correct tension. Refer to "Belt Tension" later in this section.

FAN AND FAN CLUTCH

Vehicles equipped with a 403 cubic inch engine have a heavy duty fan clutch and a revised replacement procedure for fan and clutch (see below). The fan has a full shroud to replace the partial shroud and venturi rings used with the 455 cubic inch engine. For 1977 model vehicles equipped with 455 cubic inch engines, refer to Section 6K, Maintenance Manual X-7525 for fan and fan clutch replacement procedure.

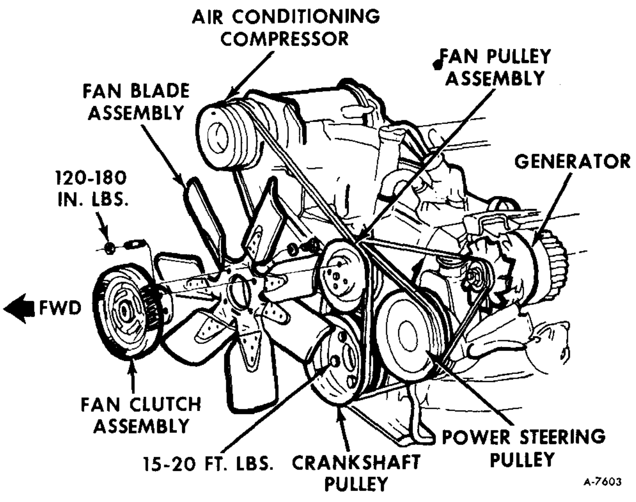


Figure 1—Fan and Drive Belts

REMOVAL

1. Raise vehicle.
2. Remove the four nuts attaching fan clutch to water pump hub (see figure 1).
3. With assembly in the shroud area and removed from the hub, remove the four attaching bolts that secure fan clutch.
4. Remove fan and fan clutch after they are separated from each other.

WARNING: IF A FAN BLADE IS BENT OR DAMAGED IN ANY WAY, NO ATTEMPT SHOULD BE MADE TO REPAIR AND REUSE THE DAMAGED PART. A BENT OR DAMAGED FAN ASSEMBLY SHOULD ALWAYS BE REPLACED WITH A NEW FAN ASSEMBLY. IT IS ESSENTIAL THAT FAN ASSEMBLIES REMAIN IN PROPER BALANCE AND PROPER BALANCE CANNOT BE ASSURED ONCE A FAN ASSEMBLY HAS BEEN BENT OR DAMAGED. A FAN ASSEMBLY THAT IS NOT IN PROPER BALANCE COULD FAIL AND FLY APART DURING SUBSEQUENT USE CREATING AN EXTREMELY DANGEROUS CONDITION.

INSTALLATION

1. Install fan and fan clutch separately into the area in the shroud between the water pump and the radiator. Be careful not to damage the radiator core.

2. Install four attaching bolts that secure the fan to the fan clutch and torque to 15-20 ft. lbs. (See figure 1).

3. Position the assembly over the water pump hub studs and torque the attaching nuts to 15-20 ft. lbs.

4. Lower vehicle.

WATER PUMP

1977 and 1978 vehicles equipped with a 403 cubic inch engine have a new water pump replacement procedure.

REMOVAL

1. Drain radiator. Disconnect bypass and remove heater hose from water pump. Loosen all pulley belts.

2. Raise vehicle. Disconnect lower radiator hose from water pump.

3. Remove four nuts attaching fan clutch to water pump hub. (See figure 1.) Position fan and fan clutch assembly forward in the shroud. Be careful not to allow the assembly to damage the radiator core.

4. Remove water pump pulley.

5. Disconnect the power steering pump.

6. Remove water pump attaching bolts. Remove water pump.

7. Clean engine block of old gasket at sealing surfaces.

INSTALLATION

1. Apply a thin coat of Part No. 1050026 Sealer or equivalent to the water pump housing to retain the new gasket, then position on the housing.

2. Install the pump assembly. Coat all bolts with engine oil and torque the self-tapping bolts to 13 ft. lbs. and torque the others to 25 ft. lbs.

3. Connect the power steering pump bracket. Torque nut to 22 ft. lbs.

4. Install water pump pulley. Reposition all belts.

5. Install fan and fan clutch assembly. Torque four nuts to 15-20 ft. lbs. See figure 1.

6. Connect lower radiator hose to water pump.

7. Lower vehicle.

8. Secure clamp on bypass hose and install heater hose to water pump.

9. Tension all belts. Refer to "Belt Tension" later in this section.

10. Refill radiator. If new coolant is used refer to Section 0, Maintenance Manual X-7525.

BELT TENSION

To carry their full load, drive belts must grip the entire area of contact with the pulley. When operated in a loose condition, belts can slip, tear, burn or grab and snap. More belts fail from undertightening than from overtightening.

When operated in too tight a condition, belts can damage the engine by causing side loading on the crankshaft, crankshaft bearings, and accessories or accessory bearings. Excessive tension will also stretch and weaken belts.

DO NOT use belt dressings to extend belt life. Most dressings contain chemicals which tend to soften belts. This softening process will increase the friction between the belt and pulley grooves; however, this is only temporary.

NOTE: After a belt has been in operation one hour or approximately 50 miles, it is considered used. A "used" belt should be tightened to 70 to 80 pounds. A new belt or belt that has never been tensioned before should be tightened to 110 to 140 pounds. All belt tension checks must be taken midway on the greatest span of that belt. When drive belts are worn they should be replaced, as excessive tightening will not prevent slippage and can cause damage to bearings.

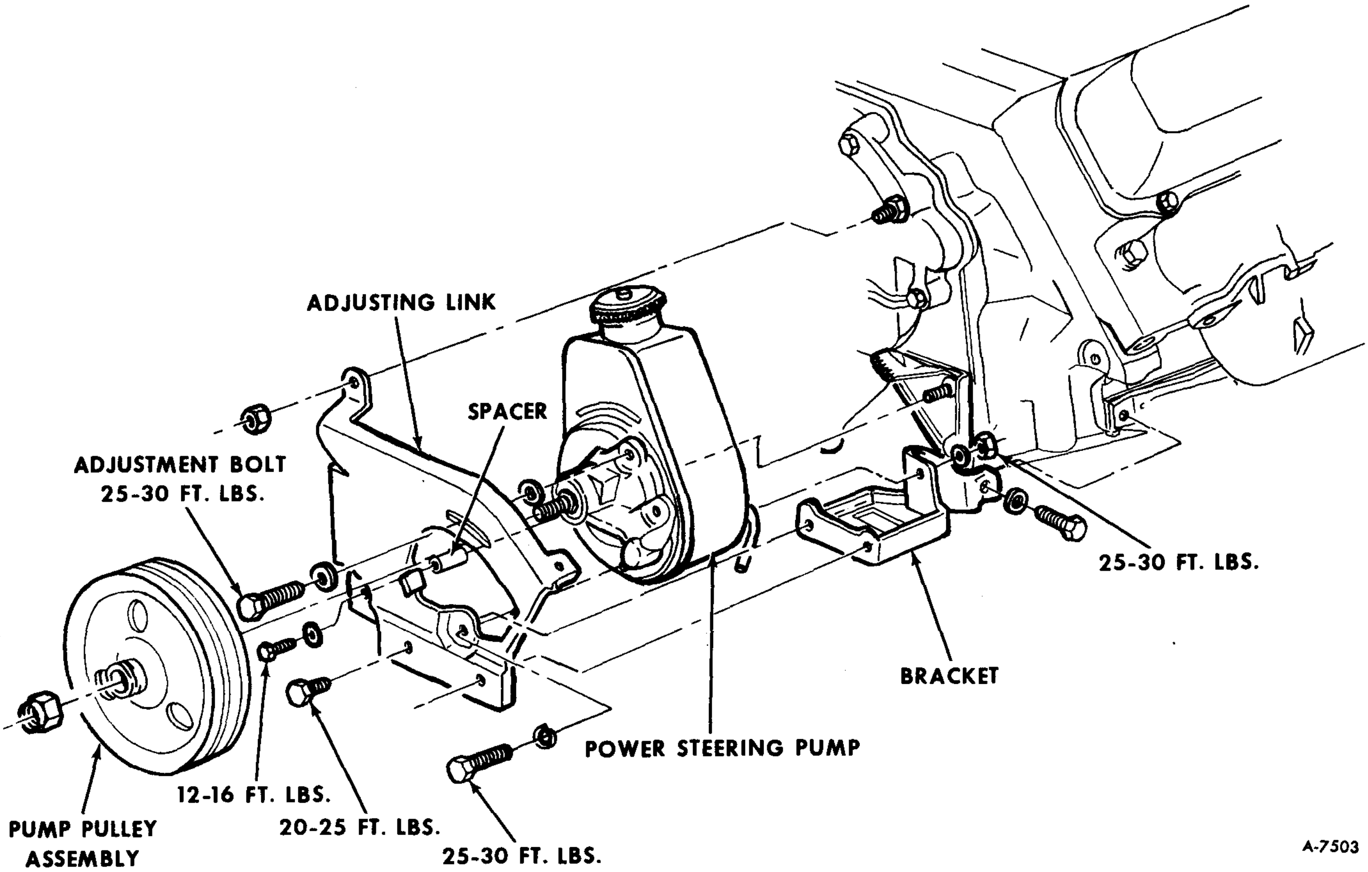


Figure 2—Power Steering Pump Mounting

All vehicles MUST have power steering belt checked and adjusted, if necessary, first. Then check and adjust (as required) the generator and air conditioning compressor belts. Use Belt Tension Gauge J-23573 (Burroughs Tool-BT-33-73F). If the belt tension on any belt is incorrect, proceed to adjust tension as outlined below.

ADJUSTING BELT TENSION

POWER STEERING PUMP BELT
(FIGURE 2)

When adjusting a power steering pump belt, never pry against the pump reservoir or pull against the filler neck. To increase belt tension move the pump outward by prying against the bracket pry lugs, or against the pump housing casting extension directly behind the pump drive pulley. Also, power steering hoses should not be damaged or twisted during belt tensioning procedure.

1. Loosen the power steering pump attaching bolts and adjust the pump drive belt to correct tension with belt tension gauge by moving the pump outward, away from the engine.
2. Tighten all mounting bolts until snug, then remove pry bar.
3. Tighten mounting bolts to specified torque (figure 2).
4. Check belt tension and remove belt tension gauge.

GENERATOR AND AIR
CONDITIONING COMPRESSOR BELTS

To adjust generator or air conditioning compressor belts:

1. Loosen bolts at support bracket.
2. Move generator or air conditioning compressor away from engine to increase belt tension.
3. Tighten mounting bolts to specified torque (figures 3 and 4).
4. Check belt tension and remove belt tension gauge.

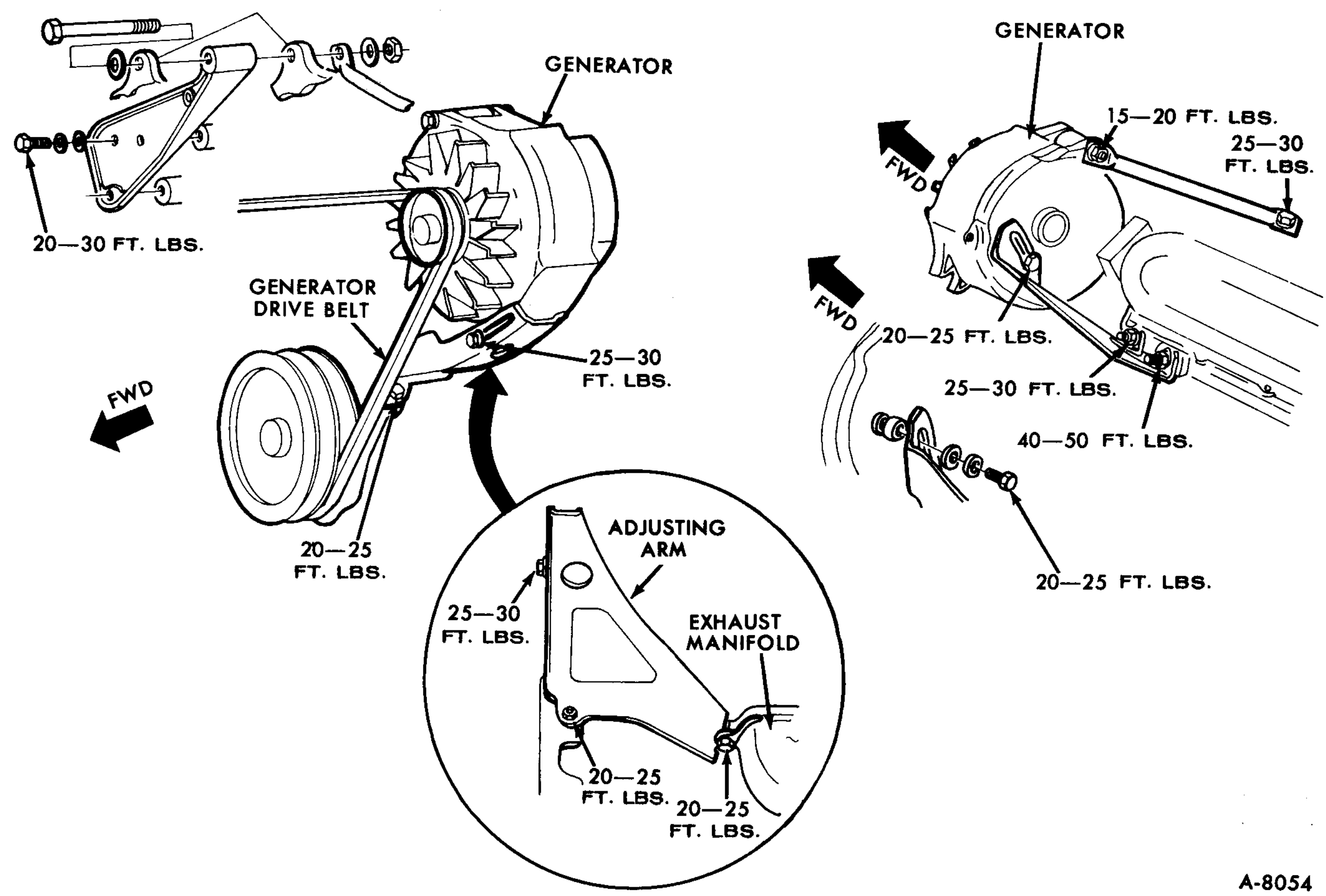


Figure 3—Generator Mounting

BELT REPLACEMENT

POWER STEERING PUMP BELT

Removal

1. Loosen generator attaching bolts. Loosen air conditioning compressor bolts and remove generator and air conditioning compressor belts (see below).
2. Remove power steering pump belt.

Installation

1. Install belts.
2. Adjust belt tension, tighten bolts to specified torque (figure 2).
3. Check pump fluid level, add fluid as necessary.

GENERATOR BELT

Removal

1. Loosen bolts at generator adjusting arm and loosen pivot bolt at generator support bracket.
2. Move generator toward engine until belt can be removed from pulley.

Installation

1. To install new belt, position belt on pulley and move generator away from engine until required tension is measured.
2. Tighten generator adjusting arm bolts and pivot bolt to specified torque (figure 3).

AIR CONDITIONING COMPRESSOR BELT

Removal and installation of air conditioning compressor belt is accomplished in the same manner as described above. Refer also to figure 4 for view of compressor mounting and for torque specifications.

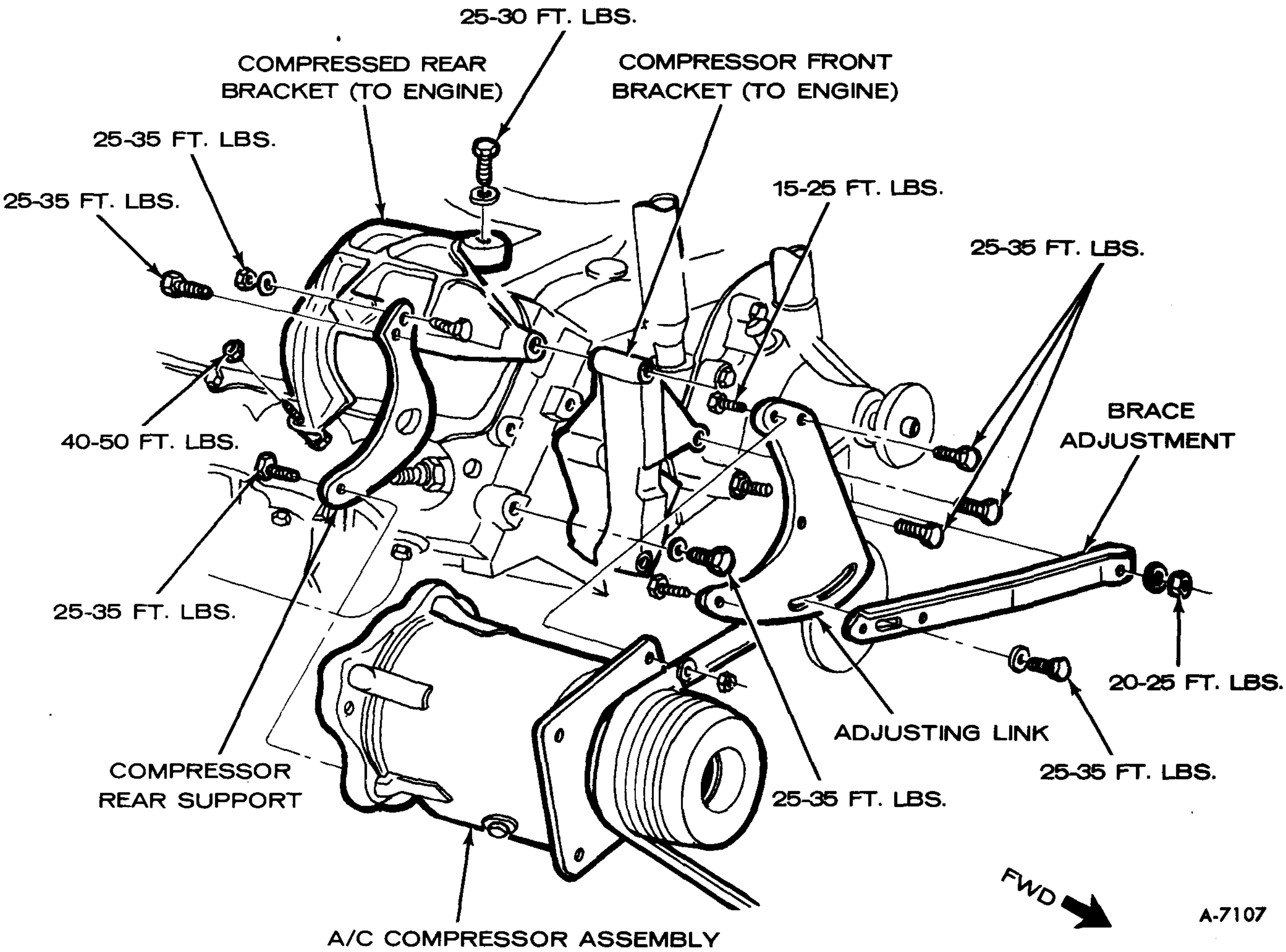


Figure 4—Air Conditioning Compressor Mounting

SPECIAL TOOLS

J-23573. . . . . Belt Tension Gauge

SECTION 6M
ENGINE FUEL SYSTEM

The information described in Maintenance Manual X-7525 under the heading ENGINE FUEL SYSTEM (SEC. 6M) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

CARBURETOR

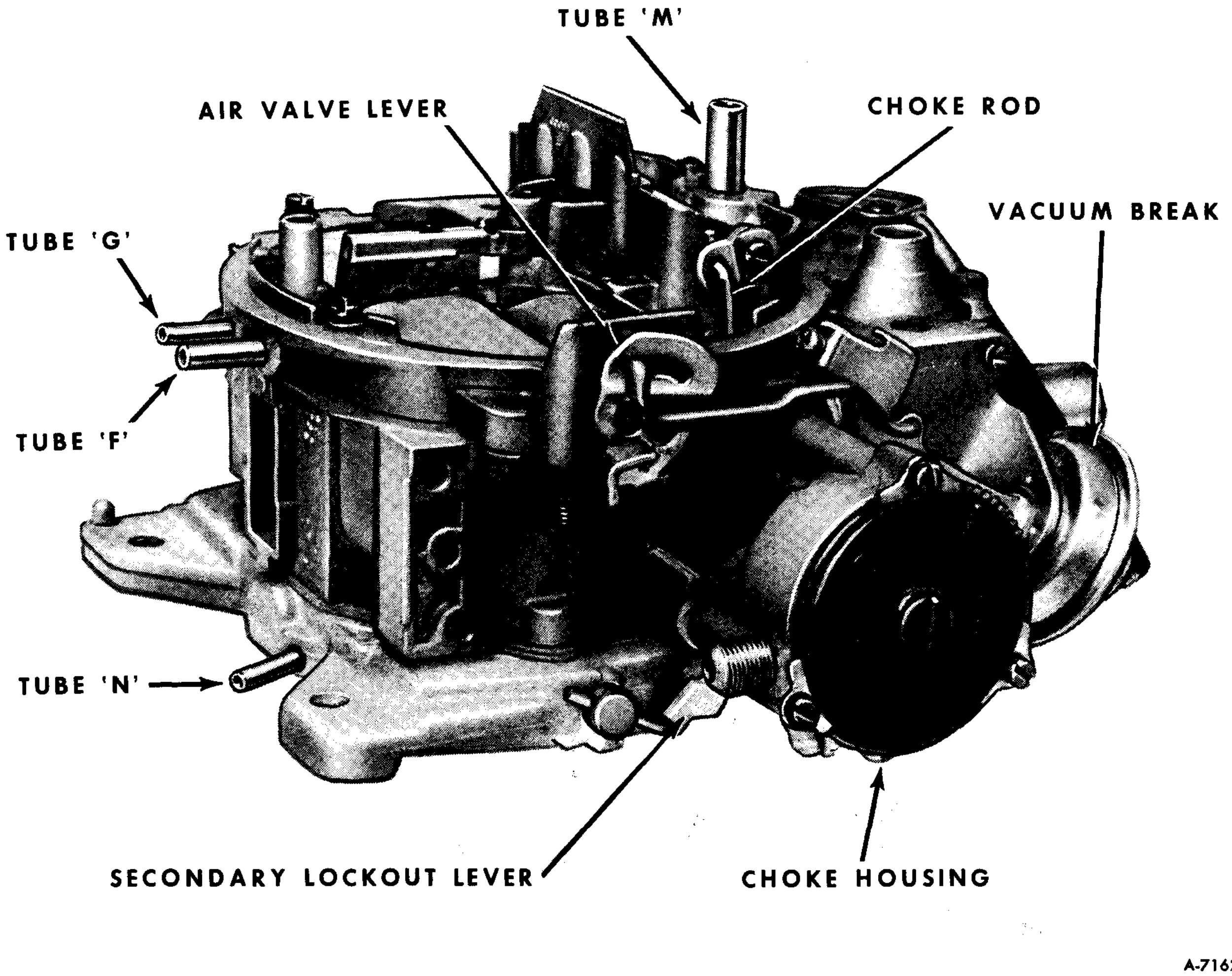


Figure 1—M4MC Carburetor (Side View)

GENERAL DESCRIPTION

The M4MC model carburetor (figure 1 and 2) used on the 403 cubic inch engine is a two stage carburetor of downdraft design. The triple venturi system is used on the primary side of the carburetor with 1-3/8" throttle valve bores.

NOTE: For carburetor service information on the 1977 Certified 455 cubic inch engine, refer to SECTION 6M of Maintenance Manual X-7525. Procedures are the same as those described for the carburetor on the 1976 certified engine.

The secondary side has two large bores (2-1/2"). Using the air valve principle in the secondary side, fuel is metered in direct proportion to the air passing through the secondary bores.

A baffle is used on the secondary side of the air horn, above the main well bleed tubes, to deflect incoming air for good secondary nozzle performance on heavy acceleration.

For ease of serviceability, alphabetical code letters are included in the air horn, float bowl, and throttle body at external tube locations to identify air and vacuum hose routings (figures 1 and 2).

Code letters for figures 1 and 2 tube identification are:

AIR HORN
- A—Vacuum Hose to Vacuum Break
- M—Vent Tube for Float Bowl
- F—Clean Air Hose to Choke Hot Air Pipe
- G—Vent Hose to Vacuum Delay Valve

FLOAT BOWL
- B—Hose to TVS Switch and Solenoid Valve
- H—Hose to TVS Switch
- T—Hose to carbon Canister (1978 California Carburetor, ONLY)

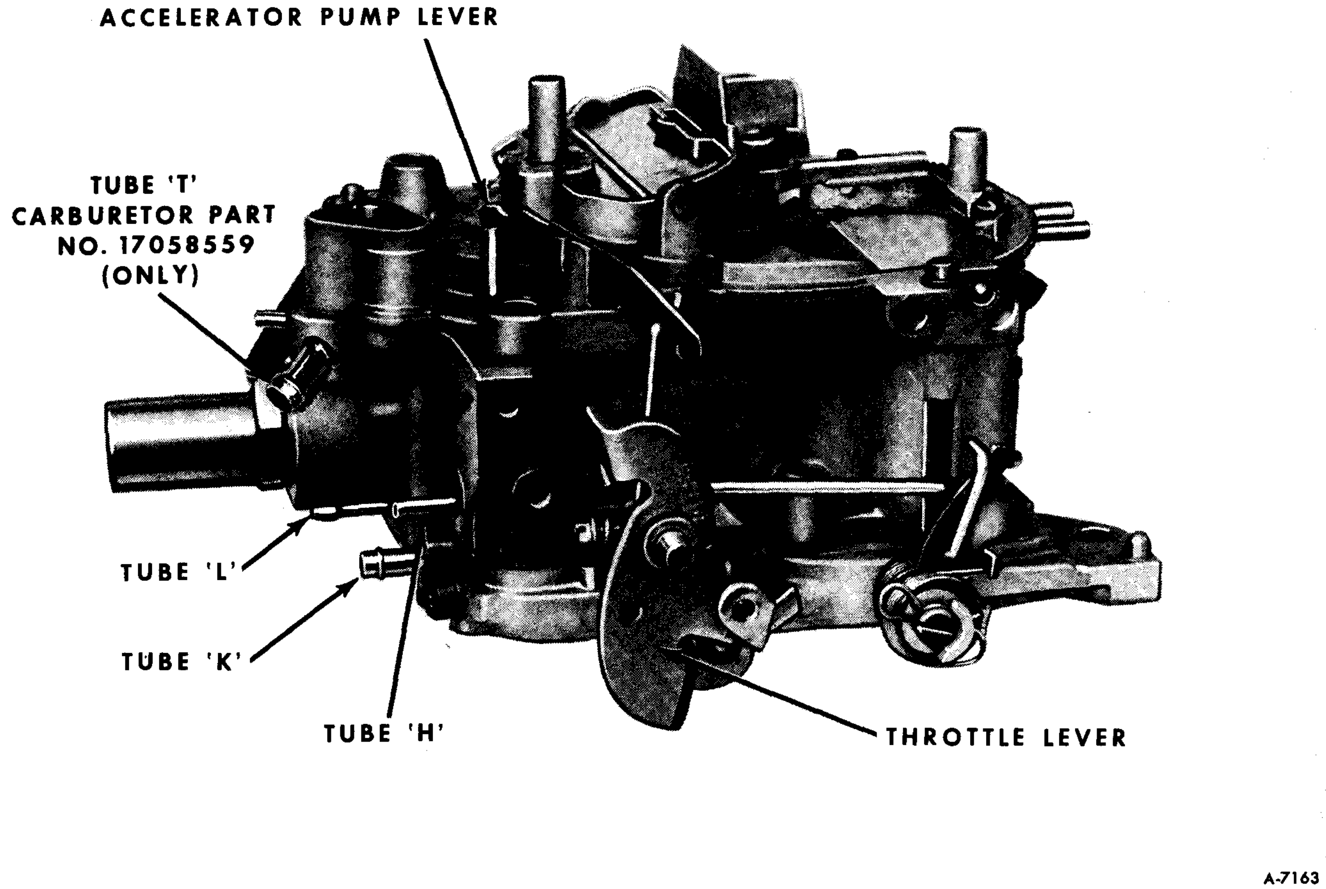


Figure 2—M4MC Carburetor (Side View)

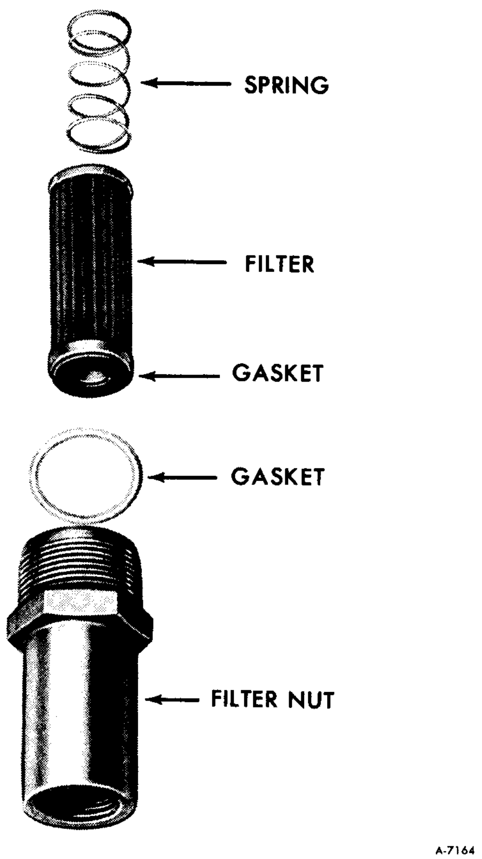


Figure 3—Fuel Filter

THROTTLE BODY
N—Hose to Air Cleaner
L—PCV Valve to Throttle Body
K—Carbon Canister Purge Hose

The float assembly is used with a windowless type needle seat for good fuel handling in the float bowl. Also, a plastic filler block is used above the float chamber to reduce fuel slosh in this area. A 2" pleated paper fuel inlet filter is used for maximum filtration of incoming fuel (figure 3).

The main metering system uses separate main wells to feed each fuel nozzle for improved fuel flow in the venturi system.

In order to provide a close tolerance adjustment in the main metering system, an adjustment screw is provided in a well next to the main power piston to very accurately set the depth of the metering rods in the main metering jets.

CAUTION: *No attempt should be made to change the APT adjustment. If float bowl replacement is required the new bowl assembly will include an adjustment screw pre-set by the factory.*

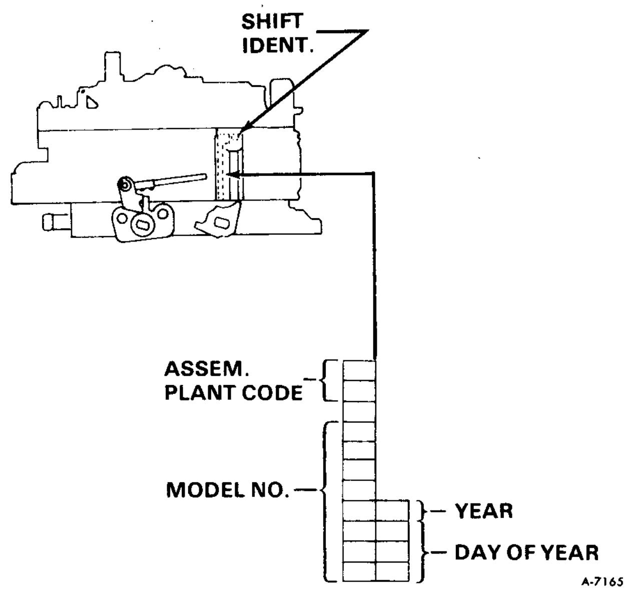


Figure 4—Carburetor Identification

An expander (garter) spring beneath the plunger cup on the accelerator pump assembly improves pump fuel delivery.

All models use the bowl mounted hot air choke housing with thermostatic control assembly. A single (front) vacuum break assembly is used.

The choke shaft and certain other parts of the choke system are Teflon coated to insure smooth choke operation.

The carburetor part number is stamped on a vertical section of the float bowl, near the secondary throttle lever. Refer to part number on the bowl when servicing the carburetor (figure 4).

The primary side of the carburetor has six systems of operation. They are float, idle, main metering, power, pump, and choke (figures 5 thru 10). The secondary side has one metering system which supplements the primary main metering system and receives fuel from a common float chamber.

CARBURETOR REPLACEMENT

REMOVAL

1. Raise engine cover to gain access to carburetor (allow engine cover to lean against instrument panel).
2. Remove air cleaner.
3. Disconnect fuel inlet line from carburetor fuel filter.
4. Disconnect vacuum hoses.
5. Disconnect throttle cable. Disconnect cruise control linkage (if so equipped).

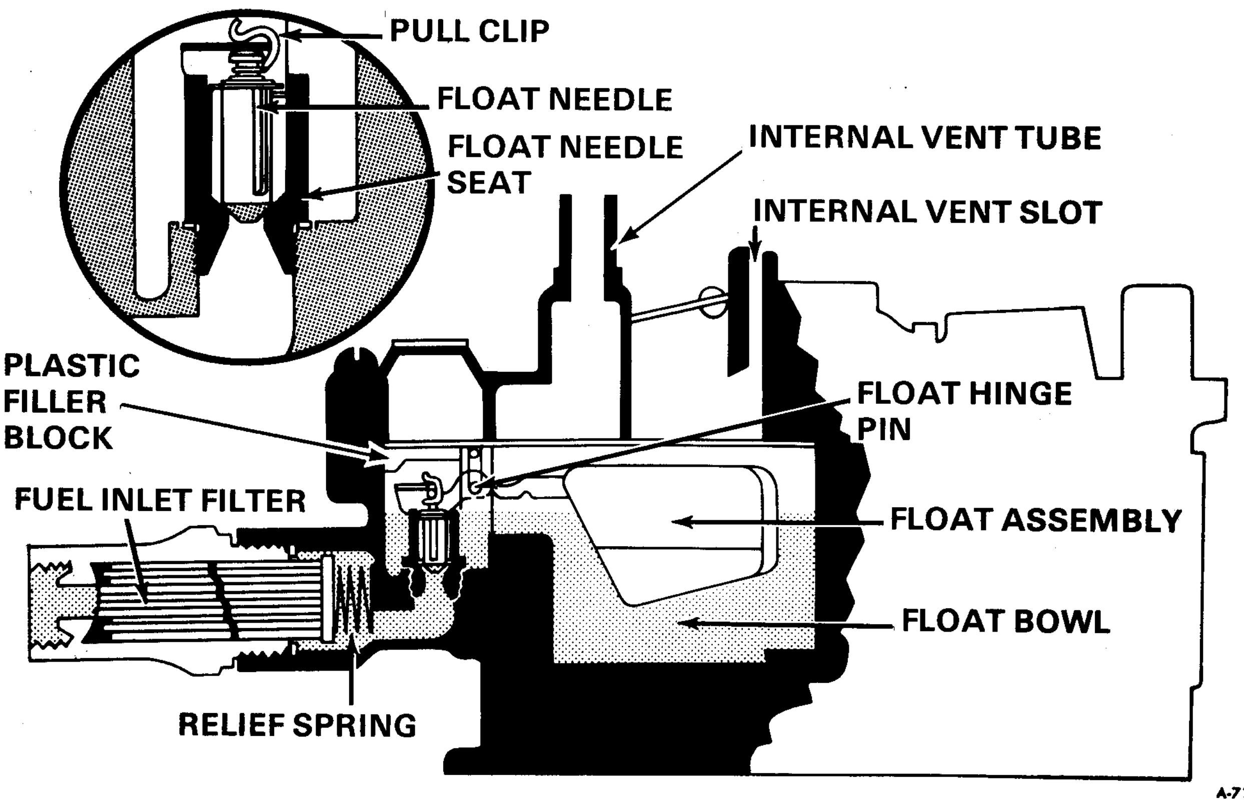


Figure 5—Float System

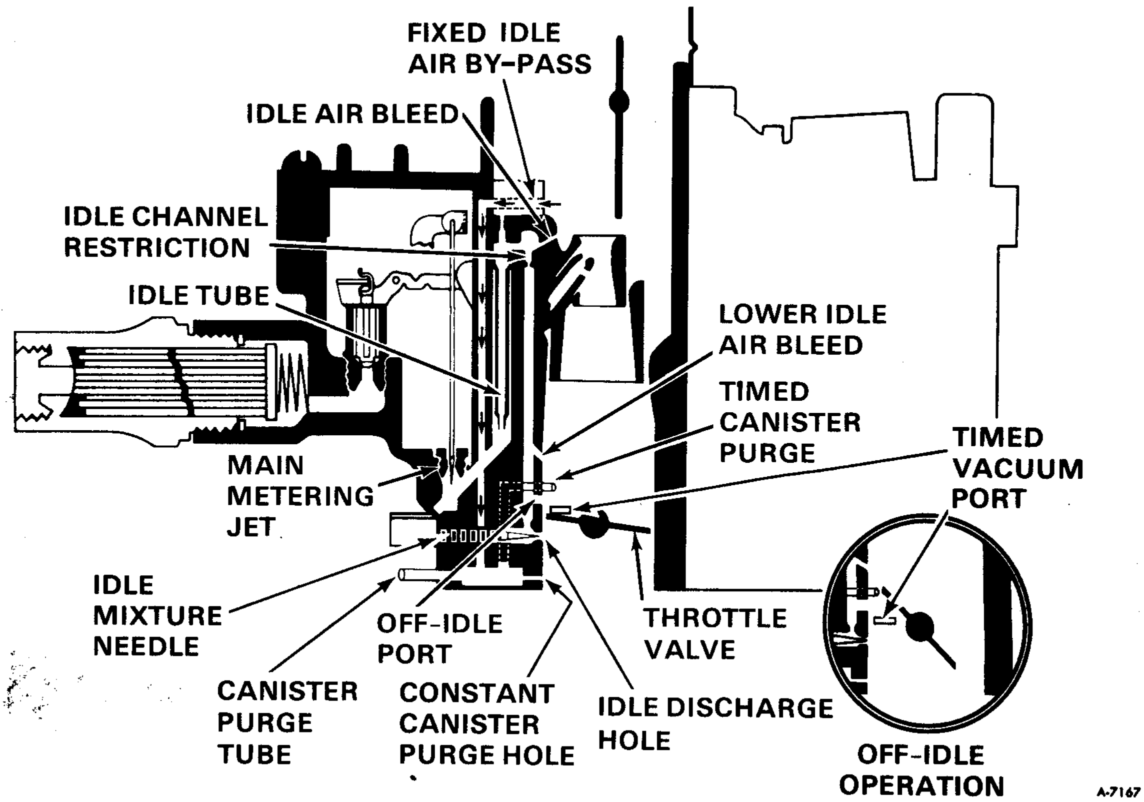


Figure 6—Idle System

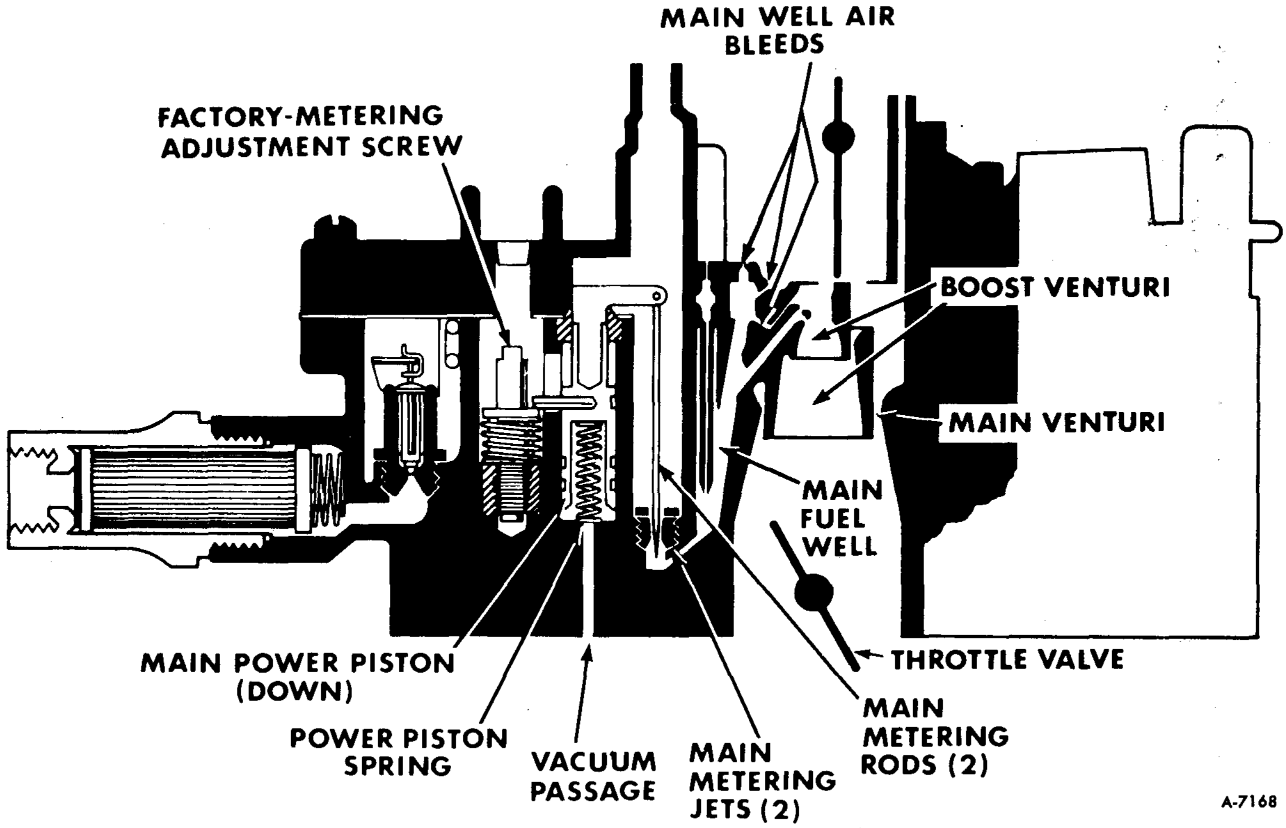


Figure 7—Main Metering System

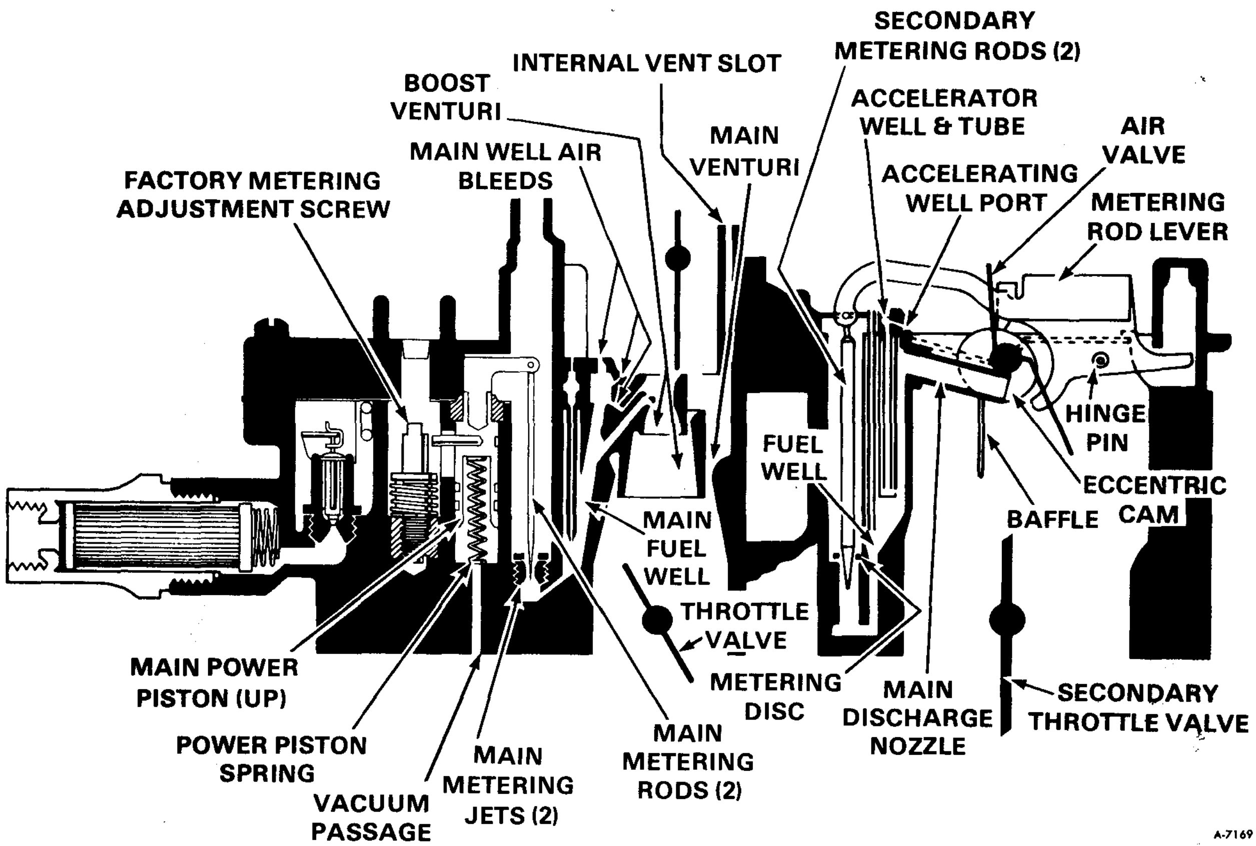


Figure 8—Power System

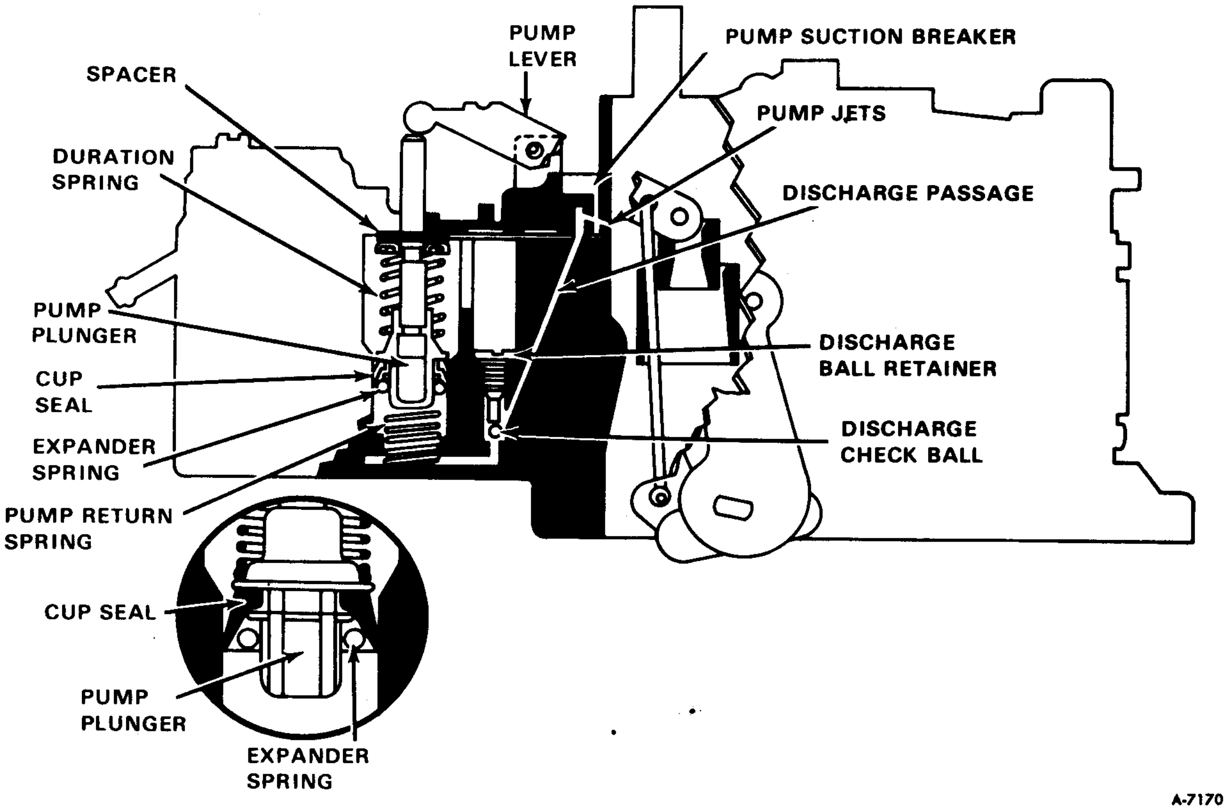


Figure 9—Pump System

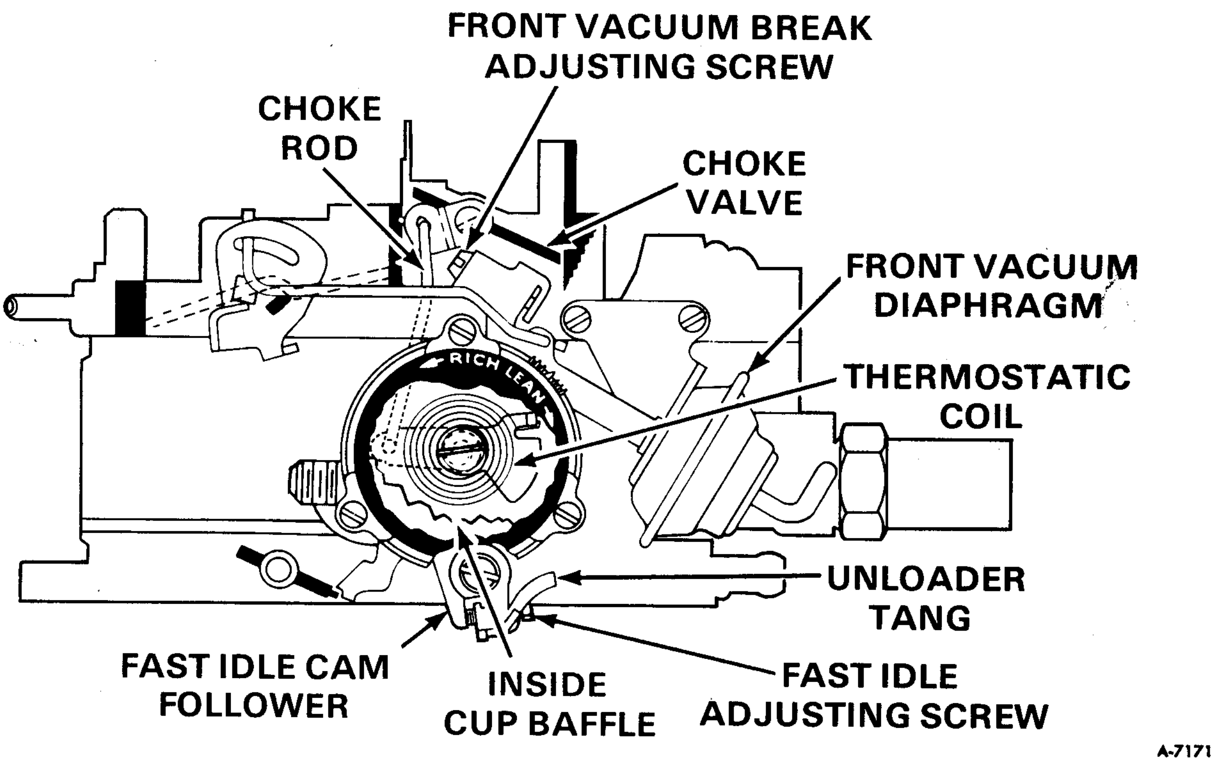


Figure 10—Choke System

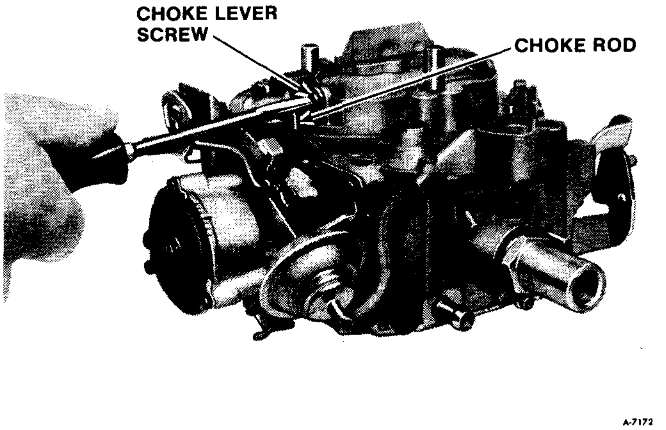


Figure 11—Removing Upper Choke Lever

6. Remove air cleaner stud.
7. Disconnect choke housing pipe.
8. Remove four carburetor to manifold attaching bolts.
9. Remove carburetor.

INSTALLATION

1. Install a new carburetor to manifold gasket.
2. Install carburetor. Tighten the four attaching bolts to 120 in. lbs. using the following tightening sequence:
   a. Left Rear Bolt.
   b. Right Front Bolt.
   c. Right Rear Bolt.
   d. Left Front Bolt.
3. Connect choke housing pipe.
4. Install air cleaner stud.
5. Connect throttle cable. Connect cruise control linkage if removed.
6. Connect vacuum lines.

NOTE: To aid in connecting vacuum hoses to the proper port on the carburetor, refer to "General Information" earlier in this section for explanation of carburetor vacuum port codes. Also, refer to Sections 6T and 8 of this supplement for vacuum hose routing diagrams.

CARBURETOR DISASSEMBLY

NOTE: Before performing any service on the carburetor, it is essential that the carburetor be placed on a holding fixture such as tool J-9789-118. Without the use of the holding fixture, it is possible to bend or nick the throttle valves.

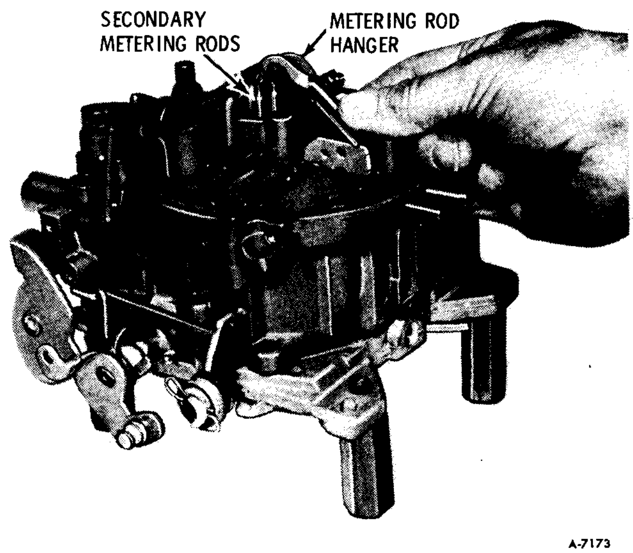


Figure 12—Removing Secondary Metering Rods

AIR HORN REMOVAL

1. Remove upper choke lever from the end of the choke shaft by removing retaining screw (figure 11). Then rotate upper choke lever to remove choke rod from slot in lever.
2. Remove choke rod from lower lever inside the float bowl casting.

NOTE: Remove choke rod by holding lower lever outward with small screwdriver.

3. Remove secondary metering rods by removing the small screw in the top of the metering rod hanger. Lift until the secondary metering rods are completely out of the air horn. Metering rods may be disassembled from the hanger by rotating ends out of the holes in the end of the hanger (figure 12).

4. With small drift, drive roll pin (pump lever pivot pin) inward just enough until pump lever can be removed from air horn. Then remove pump lever from pump rod (figure 13). Note location of rod if in inner or outer hole in pump lever.

CAUTION: *Use care in removing small roll pin to prevent damage to pump lever casting bosses in air horn.*

5. Remove nine air horn to bowl attaching screws; two attaching screws are located next to the venturi. (Two long screws, five short screws, and two countersunk screws, figure 14.) Remove air baffle deflector from beneath the two center air horn screws.

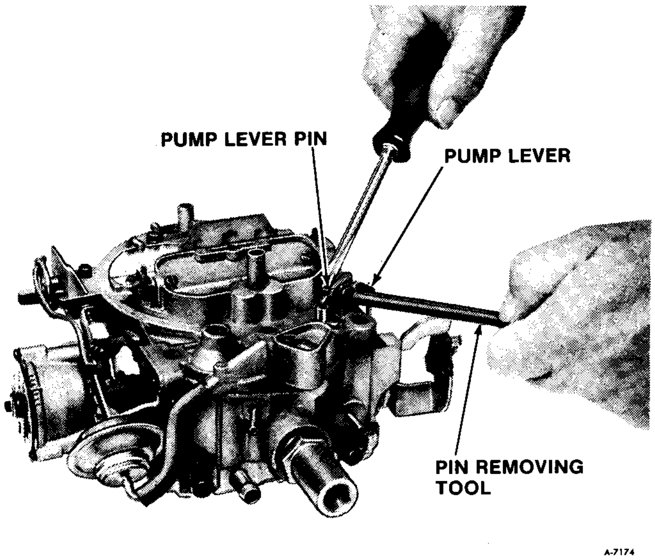


Figure 13—Removing Pump Lever

6. Remove air horn from float bowl by lifting straight up. The air horn gasket should remain on the float bowl for removal later (figure 15).

CAUTION: *When removing air horn from float bowl, use care to prevent bending the small tubes protruding from the air horn. These tubes are permanently pressed into the air horn casting. DO NOT REMOVE.*

AIR HORN DISASSEMBLY

Remove front vacuum break bracket attaching screws. The vacuum break assembly may now be removed from the air valve dashpot rod and the dashpot rod from the air valve lever (figure 16).

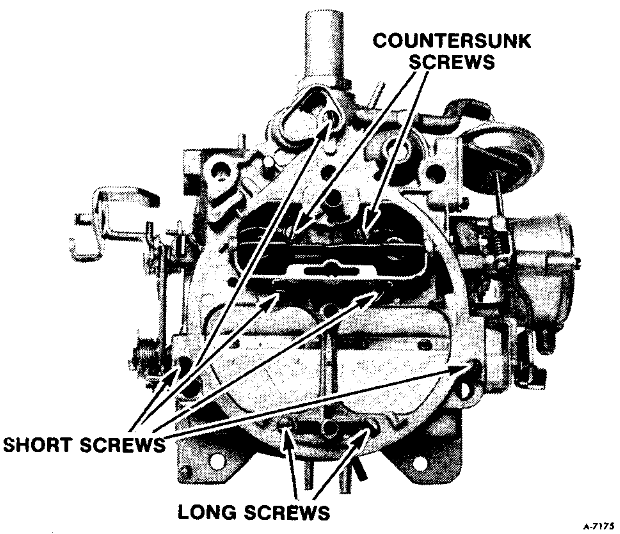


Figure 14—Removing Air Horn Screws

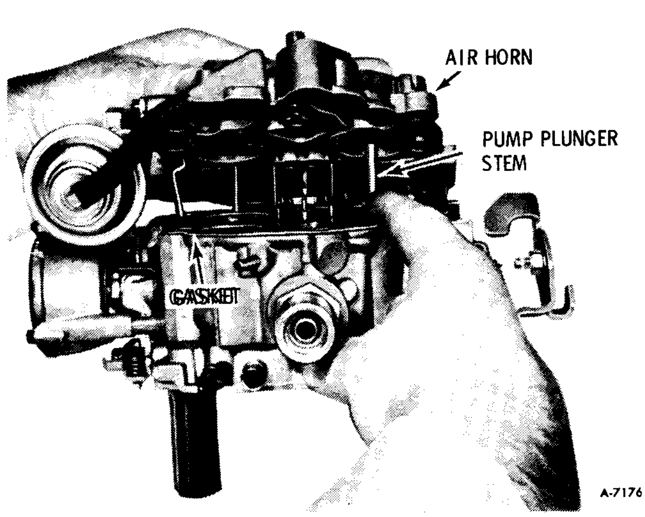


Figure 15—Removing Air Horn

CAUTION: Do not place vacuum break assembly in carburetor cleaner.

Further disassembly of the air horn is not required for cleaning purposes. If part replacement is required, proceed as follows:

Remove staking on two choke valve attaching screws, then remove choke valve and shaft from air horn.

NOTE: Air valves and air valve shaft should not be removed. However, if it is necessary to replace the air valve closing spring or center plastic eccentric cam, a repair kit is available. Instructions for assembly are included in the repair kit.

FLOAT BOWL DISASSEMBLY (FIGURE 17)

1. Remove air horn gasket by lifting out of dowel locating pins and lifting tab of gasket from beneath the power piston hanger, being

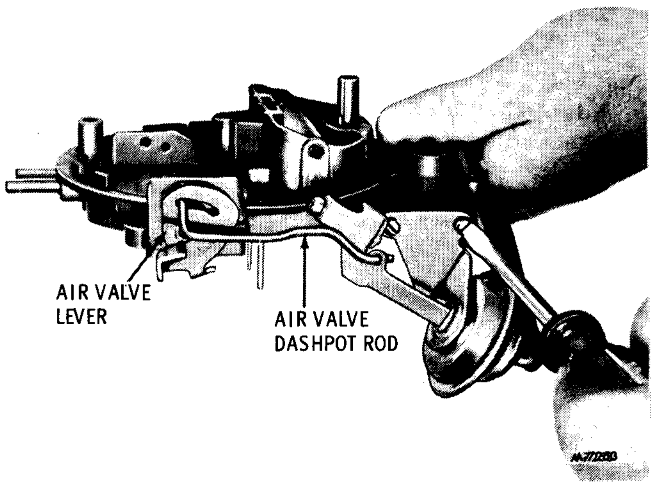


Figure 16—Removing Front Vacuum Break

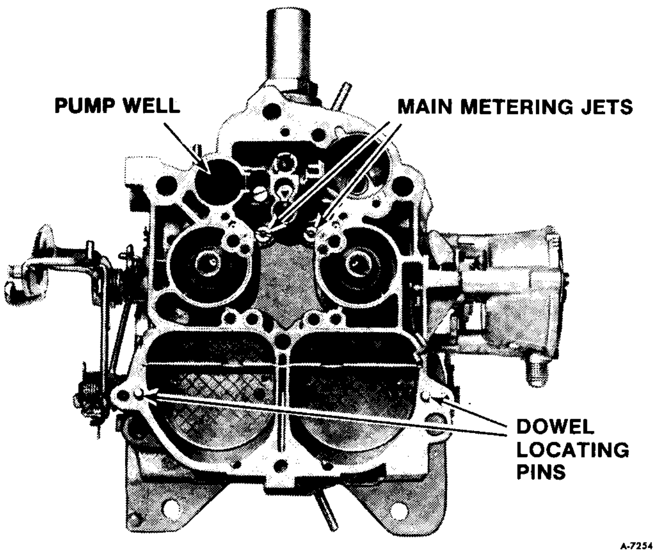


Figure 17—Float Bowl

careful not to distort springs holding the main metering rods.

2. Remove pump plunger from pump well.
3. Remove pump return spring from pump well.
4. Remove power piston and metering rods by depressing piston stem and allowing it to snap free.

The power piston can be easily removed by pressing the piston down and releasing it with a snap. This will cause the power piston spring to snap the piston up against the retainer. This procedure may have to be repeated several times.

CAUTION: *Do not remove power piston by using pliers on metering rod hanger.*

5. Remove the power piston spring from the well.

CAUTION: *The A.P.T. metering rod adjustment screw is pre-set at the factory and no attempt should be made to change this adjustment in the field. If float bowl replacement is required during service, the new bowl assembly will be supplied with an A.P.T. metering rod screw which will be pre-set as required at the factory.*

6. Remove metering rods from power piston by disconnecting tension spring from top of each rod. Then rotate rod to remove from hanger (figure 18).

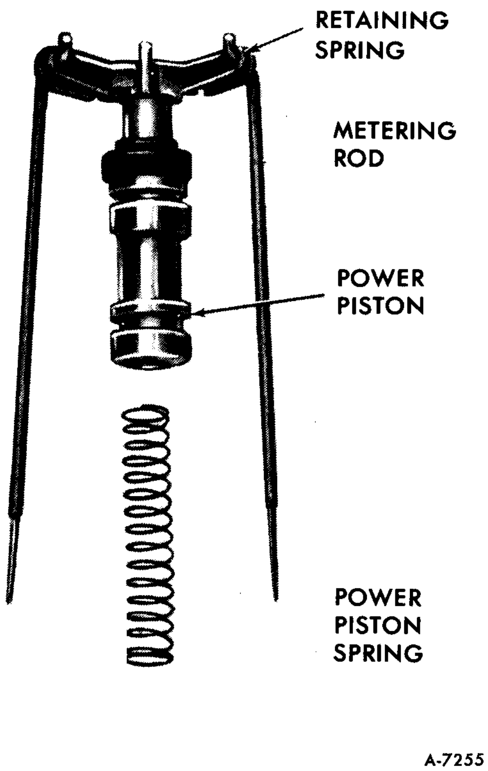


Figure 18—Power Piston and Metering Rods

CAUTION: *Use care when disassembling rods to prevent distortion of tension spring and/or metering rods. Note carefully the position of tension spring to aid later during assembly.*

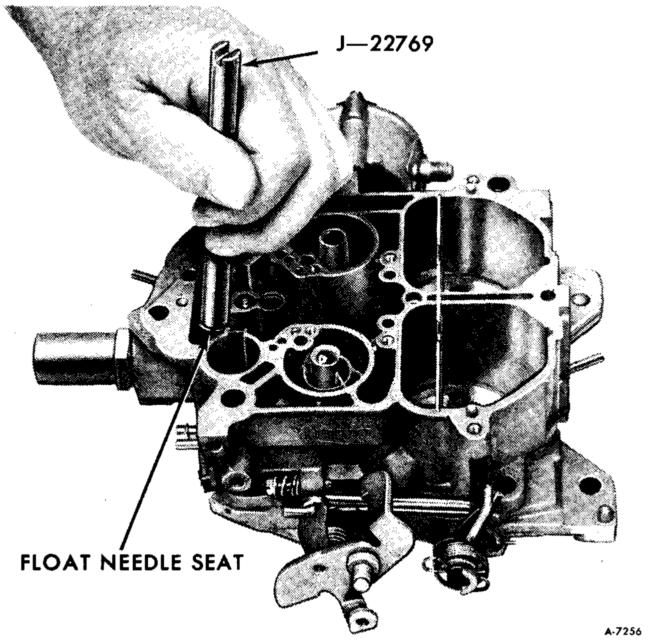


Figure 19—Removing Float Needle Seat

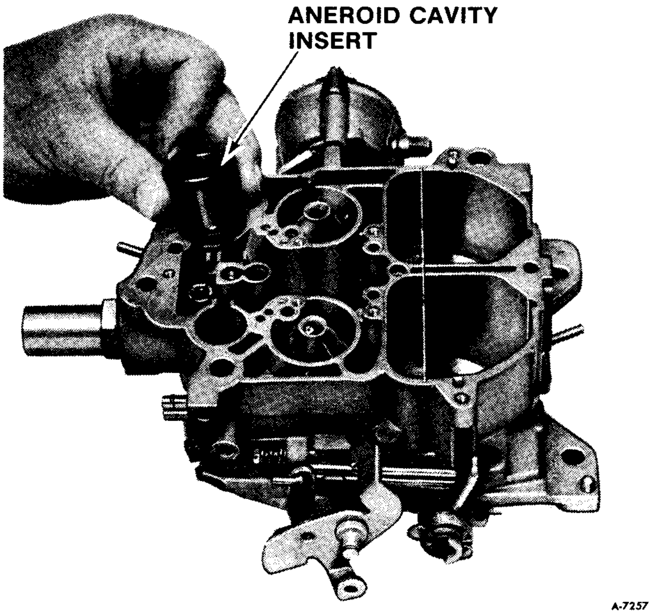


Figure 20—Removing Aneroid Cavity Insert

7. Remove plastic filler block over float valve.
8. Remove float assembly and float needle by pulling needle seat and gasket using seat remover tool J-22769 (figure 19).
9. Remove aneroid cavity insert from float bowl (figure 20).
10. Remove primary metering jets, only if necessary (figure 21).

NOTE: No attempt should be made to remove the secondary metering jets (metering orifice plates). The jets are fixed and, if damaged, bowl replacement is required.

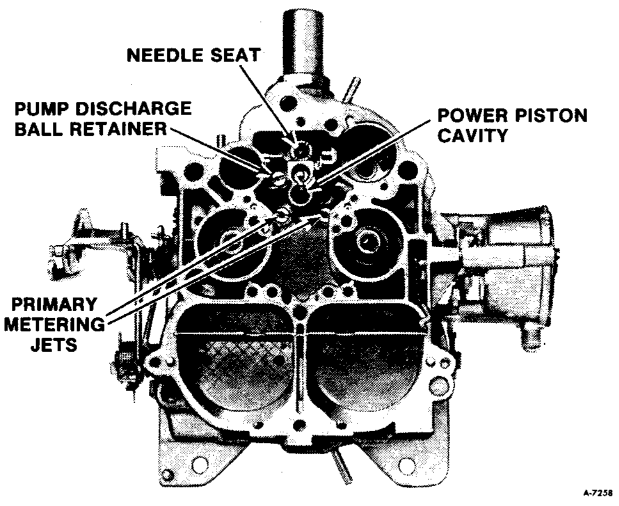


Figure 21—Primary Metering Jets

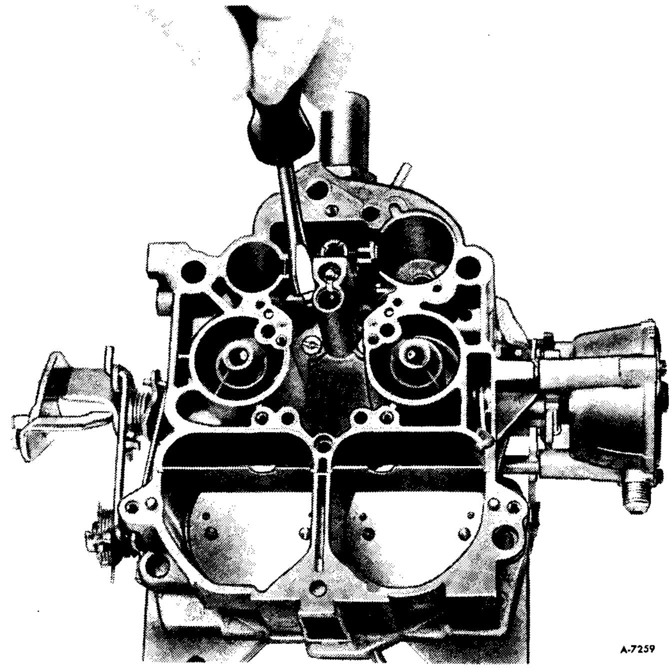


Figure 22—Removing Pump Discharge Ball Retainer and Check Ball

11. Remove pump discharge ball retainer and check ball (figure 22).
12. Remove secondary air baffle, if replacement is required.
13. Remove pump well fill slot baffle.

CHOKE DISASSEMBLY

1. Remove three attaching screws and retainers from choke cover and coil assembly. Then pull straight outward and remove choke cover and coil assembly from choke housing. Remove choke cover gasket.

NOTE: Do not remove baffle plate from beneath the thermostatic coil. Distortion of the thermostatic coil may result if forced off the center retaining post on the choke cover.

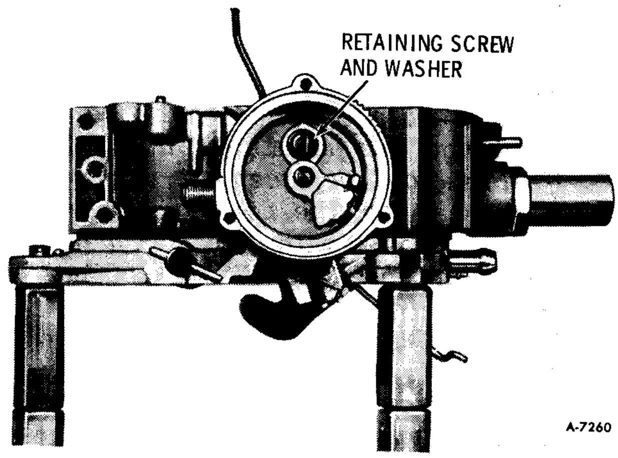


Figure 23—Choke Housing

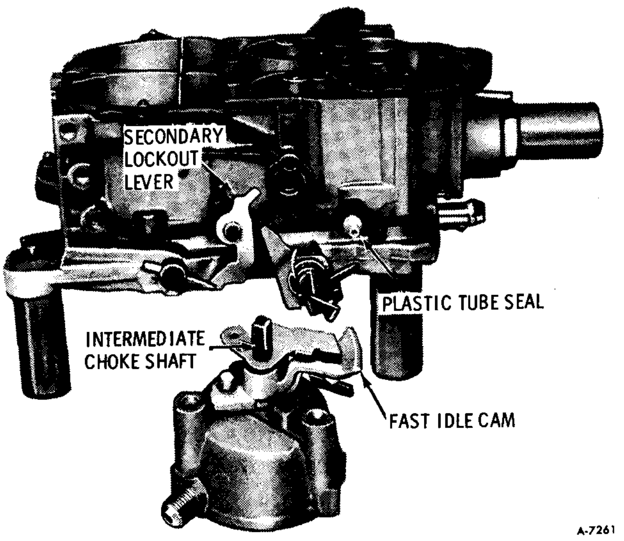


Figure 24—Choke Assembly

2. Remove choke housing assembly from float bowl by removing retaining screw and washer inside the choke housing (figure 23). The complete choke assembly can be removed from the float bowl by sliding outward.
3. Remove secondary throttle valve lockout lever from float bowl (figure 24).
4. Remove lower choke lever from inside float bowl cavity by inverting bowl.
5. Remove plastic tube seal from choke housing (figure 24).

CAUTION: *Plastic tube seal should not be immersed in carburetor cleaner.*

6. To disassemble intermediate choke shaft from choke housing, remove coil lever retaining screw at end of shaft inside the choke housing (figure 23). Then remove thermostatic coil lever from flats on intermediate chokeshaft. Remove intermediate choke shaft from the choke housing by sliding outward. The fast idle cam can now be removed from the intermediate choke shaft (figure 24).

CAUTION: *Remove the cup seal from inside choke housing shaft hole if the housing is to be immersed in carburetor cleaner. Also, remove the cup seal from the float bowl plastic insert for bowl cleaning purposes. DO NOT ATTEMPT TO REMOVE PLASTIC INSERT.*

REMAINING FLOAT BOWL PARTS

1. Remove fuel inlet nut, gasket, filter assembly and spring (figure 25).

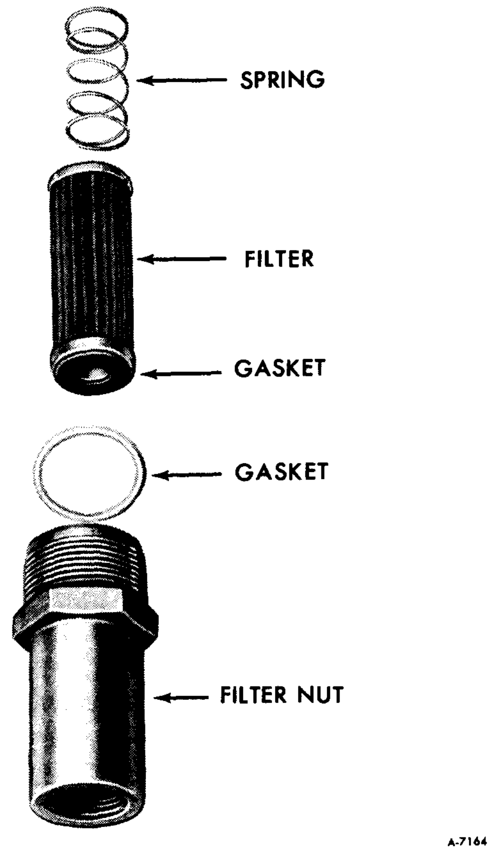


Figure 25—Fuel Filter

2. Remove throttle body by removing throttle body attaching screws.
3. Remove throttle body to float bowl insulator gasket.

THROTTLE BODY DISASSEMBLY

1. Remove pump rod from throttle lever.
2. DO NOT REMOVE idle mixture limiter caps, unless it is necessary to replace the mixture needles or normal soaking and air pressure fails to clean the idle passages. If the idle mixture needles are removed, adjustment procedures are covered later in this section under "Idle Mixture Adjustment".

If necessary to remove the idle mixture needle, destroy plastic limiter cap. Do not install a replacement cap as a bare mixture screw is sufficient to indicate that the mixture has been re-adjusted.

CARBURETOR CLEANING AND INSPECTION

The carburetor parts should be cleaned in cold immersion type cleaner.

CAUTION: *Any rubber parts, plastic parts, diaphragms and pump plungers should not be put in immersion type cleaner as these components will swell, harden or distort.*

The plastic cam on the air valve shaft (where used) and bushing in float bowl will withstand normal cleaning. Rinse thoroughly after cleaning.

1. Thoroughly clean all metal parts and blow dry with compressed air. Make sure all fuel passages and metering parts are free of burrs and dirt.
2. Check, repair or replace parts if the following problems are encountered.

a. FLOODING

1. Inspect float needle for dirt, deep wear grooves, scores from proper seating.
2. Inspect float, float arms and hinge pin for distortion, binds and burrs. Check float for leaks and/or being loaded (heavier than normal).

b. HESITATION

1. Inspect pump plunger for cracks, scores or excessive wear. A used pump cup will shrink when dry. Soak in fuel for 8 hours, before testing if dried out.
2. Inspect pump duration and return spring for being weak or distorted.
3. Check all pump passages and jets for dirt, improper sealing inlet and discharge balls, scores in pump well.
4. Check pump linkage for excessive wear, repair or replace as necessary.

c. HARD STARTING—POOR COLD OPERATION

1. Inspect float needle for sticking, dirt, etc.
2. Examine fast idle cam for wear or damage.
3. Also check items under "FLOODING".

d. POOR PERFORMANCE—POOR GAS MILEAGE

1. Power piston, power valve, metering rods for dirt, sticking, binding, damaged parts or excessive wear.
2. Check air valve for binds and damage. If air valve is damaged, the air horn assembly must be replaced. A torsion spring kit is available for repairs to air valve closing spring. A new plastic secondary metering rod cam is included in the kit.
3. Clean all fuel and vacuum passages in castings.

e. ROUGH IDLE

1. Inspect idle needle for ridges, burrs or being bent.
2. Inspect gasket mating surfaces on castings for damage to sealing beads, nicks or burrs.
3. Check all idle fuel passages.
4. Check throttle levers and valves for binds.

CARBURETOR ASSEMBLY

THROTTLE BODY ASSEMBLY

1. If removed, install idle mixture needles and springs until seated. Back out the mixture needles four turns as a preliminary idle adjustment. Final adjustment must be made on the engine using the procedures described under idle mixture adjustment.
2. Install lower end of pump rod in throttle lever by aligning tang on rod with slot in lever. End of rod should point toward throttle lever.

FLOAT BOWL ASSEMBLY

1. Install new throttle body to bowl gasket over two locating dowels on bowl.
2. Install throttle body making certain throttle body is properly located over dowels on float bowl, then install throttle body to bowl screws and tighten evenly and securely.
3. Place carburetor on proper holding fixture.
4. Install fuel inlet filter spring, filter assembly, new gasket and inlet nut and tighten nut (18 ft. lbs.).

NOTE: Ribs on closed end of filter element prevent filter from being incorrectly installed unless forced.

CAUTION: *Tightening beyond specified torque can damage nylon filter gasket.*

CHOKE HOUSING TO FLOAT BOWL ASSEMBLY

1. Install new cup seal into plastic insert on side of float bowl for intermediate choke shaft. Lip on cup seal faces outward.
2. Install secondary throttle valve lock-out lever on boss on float bowl with recess in hole in lever facing inward (figure 26).
3. Install new cup seal into inside choke housing shaft hole. Lips on seal face inward, toward inside of housing.
4. Install fast idle cam onto the intermediate choke shaft (steps on fast idle cam face downward).
5. Carefully install fast idle cam and intermediate choke shaft assembly through seal in choke housing, then install thermostatic coil lever onto flats on intermediate choke shaft.

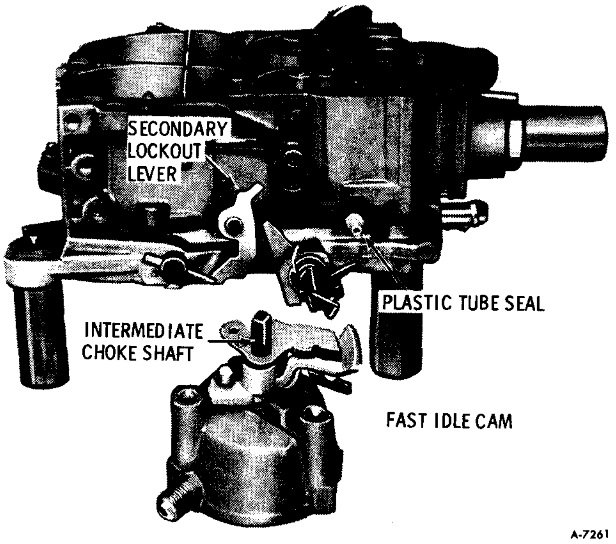


Figure 26—Secondary Lockout Lever

Inside thermostatic choke coil lever is properly aligned when both inside and outside levers face toward fuel inlet. Install inside lever retaining screw into end of intermediate choke shaft. Tighten securely.

6. Install lower choke rod inner lever into cavity in float bowl. Install plastic tube seal into cavity on choke housing before assembling choke housing to bowl. Install choke housing to bowl, sliding intermediate choke shaft into lower choke inner lever (figure 27).

NOTE: Tool J-23417 can be used to hold the lower choke lever in position while installing the choke housing.

NOTE: The intermediate choke shaft lever and fast idle cam are in correct position when the tang on lever is beneath the fast idle cam. Do not install choke cover and coil assembly until inside coil lever is adjusted. See carburetor adjustments at the end of this section.

COMPLETION OF FLOAT BOWL ASSEMBLY

1. If removed, install air baffle in secondary side of float bowl with notches toward the top. Top edge of baffle must be even with bowl casting.
2. Install baffle inside of pump well with slot toward bottom.
3. Install pump discharge check ball and retainer in passage next to pump well (figure 28). Tighten retainer securely.
4. Install primary main metering jets, if removed (figure 28).

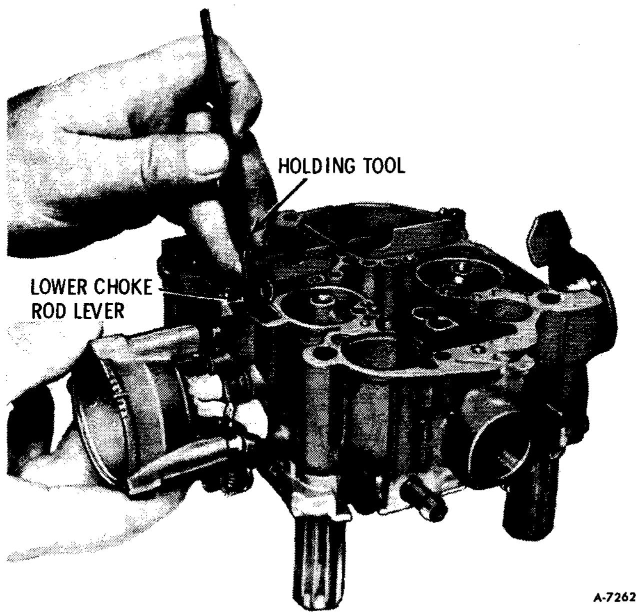


Figure 27—Installing Choke Lever and Housing

5. Install aneroid cavity insert into float bowl.
6. Install new needle seat assembly, with gasket, using seat installer J-22769.
7. To make float adjustment easier, carefully bend float arm upward at notch in arm before assembly. Install needle by sliding float lever under needle pull clip — correct installation of the needle pull clip is to hook the clip over the edge of the float on the float arm facing the float pontoon (figure 29). With float lever in pull clip, hold float assembly at toe and install retaining pin from aneroid cavity side (ends of retaining pin face the accelerating pump well).

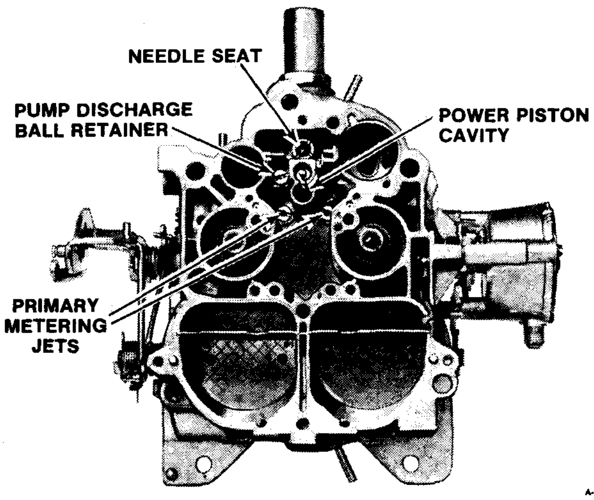


Figure 28—Primary Metering Jets

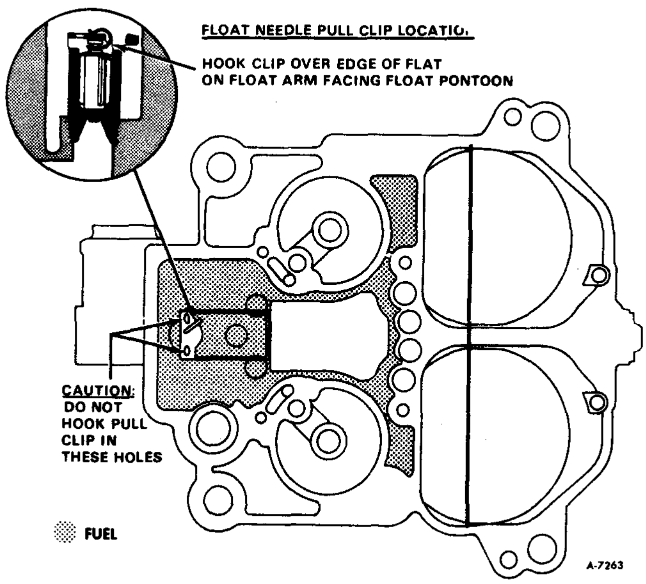


Figure 29—Float Needle Pull Clip Location

CAUTION: *Do not install float needle pull clip into holes in float arm.*

FLOAT LEVEL ADJUSTMENT (FIGURES 37 AND 42)

1. Hold float retainer firmly in place.
2. Push float down lightly against needle.
3. With adjustable T-scale, gauge from top of float bowl casting (air horn gasket removed) to top of float at toe-gauging point 3/16" back from toe (see insert, figures 37 and 42).
4. Bend float arm as necessary for proper adjustment by pushing on pontoon (see figures 33 and 40 for specification).
5. Visually check float alignment after adjustment.
6. Install plastic filler block over float needle, pressing downward until properly seated.
7. Install primary power piston spring in power piston well.

If primary metering rods were removed from hanger, reinstall making sure tension spring is connected to top of each rod (figure 30). Install power piston assembly in well (aligning pin on piston with slot in well) with metering rods properly positioned in metering jets. Press down firmly on plastic power piston retainer to make sure the retainer is seated in recess in bowl and the top is flush with the top of the bowl casting. If necessary, using a drift punch and small hammer, tap retainer lightly in place.

8. Install pump return spring in pump well.
9. Install air horn gasket by carefully sliding tab of gasket around primary metering rods and beneath the primary power piston hanger.

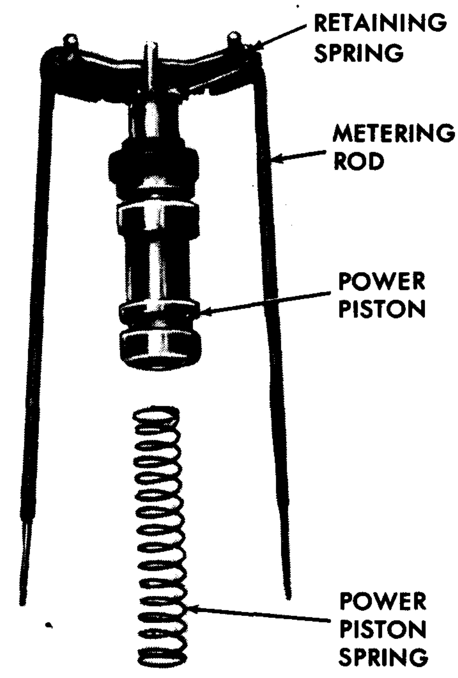


Figure 30—Power Piston and Metering Rods

Position gasket over the two dowel pins on the float bowl.

10. Carefully lift corner of the air horn gasket and install pump plunger in the pump well against return spring tension. While holding in this position, align pump plunger stem with hole in gasket.

AIR HORN ASSEMBLY

If removed, install choke shaft, choke valve and two attaching screws. Tighten screws securely and stake lightly in place.

NOTE: Check choke valve for freedom of movement and proper alignment before staking screws in place.

AIR HORN TO BOWL INSTALLATION

1. Holding down on air horn gasket at pump plunger location, carefully lower air horn assembly onto float bowl making sure that the bleed tubes, accelerating well tubes, pull-over enrichment tubes (if used) and pump plunger stem are positioned properly through the holes in the air horn gasket.

CAUTION: *Do not force the air horn assembly onto the bowl but rather lightly lower in place.*

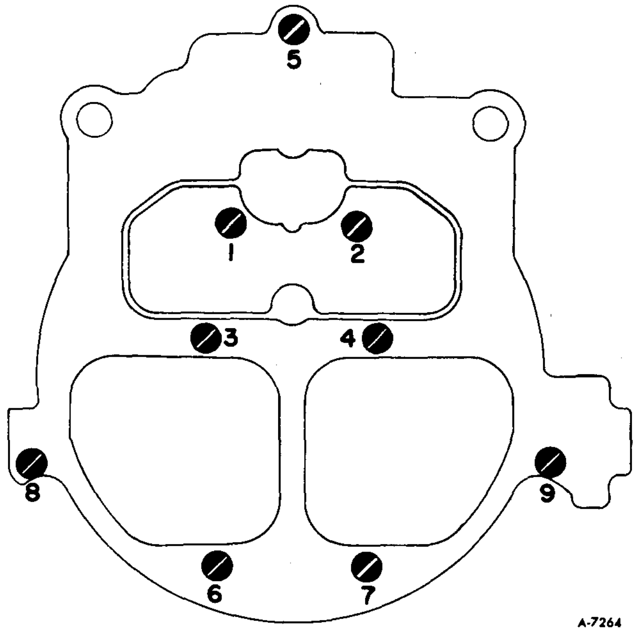


Figure 31—Air Horn Screw Tightening Sequence

2. Install two long air horn screws, five short screws, and two countersunk screws into primary venturi area (figure 31).

NOTE: Install secondary air baffle beneath screws No. 3 and 4 (figure 31). All air horn screws must be tightened evenly and securely.

3. Install vacuum break diaphragm rod into the slot in lever on the end of the air valve shaft. Then install the other end of rod into hole in the front vacuum break diaphragm plunger. Install front vacuum break diaphragm and bracket assembly to air horn using two retaining screws through the bracket. Tighten screws securely (figure 32).

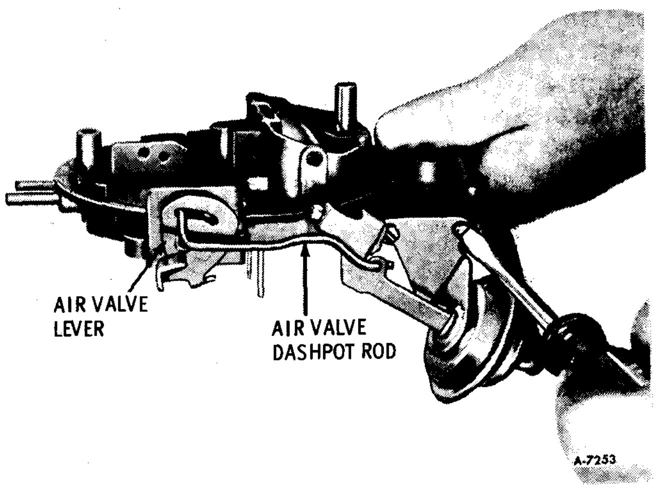


Figure 32—Installing Front Vacuum Break

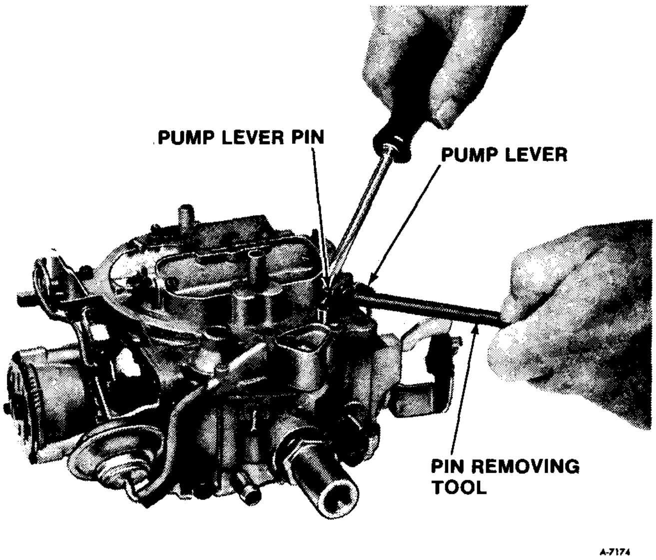


Figure 33—Installing Pump Lever

NOTE: Do not attach vacuum break hose until vacuum break adjustments are completed. See carburetor adjustments later in this section.

4. Connect upper end of pump rod to pump lever by placing rod in specified hole in lever, noted at disassembly. Align hole in pump lever with hole in air horn casting. Using screwdriver, push pump lever roll pin back through casting until end of pin is flush with casting bosses in air horn (figure 33).

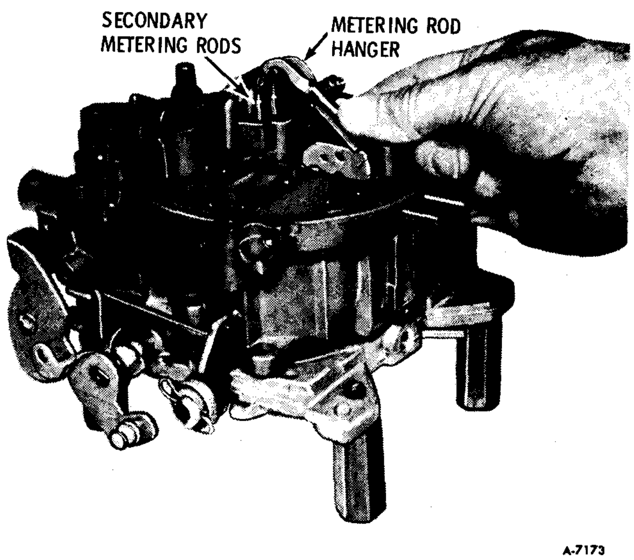


Figure 34—Installing Secondary Metering Rods

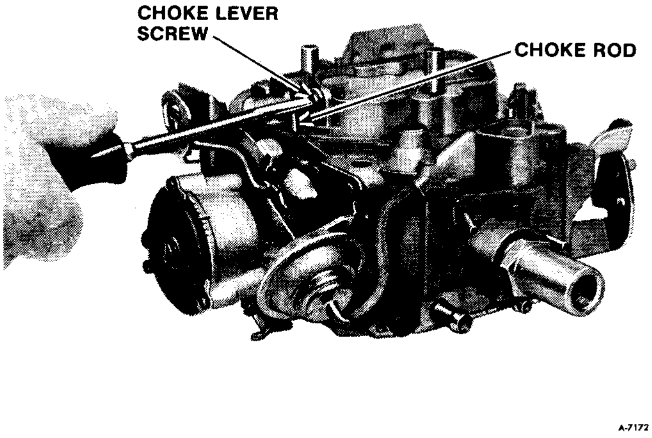


Figure 35—Installing Choke Lever

CAUTION: *Use care installing the small roll pin to prevent damage to pump lever casting bosses.*

5. Install two secondary metering rods into the secondary metering rod hanger (upper end of rods point toward each other). Install secondary metering rod holder, with rods, onto air valve cam follower. Install retaining screw and tighten securely. Work air valves up and down several times to make sure they are free in all positions (figure 34).

6. Connect choke rod into lower choke lever inside bowl cavity; then install choke rod into slot in upper choke lever and retain the choke lever to the end of the choke shaft with attaching screw (figure 35). Tighten screw securely.

NOTE: Make sure the flats on the end of the choke shaft align with flats in the choke lever.

NOTE: The front vacuum break and fast idle cam must be adjusted. Then, the thermostatic coil lever inside the choke housing has to be indexed properly before installing the choke thermostatic coil and cover assembly and gasket. Refer to Carburetor Adjustments, later in this section.

7. After the vacuum break, fast idle cam, and inside thermostatic coil lever are adjusted, the thermostatic coil and cover assembly and gasket should be installed and the cover assembly rotated until the choke valve just closes. At this point, the index cover should be adjusted. See Carburetor Adjustments, later in this section. Install three choke cover retainers and screws and tighten securely. Torque the choke pipe nut to 95 in. lbs.

IDLE SETTING PROCEDURE (ON-VEHICLE)

Adjustment must be made with test equipment known to be accurate. Refer to Emission Control Information Label (located on engine valve cover).

1. Adjustments must be made with engine at normal operating temperature, choke open, and air conditioning off. Remove air cleaner and disconnect air cleaner vacuum hose at carburetor Port "N". Plug port "N".
2. Set parking brake and block drive wheels.
3. At carburetor, disconnect vacuum hoses to TVS switch (Port "B" and "H"). Also disconnect hose to carbon canister (Port "K"). Plug these ports at carburetor.
4. Set timing to specification.
5. Adjust idle speed screw to 600 rpm (In DRIVE "D").
6. With throttle lever held against idle speed screw, adjust stem of throttle lever actuator to provide 0.020" clearance between the actuator stem and throttle lever.
7. Adjust fast idle as follows: Place cam follower on low step of fast idle cam against the shoulder of next higher step. Adjust fast idle screw to 900 rpm (In "PARK").
8. Remove plugs from carburetor vacuum ports. Connect the previously disconnected vacuum hoses.
9. Install air cleaner and connect air cleaner vacuum hose.

IDLE MIXTURE ADJUSTMENT

Idle mixture screws are preset and capped at the factory.

Before suspecting the carburetor to be the cause of poor engine performance or rough idle, check ignition system including distributor, timing, spark plugs and wires. Check air cleaner, evaporative emission system, PCV system and compression. Also, check vacuum hoses for leaks.

In the case of major carburetor overhaul, throttle body replacement, or when poor idle quality exists, idle mixture may be adjusted. To properly set idle mixture to achieve the smoothest idle while maintaining emission levels within the standards prescribed by Federal and State laws, the following procedures MUST be followed:

1. With engine at normal operating temperature, choke open, air conditioning off, remove air cleaner and disconnect air cleaner vacuum hose at carburetor Port "N". Plug Port "N".
2. Set parking brake and block drive wheels.

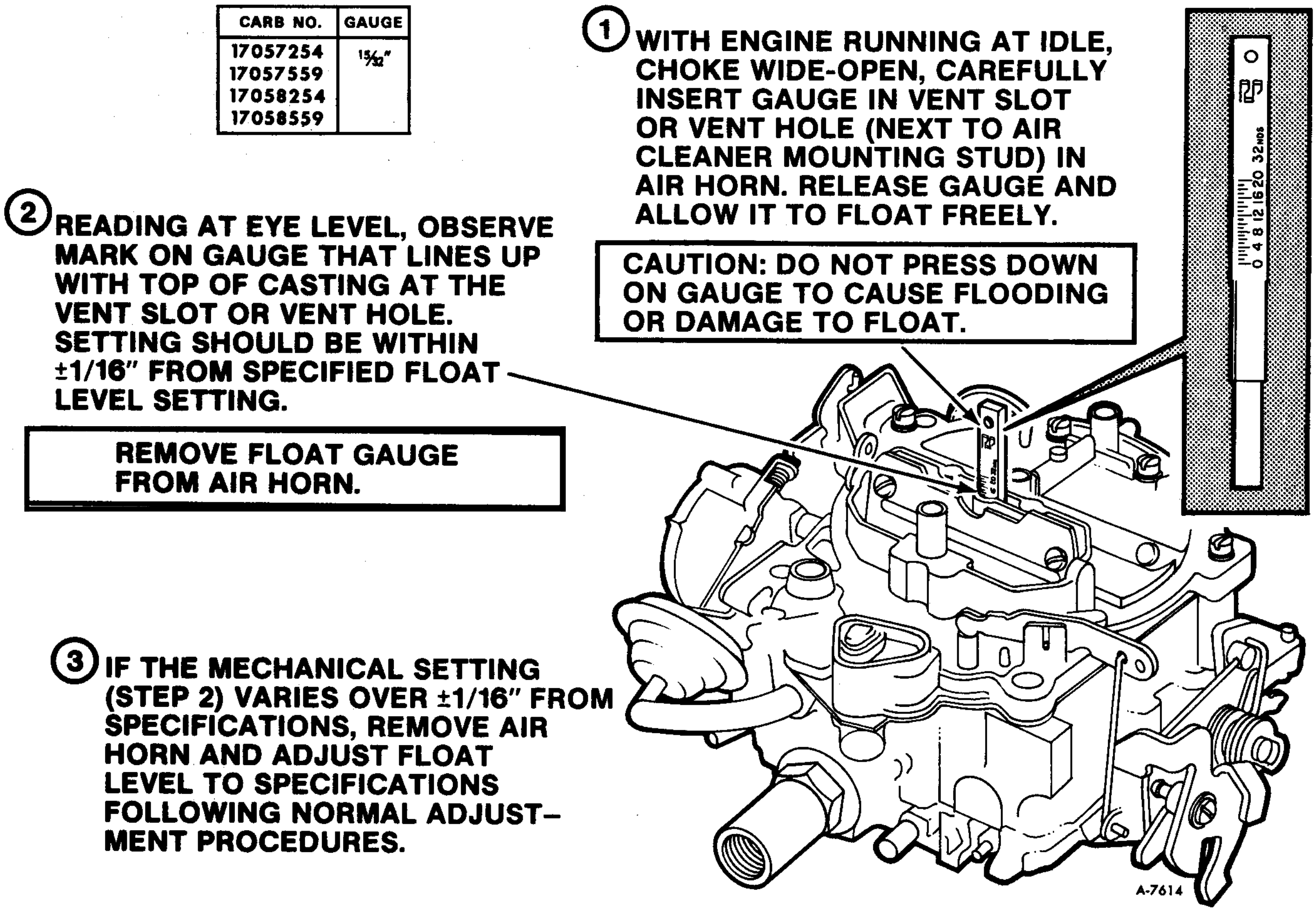


Figure 36—Float Gauge - External Checking Procedure

3. At carburetor, disconnect vacuum hoses to TVS switch (Port "B" and "H"). Also disconnect hose to carbon canister (Port "K"). Plug these ports at carburetor.

4. Connect an accurate vacuum gauge to the intake manifold. Also connect an ACCURATE tachometer to the engine.

5. Carefully remove caps from idle mixture screws. Be careful not to bend screws.

6. Lightly seat screws, then EQUALLY richen (back out screws 4 full turns).

7. Start engine and adjust idle speed screw to obtain 650 rpm (in DRIVE "D").

8. Adjust mixture screws EQUALLY to obtain maximum rpm.

9. With transmission in DRIVE "D", adjust idle speed screw to obtain 650 rpm. Note manifold vacuum reading.

10. EQUALLY lean (turn in) mixture screws until the idle speed is 600 rpm. Manifold vacuum reading should not be reduced by more than 2 inches of mercury from reading obtained in Step 9. If reading is reduced more than 2 inches, repeat steps 6-10.

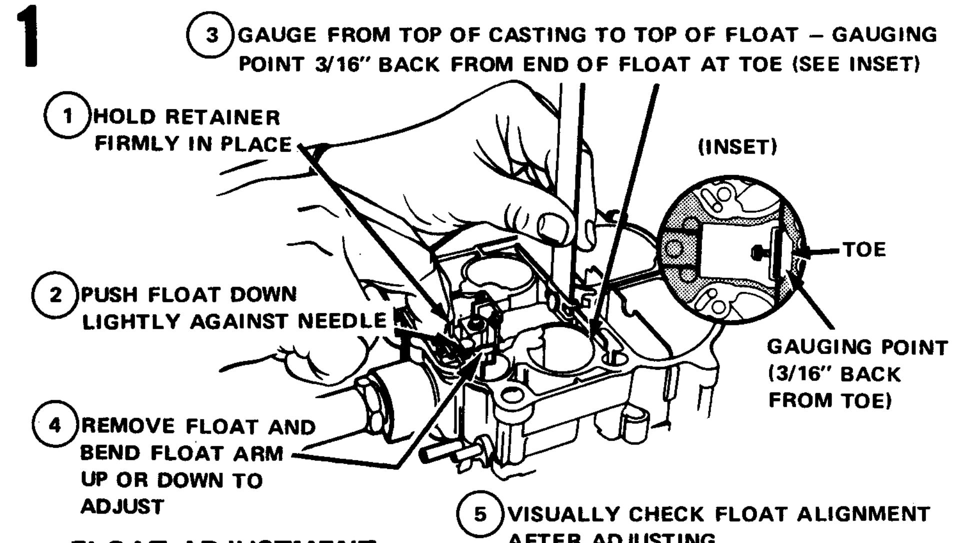
11. Remove plugs from carburetor vacuum ports. Connect the previously disconnected vacuum hoses.

12. Install air cleaner and connect air cleaner vacuum hose.

CARBURETOR ADJUSTMENTS

On 1978 and past model carburetors (except those using a screen over the vent slot in the air horn), it is now possible to externally check the float level using a new float gauge J-9789-130 (figure 36). This gauge is designed to quickly and accurately measure externally the float level on carburetors to eliminate the need to remove the carburetor air horn to check float level. Using this gauge, the float level may be checked "on-the-vehicle".

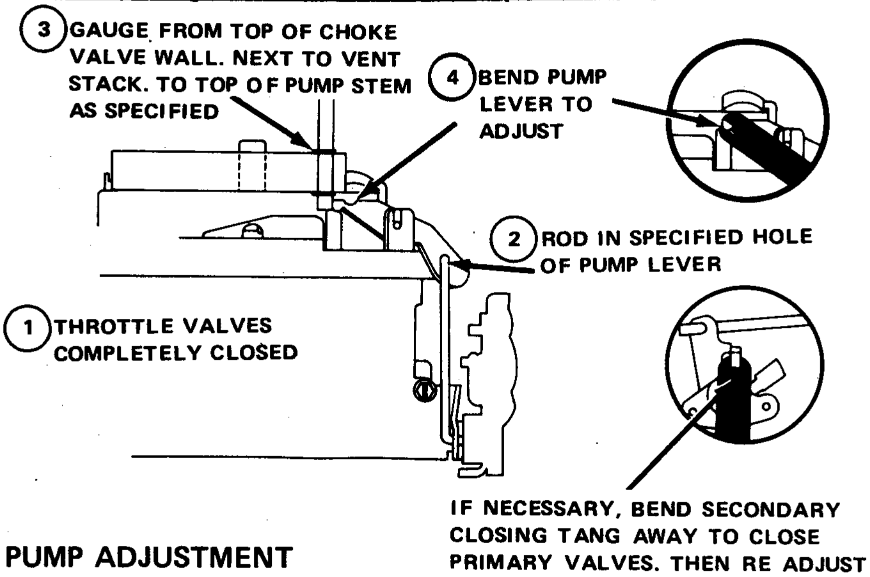
1



FLOAT ADJUSTMENT

CARB. NO.	GAUGE	
17057254 17057559	15/32"	

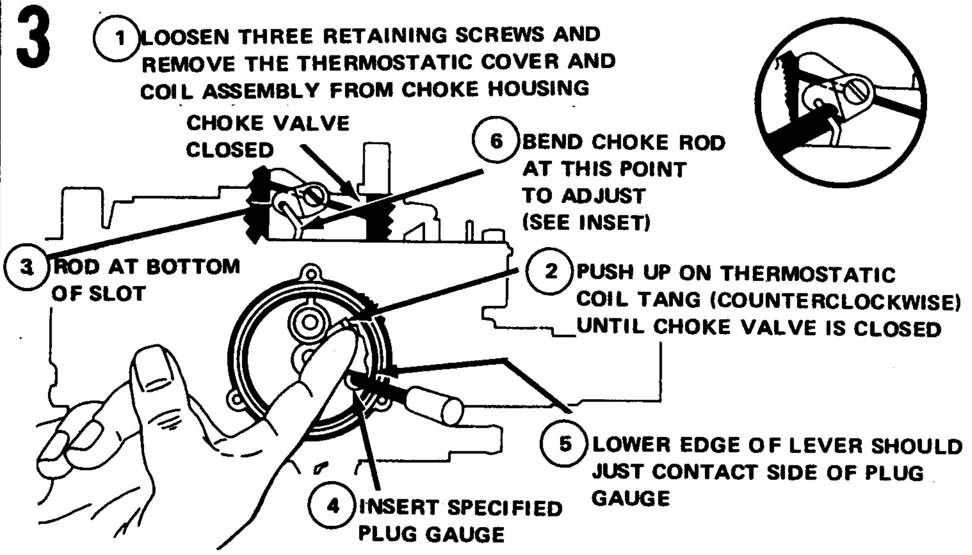
2



PUMP ADJUSTMENT

CARB. NO.	GAUGE	HOLE LOC.
17057254 17057559	9/32"	Inner

3



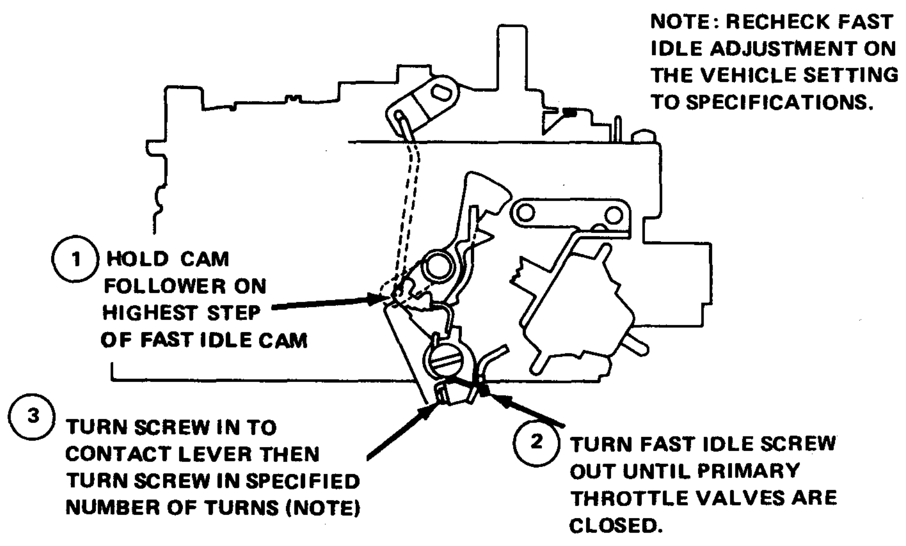
CHOKE COIL LEVER ADJUSTMENT

A-7265

CARB. NO.	PLUG GAUGE	
17057254 17057559	.120"	

Figure 37—1977 Carburetor Adjustments

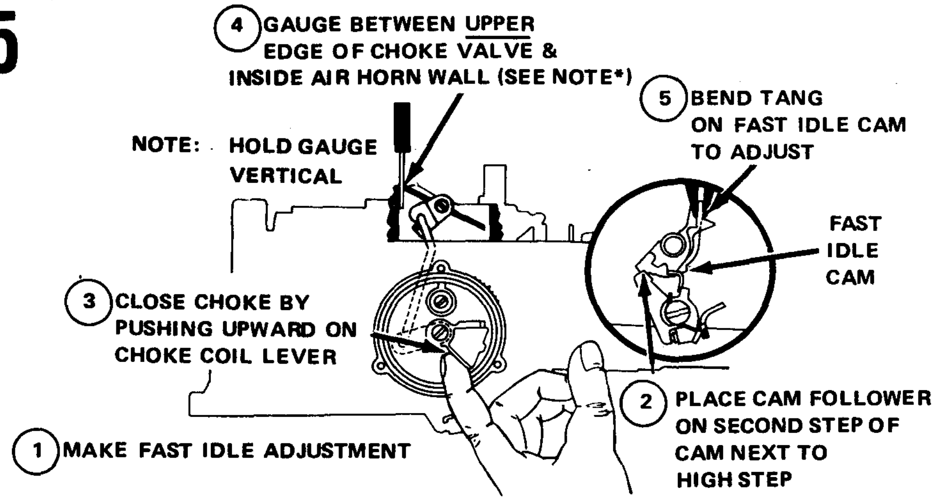
4



FAST IDLE ADJUSTMENT (BENCH SETTING)

CARB. NO.	NO. TURNS
17057254 17057559	3

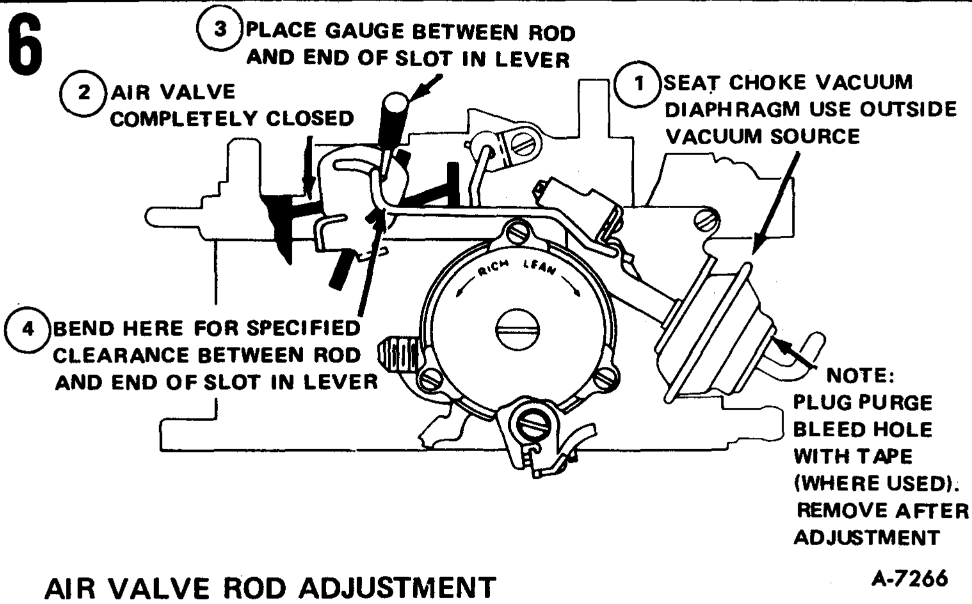
5



CHOKE ROD (FAST IDLE CAM) ADJUSTMENT

CARB. NO.	PLUG GAUGE
17057254 17057559	.100"

6

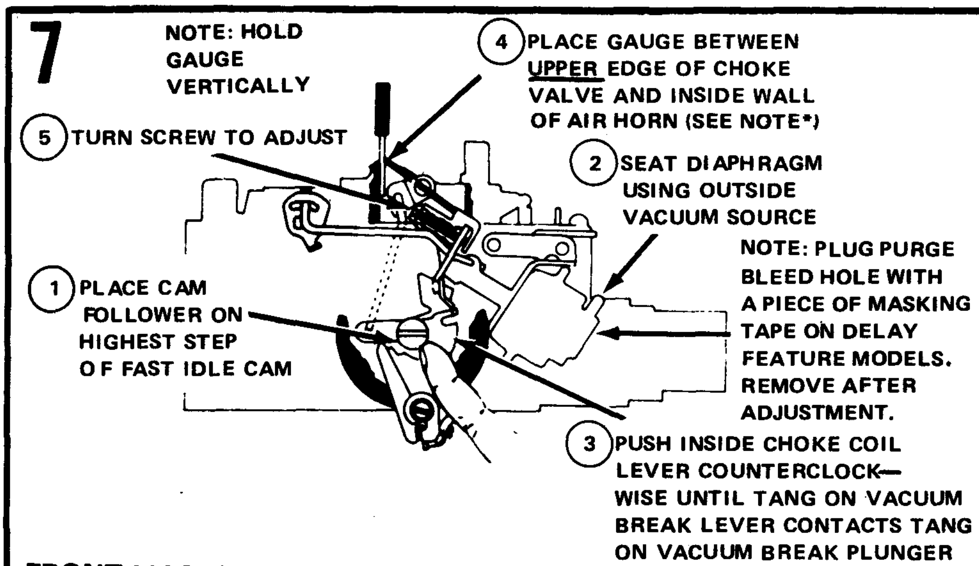


AIR VALVE ROD ADJUSTMENT

CARB. NO.	PLUG GAUGE
17057254 17057559	.030"

Figure 38—1977 Carburetor Adjustments

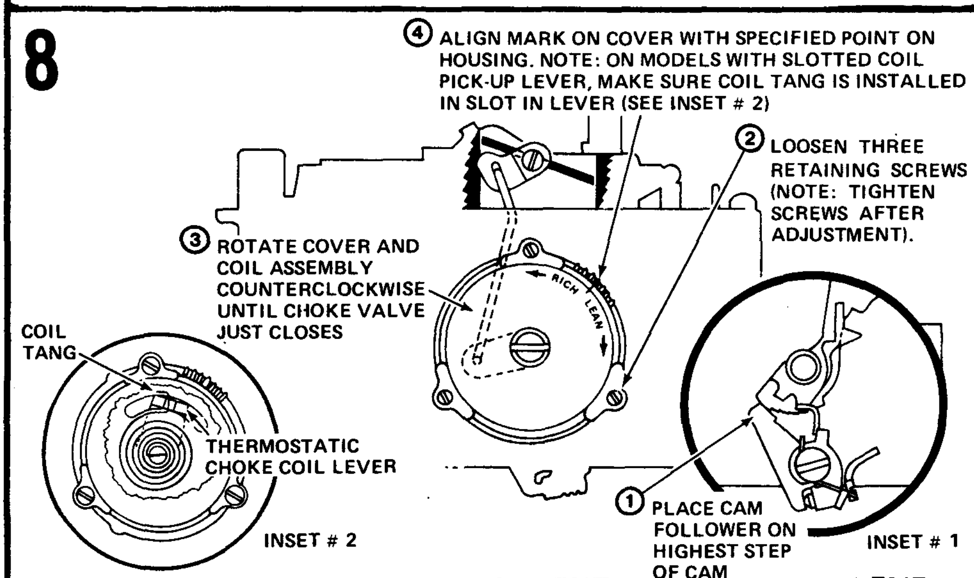
7



FRONT VACUUM BREAK ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17057254	.135"	
17057559	.140"	

8

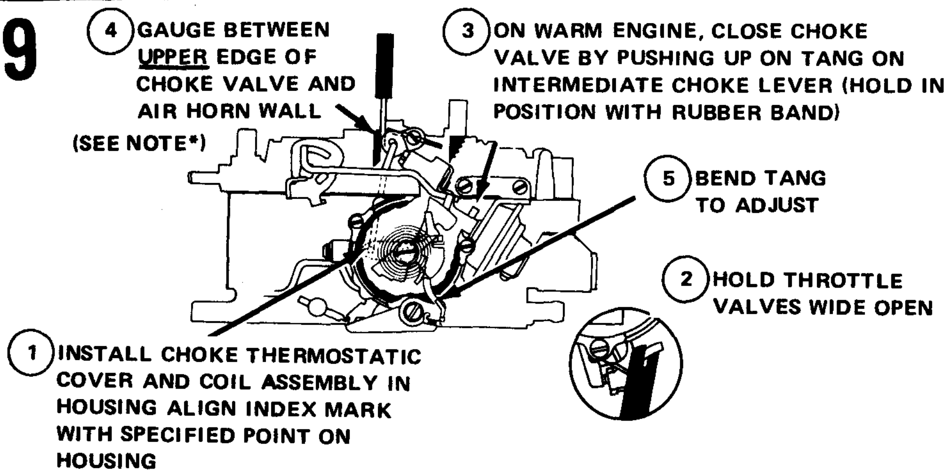


AUTOMATIC CHOKE COIL ADJUSTMENT

CARB. NO.	INDEX MARK	
17057254	3NR	
17057559		

Figure 39—1977 Carburetor Adjustments

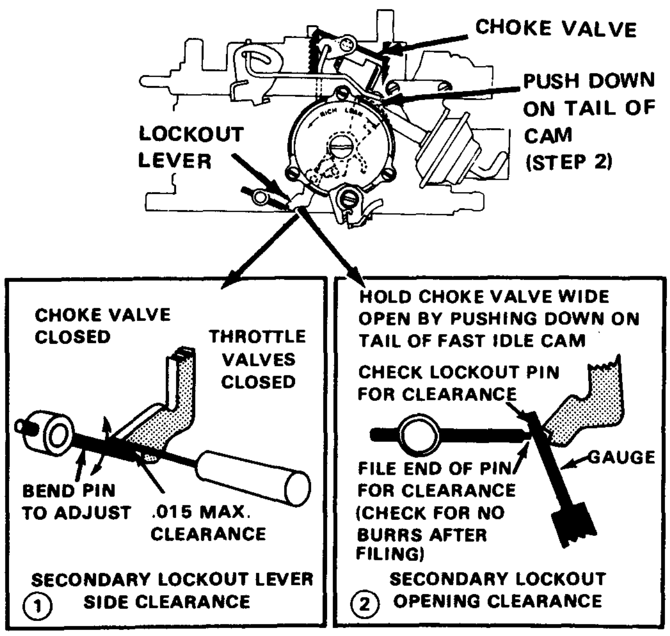
9



UNLOADER ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17057254	.220"	
17057559	.230"	

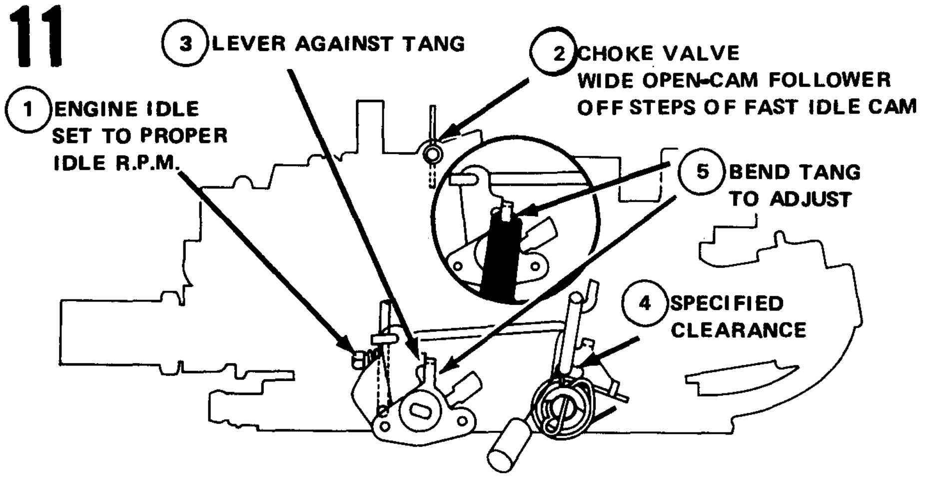
10



SECONDARY LOCKOUT ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17057254	.015"	
17057559		

11



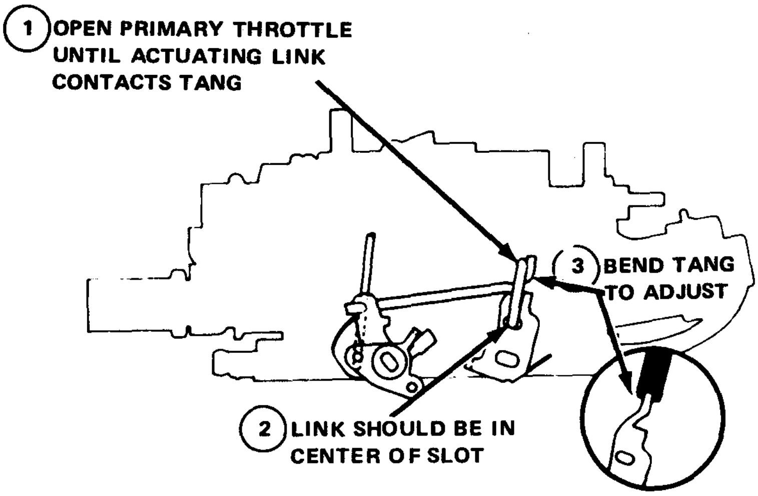
SECONDARY CLOSING ADJUSTMENT

A-7268

CARB. NO.	PLUG GAUGE	
17057254	.020"	
17057559		

Figure 40—1977 Carburetor Adjustments

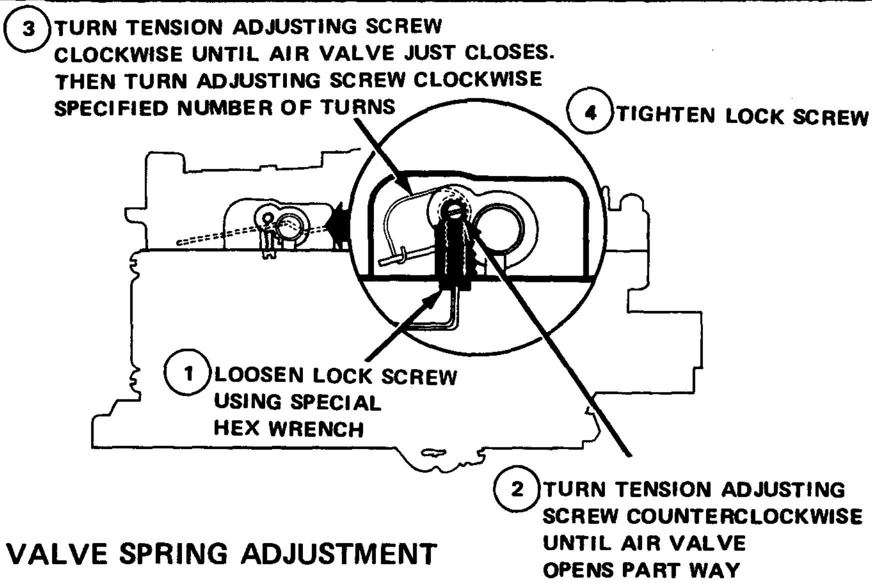
12



SECONDARY OPENING ADJUSTMENT

(See Figure)

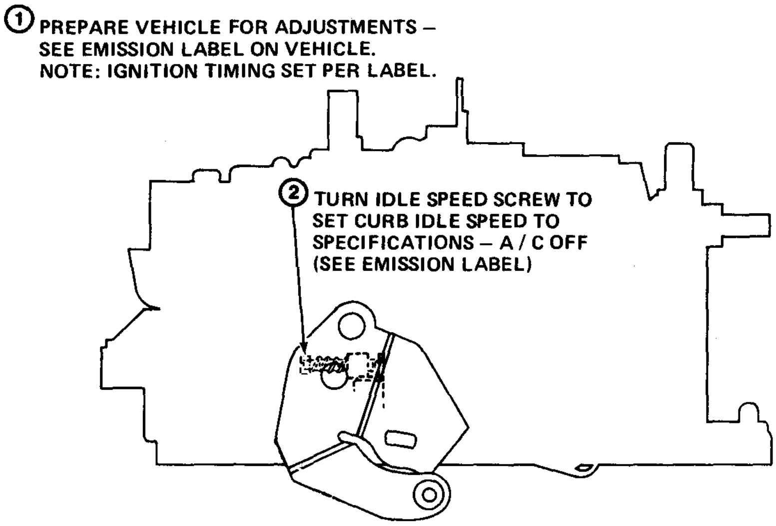
13



AIR VALVE SPRING ADJUSTMENT

CARB. NO.	NO TURNS	
17057254	½	
17057559		

14

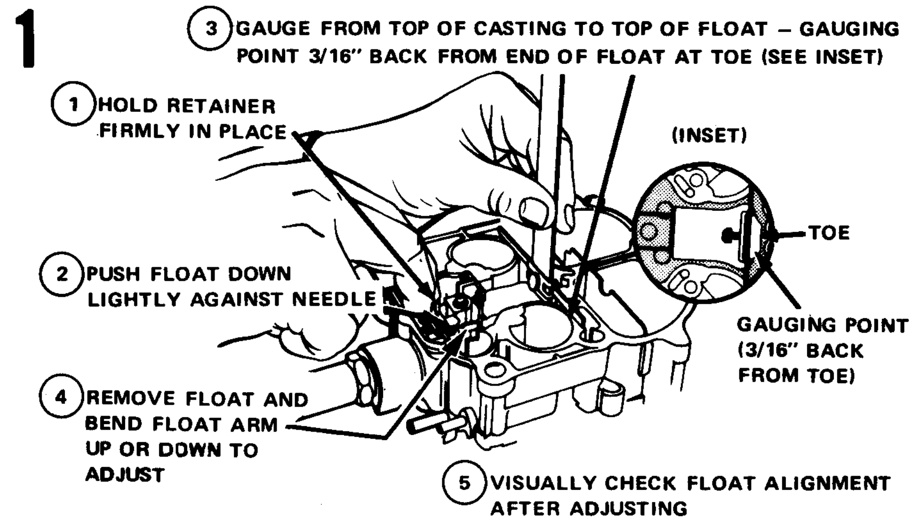


IDLE SPEED ADJUSTMENT

A-7269

Figure 41—1977 Carburetor Adjustments

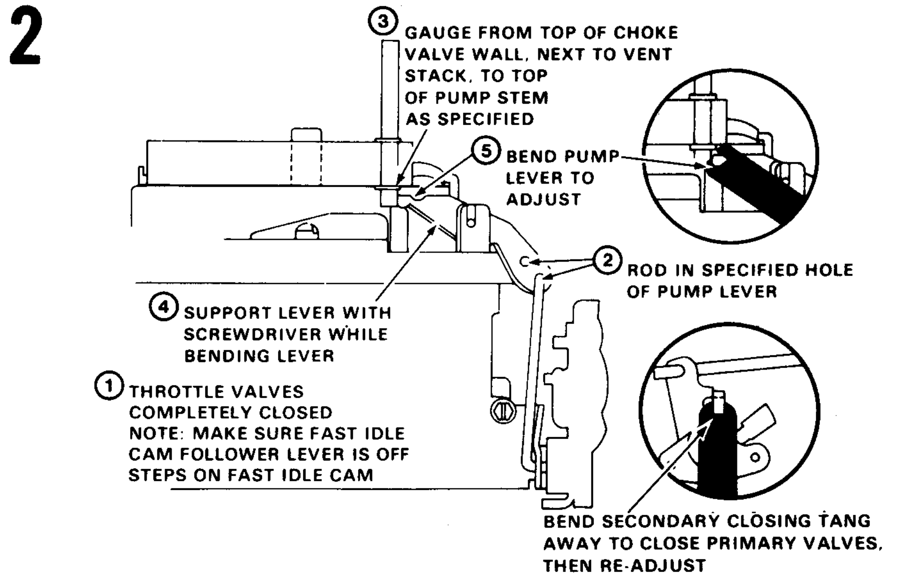
1



FLOAT LEVEL ADJUSTMENT

CARB. NO.	GAUGE	
17058254 17058559	15/32"	

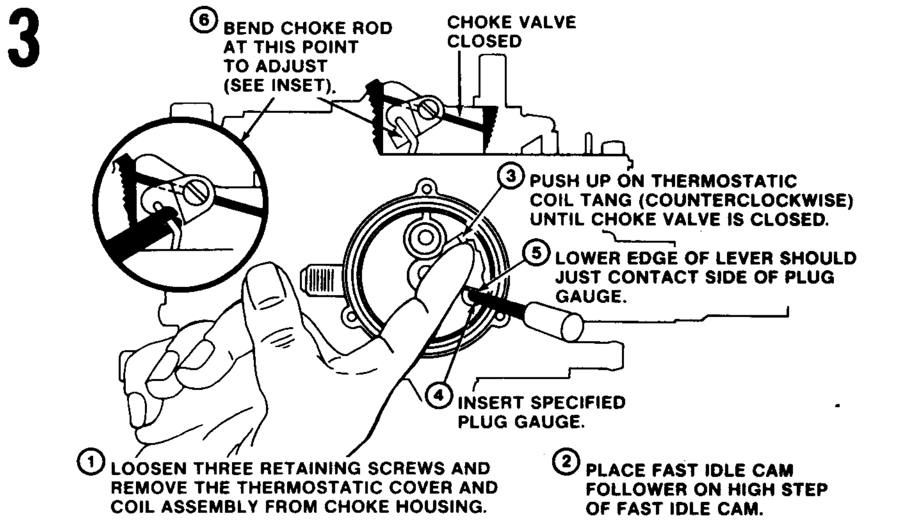
2



PUMP ADJUSTMENT

CARB. NO.	GAUGE	HOLE LOC
17058254 17058559	9/32"	Inner

3



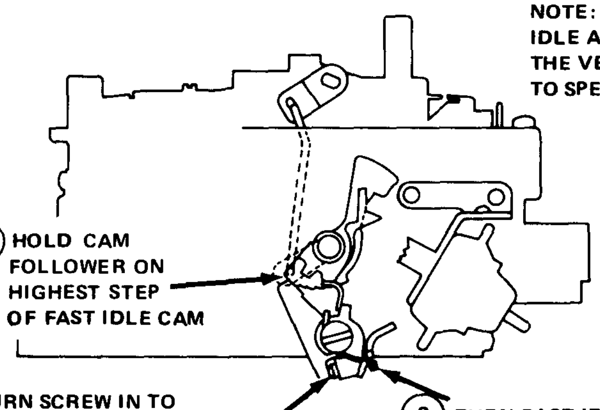
CHOKE COIL LEVER ADJUSTMENT

A-7615

CARB. NO.	PLUG GAUGE	
17058254 17058559	.120"	

Figure 42—1978 Carburetor Adjustments

4



FAST IDLE ADJUSTMENT (BENCH SETTING)

CARB. NO.	NO. TURNS	
17058254	3	
17058559		

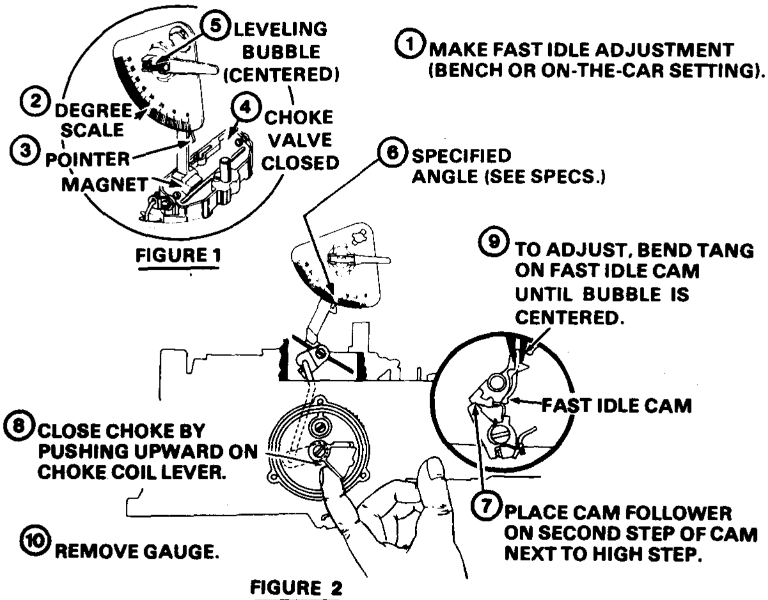
5

FIGURE 1

1. MAKE FAST IDLE ADJUSTMENT (BENCH OR ON-THE-CAR SETTING).
2. USE CHOKE VALVE MEASURING GAUGE J-26701 OR BT-7704. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
3. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
4. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
5. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

6. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
7. PLACE CAM FOLLOWER ON SECOND STEP OF CAM NEXT TO HIGH STEP.
8. CLOSE CHOKE BY PUSHING UPWARD ON CHOKE COIL LEVER.
9. TO ADJUST, BEND TANG ON FAST IDLE CAM UNTIL BUBBLE IS CENTERED.
10. REMOVE GAUGE.



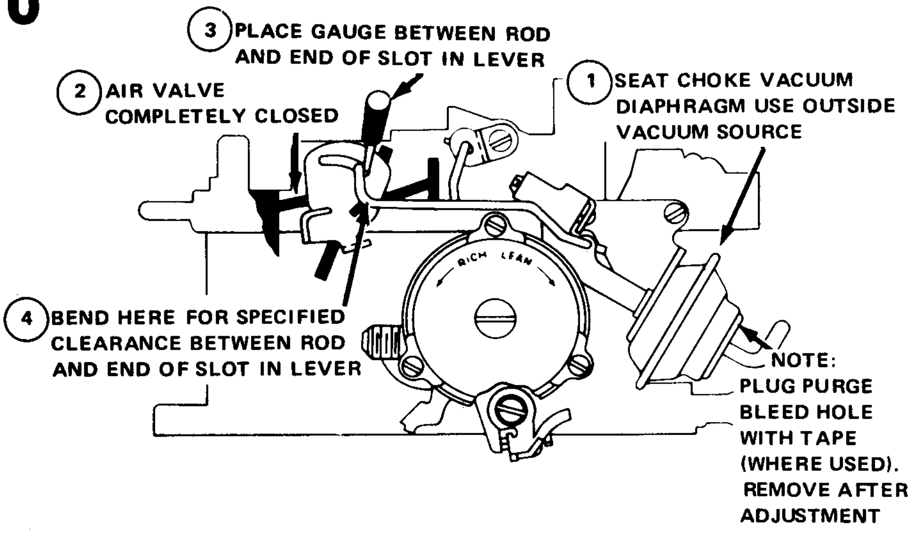
CHOKE ROD (FAST IDLE CAM) ADJUSTMENT - ANGLE GAUGE METHOD

A-7616

CARB. NO.	ANGLE GAUGE	PLUG GAUGE
17058254	19°	.100"
17058559		

Figure 43—1978 Carburetor Adjustments

6



AIR VALVE ROD ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17058254 17058559	.030"	

7

FIGURE 1

1. USE CHOKE VALVE MEASURING GAUGE J-26701 OR BT-7704. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
2. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
3. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
4. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2

5. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUST MENT IS OPPOSITE POINTER.
6. SEAT CHOKE VACUUM DIAPHRAGM USING VACUUM SOURCE.
7. HOLD CHOKE VALVE TOWARDS CLOSED POSITION, PUSHING COUNTER-CLOCKWISE ON INSIDE COIL LEVER.
8. TO ADJUST, TURN SCREW IN OR OUT UNTIL BUBBLE IS CENTERED.
9. REMOVE GAUGE.

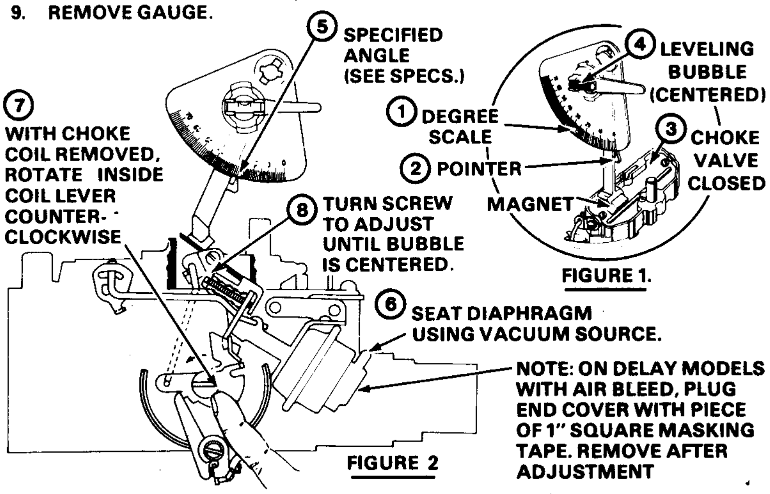


FIGURE 2

FIGURE 1.

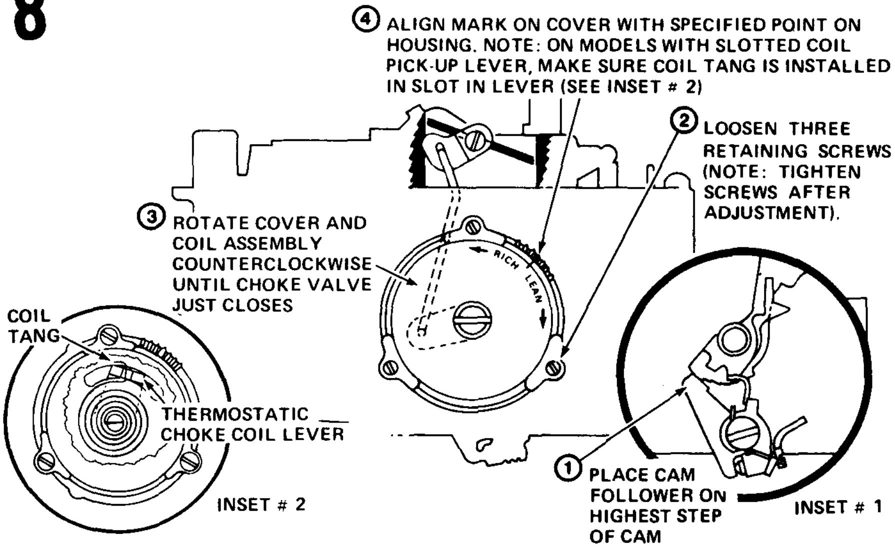
FRONT VACUUM BREAK ADJUSTMENT - ANGLE GAUGE METHOD

A-7617

CARB. NO.	ANGLE GAUGE	PLUG GAUGE
17058254 17058559	24°	.135"

Figure 44—1978 Carburetor Adjustments

8



AUTOMATIC CHOKE COIL ADJUSTMENT

CARB. NO.	INDEX MARK
17058254	3NR
17058559	

9

FIGURE 1
1. USE CHOKE VALVE MEASURING GAUGE J-26701 OR BT-7704. TOOL MAY BE USED WITH CARBURETOR ON OR OFF ENGINE. IF OFF ENGINE, PLACE CARBURETOR ON HOLDING FIXTURE SO THAT IT WILL REMAIN IN SAME POSITION WHEN GAUGE IS IN PLACE.
2. ROTATE DEGREE SCALE UNTIL ZERO (0) IS OPPOSITE POINTER.
3. WITH CHOKE VALVE COMPLETELY CLOSED, PLACE MAGNET SQUARELY ON TOP OF CHOKE VALVE.
4. ROTATE BUBBLE UNTIL IT IS CENTERED.

FIGURE 2
5. ROTATE SCALE SO THAT DEGREE SPECIFIED FOR ADJUSTMENT IS OPPOSITE POINTER.
6. INSTALL CHOKE THERMOSTATIC COVER AND COIL ASSEMBLY IN HOUSING. ALIGN INDEX MARK WITH SPECIFIED POINT ON HOUSING.
7. HOLD PRIMARY THROTTLE VALVES WIDE OPEN.
8. ON WARM ENGINE, CLOSE CHOKE VALVE BY PUSHING UP ON TANG ON VACUUM BREAK LEVER (HOLD IN POSITION WITH RUBBER BAND).
9. TO ADJUST, BEND TANG ON FAST IDLE LEVER UNTIL BUBBLE IS CENTERED.
10. REMOVE GAUGE.

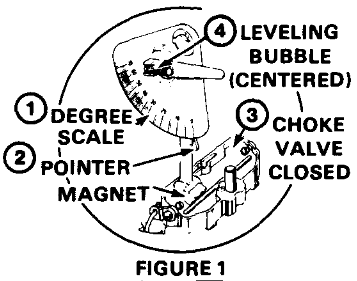


FIGURE 1

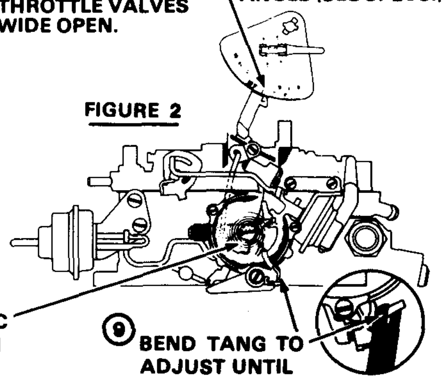


FIGURE 2

⑥ INSTALL CHOKE THERMOSTATIC COVER AND COIL ASSEMBLY IN HOUSING. ALIGN INDEX MARK WITH SPECIFIED POINT ON HOUSING.

⑨ BEND TANG TO ADJUST UNTIL BUBBLE IS CENTERED.

⑧ ON WARM ENGINE, CLOSE CHOKE VALVE BY PUSHING UP ON TANG ON VACUUM BREAK LEVER (HOLD IN POSITION WITH RUBBER BAND).

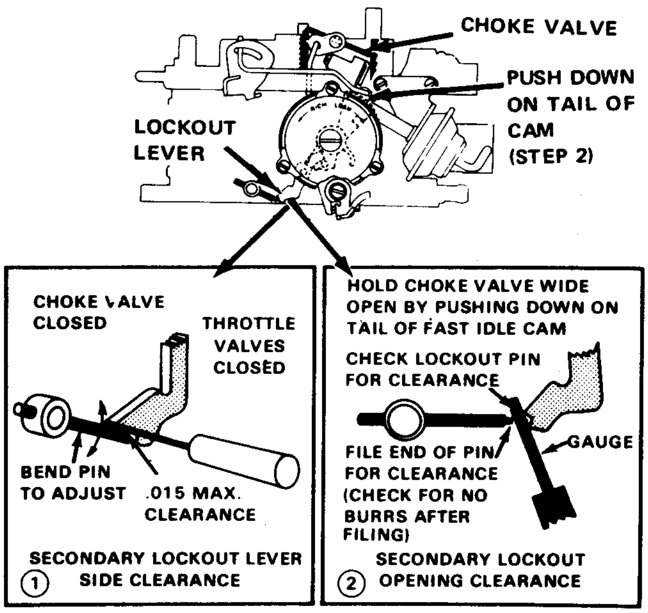
UNLOADER ADJUSTMENT - ANGLE GAUGE METHOD

A-7618

CARB. NO.	ANGLE GAUGE	PLUG GAUGE
17058254	35°	.220″
17058559	36.5°	.230″

Figure 45—1978 Carburetor Adjustments

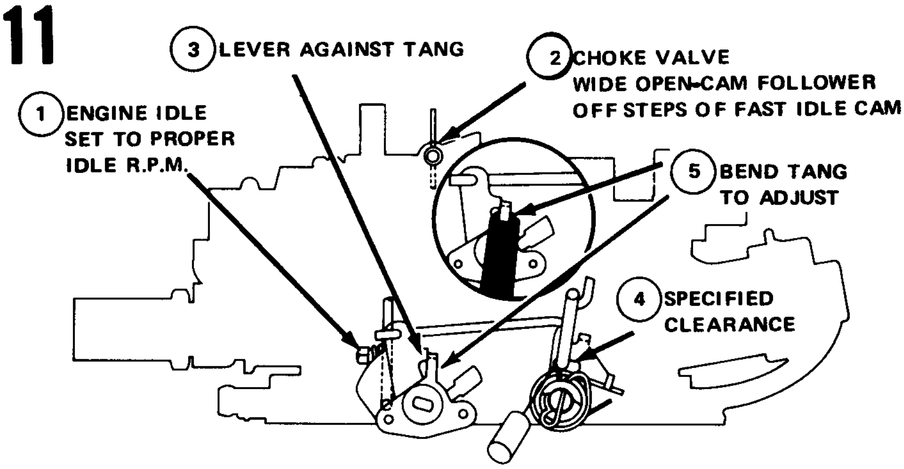
10



SECONDARY LOCKOUT ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17058254 17058559	.015"	

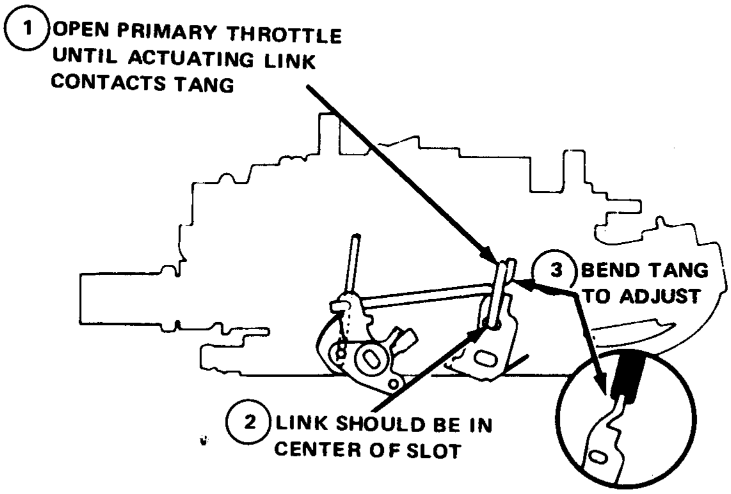
11



SECONDARY CLOSING ADJUSTMENT

CARB. NO.	PLUG GAUGE	
17058254 17058559	.020"	

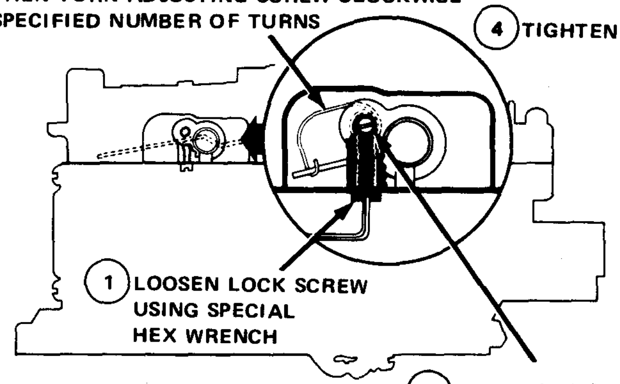
12

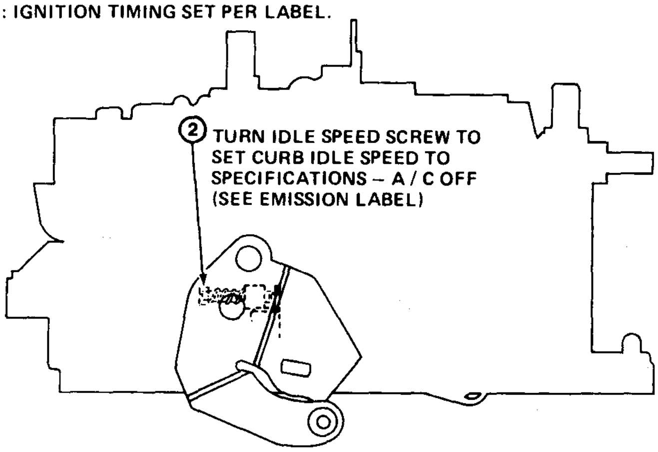


SECONDARY OPENING ADJUSTMENT A-7619

(SEE FIGURE)

Figure 46—1978 Carburetor Adjustments

<table>
<tr><td rowspan="2">13


AIR VALVE SPRING ADJUSTMENT</td><td>CARB. NO.</td><td>NO. TURNS</td><td></td></tr>
<tr><td>17058254
17058559</td><td>½</td><td></td></tr>
<tr><td>14


IDLE SPEED ADJUSTMENT -
A-7620</td><td></td><td></td><td></td></tr>
</table>

Figure 47—1978 Carburetor Adjustments

FUEL PUMP

FUEL FLOW TEST

The following revised test procedure is due to the addition of the HEI (High Energy Ignition) System:

1. Disconnect the wire from the "BAT" terminal of the HEI distributor.
2. Disconnect fuel line at the carburetor inlet fitting. Install a rubber hose approximately 8-10" long over the end of the fuel line.
3. Place a suitable container at end of the hose and crank engine a few revolutions.

NOTE: If little or no gasoline flows from open end of line then the fuel line is restricted, fuel tank screen restricted or the pump is inoperative. Correct as necessary.

4. Reconnect fuel line at the carburetor, tighten line fitting while holding fuel inlet nut.
5. Reconnect wire to the "BAT" terminal of the HEI distributor.
6. Start engine and check for leaks.

SPECIAL TOOLS

J-29789-118	Carburetor Holding Fixture
J-9789-130	Float Gauge
J-22769	Float Needle Seat Remover
J-23417	Choke Lever Installer
J-26701	Choke Angle Gauge

SECTION 6T

EMISSION CONTROL SYSTEMS

The information described in Maintenance Manual X-7525 under the heading EMISSION CONTROL SYSTEMS (SEC. 6T) is applicable to models covered by this supplement with the exception of the following:

NOTE: For emission control systems service information on the 1977 Certified 455 cubic inch engine refer to Maintenance Manual X-7525 (SEC. 6T). Procedures are the same as those described for the 1976 Certified engine.

NOTE: For intervals on servicing emission control components on the 403 cubic inch engine, refer to SECTION 0 of this supplement.

POSITIVE CRANKCASE VENTILATION (PCV)

PCV SYSTEM CHECKS

The following is a simplified PCV system checking procedure. The previously used CT-3 tester, is no longer required.

1. Remove PCV valve from engine.
2. Shake PCV valve. Listen for free movement of check needle in valve.
3. If valve does not rattle, replace valve.
4. Remove PCV valve from engine valve cover. Leave other end of valve attached to hose that is connected to carburetor at vacuum port "L". Start engine. Check for vacuum through valve by placing thumb over end of valve.
5. If no vacuum is felt, check for plugged hoses or valve. Hoses may be cleared with compressed air. If hoses are cracked or cut, replace them. The PCV valve must be replaced if plugged.

NOTE: If the PCV system is continually being plugged with deposits, the cause is generally the use of an incorrect PCV valve or excessive engine blow-by due to an engine malfunction (Refer to ENGINE (SEC. 6A) for additional assistance in diagnosing problem.)

THERMOSTATICALLY CONTROLLED AIR CLEANER

The thermostatically controlled air cleaner is standard equipment on engines covered by this manual. The unit consists of an air cleaner assembly which includes a temperature sensor, vacuum motor, control damper assembly and connecting vacuum hoses. The motor is controlled by the temperature sensor. The vacuum motor operates the air control damper assembly to control the flow of pre-heated and non pre-heated air into the carburetor. The pre-heated air is obtained from the hot air tube and shroud on the exhaust manifold.

PURPOSE

At underhood temperatures below 79°F 26°C) heated air is directed into the air cleaner. This system provides the most desirable emission control throughout the operating range of the engine and results in improved engine warm-up and eliminates tendency for ice to form in the carburetor.

OPERATION
(FIGURES 1, 2 & 3)

During engine warm-up with engine compartment temperatures below 79°F (26°C), the temperature sensor is closed. This allows engine vacuum to be directed to the vacuum motor closing the damper assembly to outside air. With the damper closed, the cool air will flow through the openings at the end of the shroud where it is heated. The heated air then flows up through the hot air pipe and adapter into the air cleaner. As the temperature inside the air cleaner reaches approximately 105°F (41°C), the sensor bleeds off vacuum to the vacuum motor causing the control damper

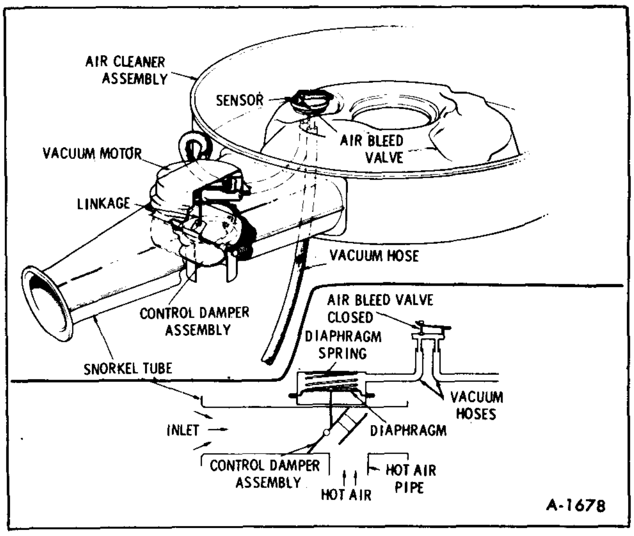


Figure 1—Hot Air Delivery Mode

to open allowing engine compartment air to be mixed with the heated air as needed to keep the air temperature approximately 105°F (41°C), if the ambient temperature is 105°F (41°C) or below.

Under full throttle or below 3" to 7" of Hg. vacuum, the vacuum motor will no longer hold the valve open to hot air. The hot air tube is closed off allowing only outside air to enter the air cleaner.

SYSTEM CHECKS

Inspect installation to make certain all vacuum hoses and the hot air flexible aluminum tube are properly connected. Check vacuum motor and damper assembly for proper operation. Checking procedure is given under "Diagnosis".

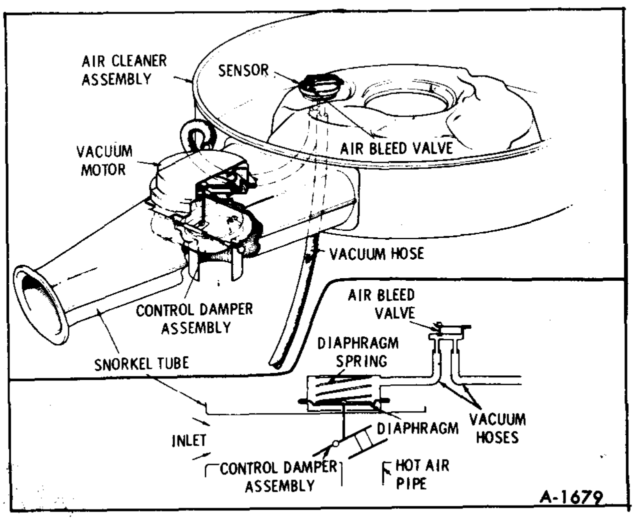


Figure 2—Regulating Mode

DIAGNOSIS

VACUUM MOTOR AND DAMPER ASSEMBLY

1. With the engine off, remove air cleaner cover and tape thermometer (J-5421) in air cleaner next to sensor (figure 4).

NOTE: If temperature is below 79°F (26°C) continue to Step 2. If temperature is above 79°F (26°C) remove air cleaner and allow to cool to at least 72°F (22°C).

2. Install a tee in vacuum line at vacuum motor and connect a vacuum gauge in line.
3. With engine off, the control damper should be open.
4. Install the cover on the air cleaner without the wing nut and start the engine.
5. With engine at idle speed, the control damper should be closed with the ambient temperature at 79°F (26°C) or below.
6. Using a small mirror observe the control damper snorkel. When it reaches the full open position (outside air), quickly remove cover on air cleaner and record reading on thermometer and vacuum gauge. Refer to "Specifications for Damper Operation" to determine if damper is operating properly.

SPECIFICATIONS FOR DAMPER OPERATION

Temperature
79°F (26°C) or lower, damper fully closed;
151°F (66°C) or higher, damper fully open.

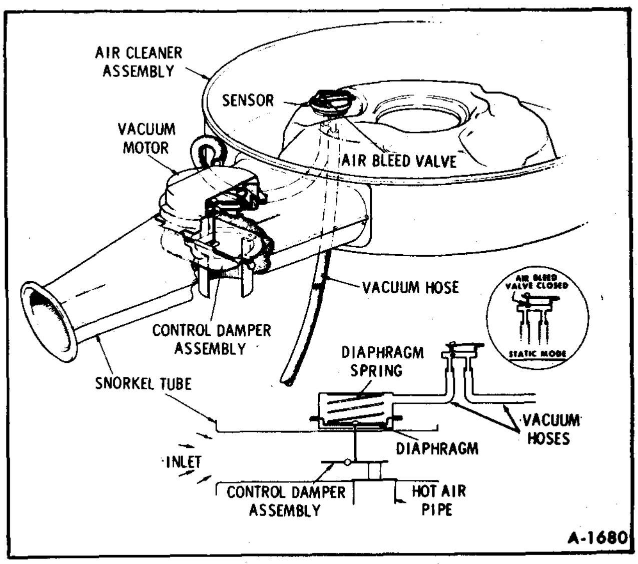


Figure 3—Cold Air Delivery Mode

Vacuum

3" of vacuum or lower, damper fully open. Below 79°F (26°C).

7" of vacuum or higher, damper fully closed. Below 79°F (26°C).

1. If temperature is within specifications, the thermostatically controlled air cleaner is functioning properly.
2. If temperature is out of specifications and vacuum is correct, replace sensor.
3. If both temperature and vacuum are within specifications and damper is not operating correctly, replace vacuum motor.
4. If both temperature and vacuum are not within specifications, it is an indication that the vacuum motor diaphragm is leaking.

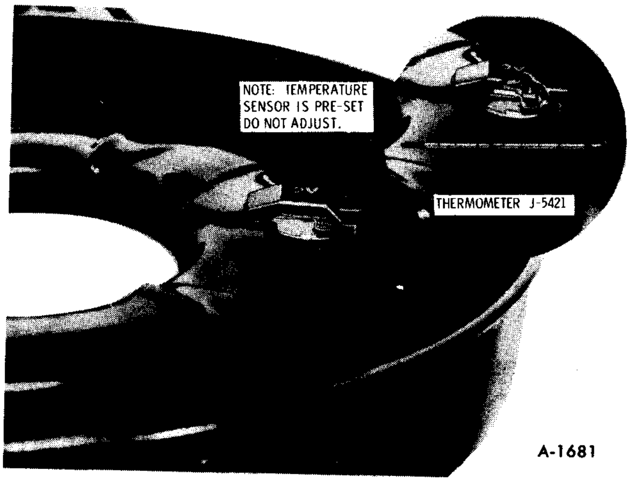


Figure 4—Checking Air Cleaner Sensor

COMPONENT REPLACEMENT

Refer to Maintenance Manual X-7525 (SEC. 6T) for component replacement procedures.

ADDITIONAL EMISSION CONTROLS

Two additional emission control systems are found on the 1977 and 1978 Certified 403 engines. The systems are Thermal Vacuum Switch (TVS) and Throttle Return Control (TRC).

NOTE: Figure 5 is a schematic of the TVS and TRC system components and hose routing for all engines except California. Figure 6 is an emission control schematic of 1977 California engines.

CARBURETOR VACUUM PORTS

All vacuum ports on the carburetor have a identification letter located on the carburetor near each port opening. Following is a list of the port openings (by letter), and also what connects to that specific port:

NOTE: It is essential when performing any service work on the engine that all vacuum hoses be reconnected to the proper vacuum port.

AIR HORN

A—Vacuum Hose to Vacuum Break
M—Vent Tube for Float Bowl
F—Clean Air Hose to Choke Hot Air Pipe
G—Vent Hose to Vacuum Delay Valve

FLOAT BOWL

B—Hose to TVS Switch and Solenoid Valve (Full Manifold Vacuum)
H—Hose to TVS Switch (Ported Vacuum)
T—Hose to Carbon Canister (1978 California Carburetor, ONLY)

THROTTLE BODY

N—Hose to Air Cleaner
L—PCV Valve to Throttle Body
K—Carbon Canister Purge Hose

TVS SYSTEM

The Thermal Vacuum Switch (TVS) System is used on all 1977 and 1978 Certified 403 engines. The TVS function is to control spark timing at specified intervals during engine operation. Differences in components exist between California engines and all other states. These differences will be explained in the following:

TVS (ALL ENGINES EXCEPT CALIFORNIA) (FIGURE 5)

Description

The retarded spark setting at idle speeds required for effective emission control makes engines tend to run hotter during idle or low speed operation.

To protect against overheating, the engine is equipped with a thermal vacuum switch (TVS). The temperature sensitive switch is mounted in the engine cooling jacket near the right

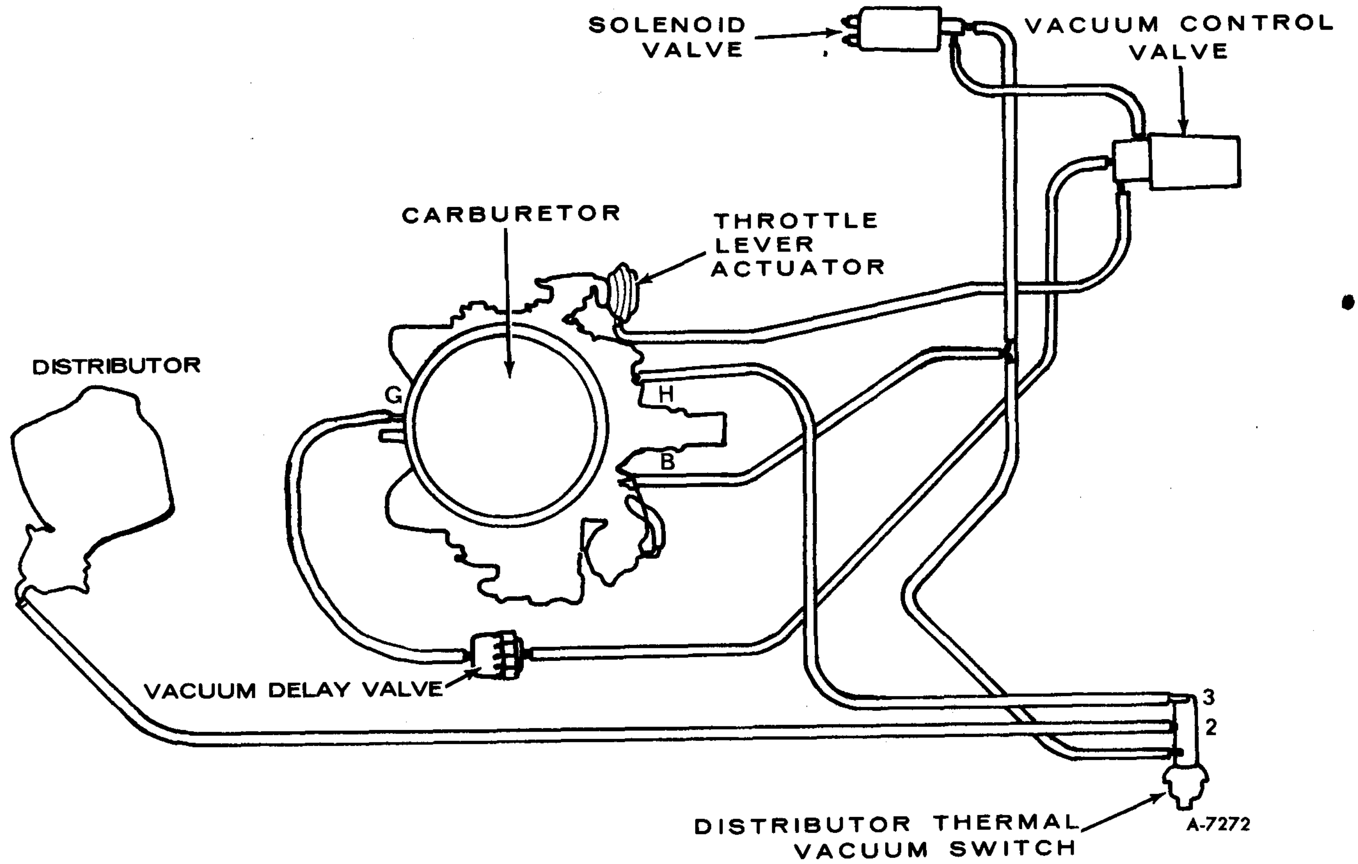


Figure 5—Emission Control Vacuum Hose Schematic (All Engines Except California)

front of the intake manifold. Vacuum control hoses are connected to the switch and to the distributor vacuum advance mechanism.

Operation

When the engine coolant reaches a temperature of 217-223°F (103-106°C) the valve inside the TVS switch changes position and directs manifold vacuum to the distributor advance mechanism. This advances the spark timing slightly and speeds up the engine. The result is less heat rejected to the coolant together with higher fan speed for better cooling action. This is the only time the distributor vacuum advance mechanism is advanced at idle speed.

When the engine has cooled down, below 210°F (99°C), the valve inside the TVS switch moves back to retard spark timing at idle speed.

TVS Switch Hose Routing

Port "3" (Top Port)	Hose to Ported Vacuum on Carburetor (Carburetor Port "H")
Port "2" (Middle Port)	Hose to Distributor Vacuum Advance Mechanism
Bottom Port	Hose to Manifold Vacuum on Carburetor (Carburetor Port "B") and Solenoid Valve

TVS Switch Functional Check

With engine off — coolant temperature below 210°F (99°C):

1. Disconnect hose and cap port "3" (top port).
2. Disconnect hose at port "2" (middle port). Connect a vacuum gauge to port "2".
3. Disconnect hose from bottom port. Connect an external vacuum source to bottom port (such as J-23738). Apply 17 inches Hg vacuum to the bottom port. If vacuum gauge at port "2" (middle port) reads greater than 5 inches Hg, replace the TVS switch.
4. Remove external vacuum source, vacuum gauge, and port cap. Reconnect vacuum hoses to proper port on switch (figure 5).

NOTE: The TVS switch must be installed with soft sealant on the threads.

5. Check all hoses for proper connection, cracking, abrasion or deterioration. Replace as necessary.

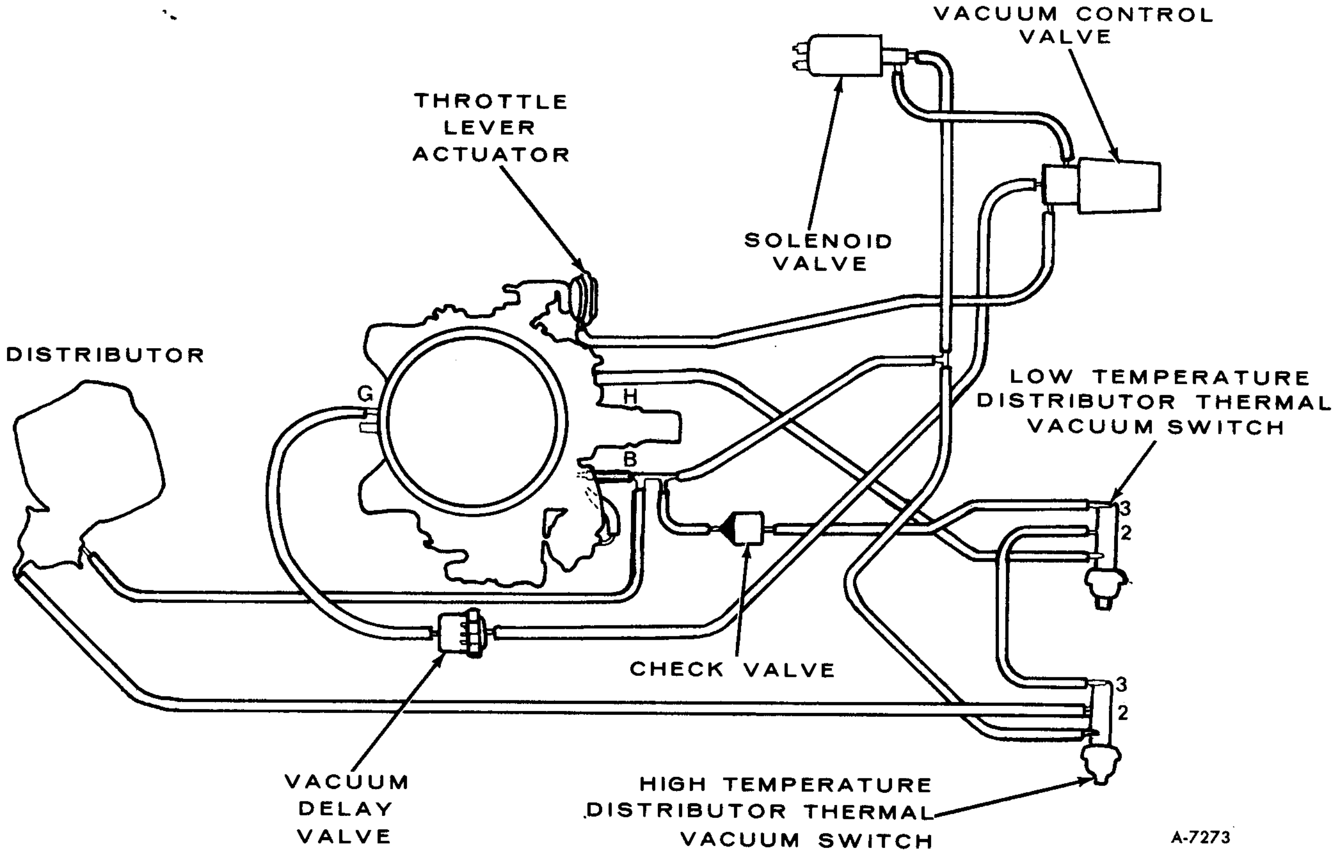


Figure 6—Emission Control Vacuum Hose Schematic (1977 California Engines)

TVS (CALIFORNIA ENGINES ONLY)
(FIGURES 6 AND 7)

NOTE: The 1977 and 1978 California TVS systems are the same, except for modifications in hose routings due to changes in the 1978 Evaporation Control System (ECS). Details of the ECS changes are covered in SEC. 8 of this supplement.

The California TVS system contains additional controls for distributor vacuum advance beyond that used on engines for other states. These additional components are: Low Temperature TVS Switch, vacuum check valve, additional vacuum hoses, and distributor vacuum unit that includes both an advance and retard feature.

NOTE: The high temperature TVS switch is the same switch as used on engines for other states. The upper portion of the high temperature TVS switch (located right front of intake manifold) is black in color. While the upper portion of the low temperature TVS switch (located left front of intake manifold) is yellowish-white in color.

Operation

1. Below 160°F (71°C)—During cold operation with temperature below 160°F (71°C), the vacuum applied to the distributor advance unit is the highest vacuum trapped by the check valve until the coolant temperature reaches 160°F (71°C). During this period the distributor is advanced (vacuum advance unit) at all throttle positions to improve cold driveability.

2. 160-180° F (71-82° C)—During normal operation with the throttle open and the coolant temperature between 160-180°F (71-82°C), ported vacuum is connected to the vacuum advance connection of the distributor. At the same time vacuum is applied to the retard connection of the distributor. This results in distributor advance because the advance side of the vacuum diaphragm unit has a larger effective area than the retard side.

At idle, with the throttle closed, ported vacuum applied to the advance connection is ineffective compared to the vacuum applied to the retard connection and the distributor timing is retarded. This is the only period in which the distributor is retarded.

3. Above 220°F (104°C)—During hot operation with coolant temperature above 220°F

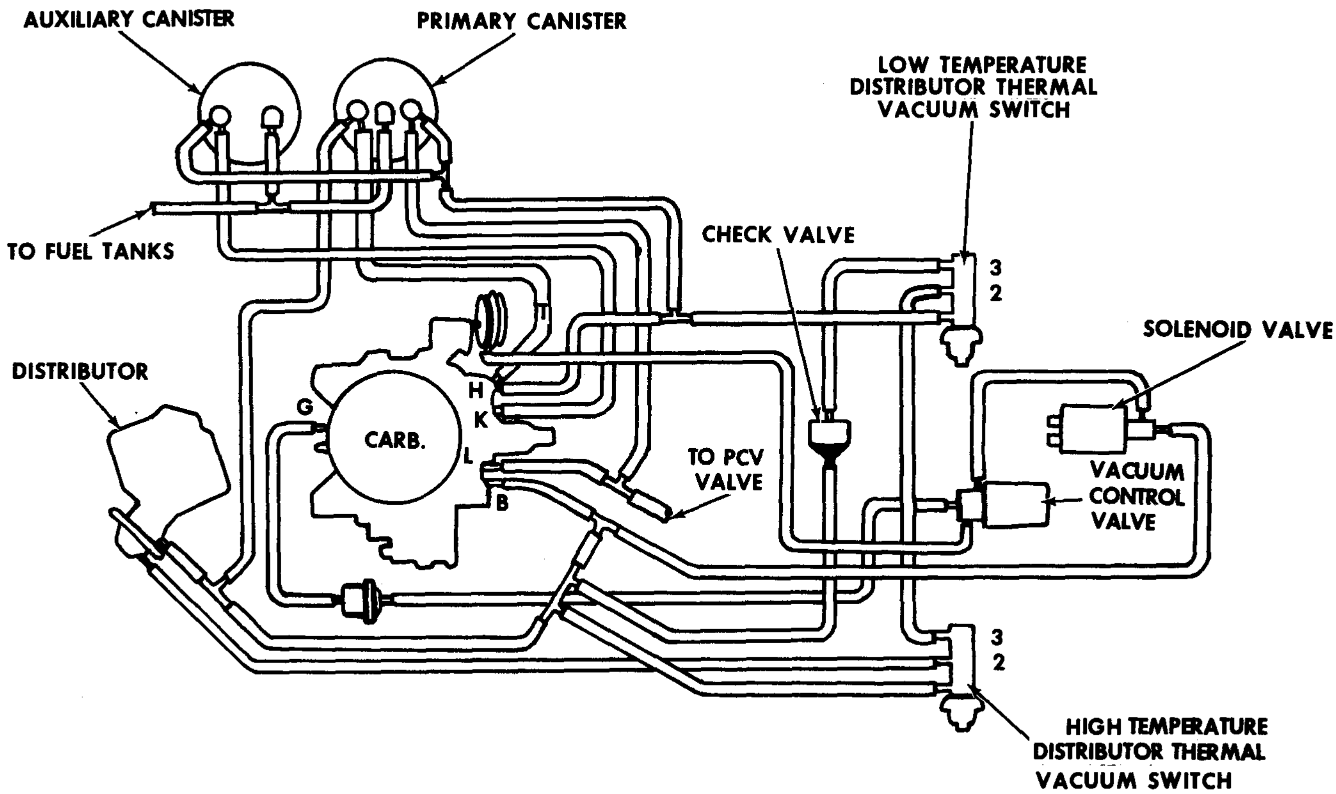


Figure 7—Emission Control Vacuum Hose Schematic (1978 California Engines)

(104°C), manifold vacuum is applied to the distributor vacuum advance connection, advancing the timing. This results in better engine cooling, particularly at idle.

High Temperature TVS Switch Hose Routing

Port "3" (Top Port)	Hose to Low Temperature TVS Switch (Port "2")
Port "2" (Middle Port)	Hose to Distributor Vacuum Advance Mechanism
Bottom Port	Hose to Manifold Vacuum on Carburetor (Carburetor Port "B") and Solenoid Valve

Low Temperature TVS Switch House Routing

Port "3" (Top Port)	Hose to Check Valve and Manifold Vacuum on Carburetor (Carburetor Port "B")
Port "2" (Middle Port)	Hose to High Temperature TVS Switch (Port "3")
Bottom Port	Hose to Ported Vacuum on Carburetor (Carburetor Port "H")

High Temperature TVS Switch Functional Check

With engine off - coolant temperature below 210°F (99°C).

1. Disconnect hose and cap port "3" (top port).
2. Disconnect hose at port "2" (middle port). Connect a vacuum gauge to port "2".
3. Disconnect hose from bottom port. Connect and external vacuum source to bottom port (such as J-23738). Apply 17 inches Hg vacuum to the bottom port. If vacuum gauge at port "2" (middle port) reads greater than 5 inches Hg, replace the TVS switch.
4. Remove external vacuum source, vacuum gauge, and port cap. Reconnect vacuum hoses to proper port on switch (figures 6 and 7).

NOTE: The TVS switch must be installed with soft sealant on the threads.

5. Check all hoses for proper connection, cracking, abrasion, or deterioration. Replace as necessary.

Low Temperature TVS Switch Functional Check - Below 160°F (71°C)

Use same procedure as "High Temperature

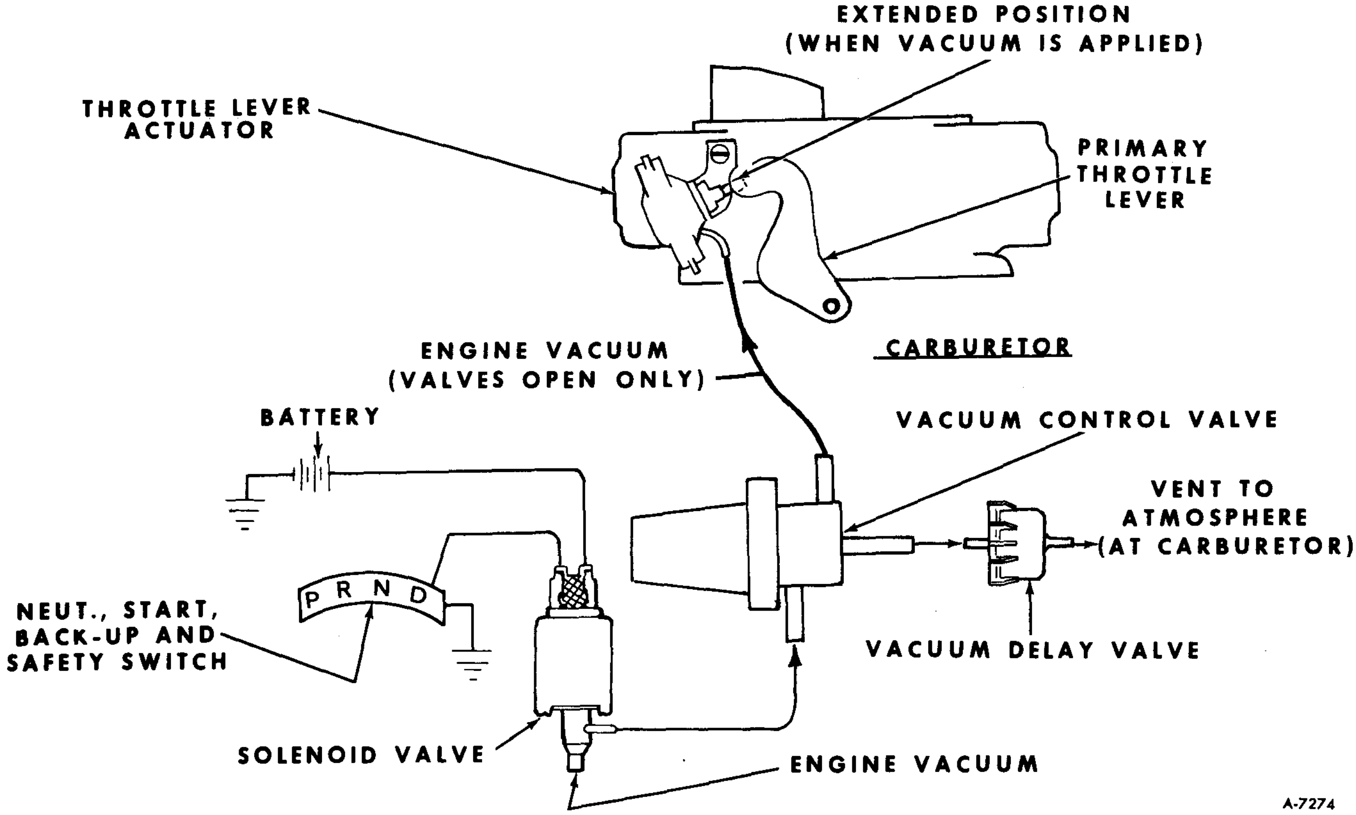


Figure 8—Throttle Return Control System

TVS Switch Functional Check" given immediately preceeding this step.

Low Temperature TVS Switch
Functional Check - Above 160°F (71°C)

With engine off - coolant temperature above 160°F (71°C).

1. Disconnect hose and cap bottom port.
2. Disconnect hose and attach a vacuum gauge to port "2" (middle port).
3. Disconnect hose from port "3" (top port). Connect an external vacuum source (such as J-23738) to port "3". Apply 17 inches of Hg vacuum to port "3". If vacuum gauge at port "2" (middle port) reads greater than 5 inches of Hg, replace the low temperature TVS switch.
4. Remove external vacuum source, vacuum gauge, and port cap. Reconnect vacuum hoses (figures 6 and 7).

NOTE: The TVS switch must be installed with soft sealant on the threads.

5. Check all hoses for proper connection, cracking, abrasion, or deterioration. Replace as necessary.

THROTTLE RETURN CONTROL (TRC)

Vacuum hose routings for the throttle return control (TRC) system is shown in figures 5, 6 and 7. Figure 8 illustrates a simplified layout of the TRC system.

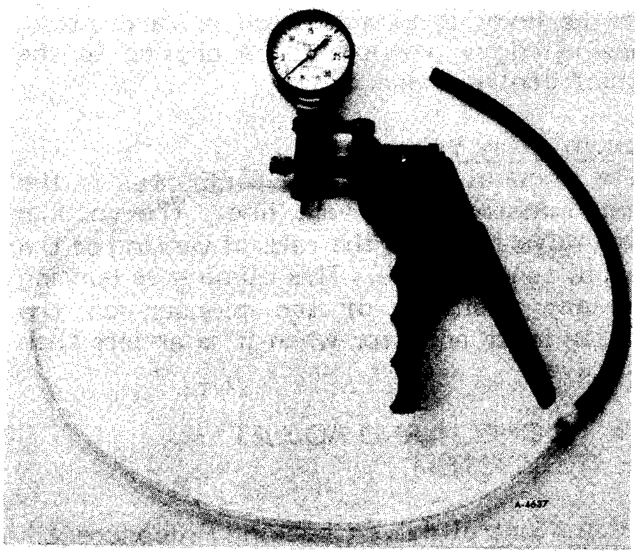


Figure 9—Vacuum Pump and Gauge (J-23738)

The TRC system is designed to reduce hydrocarbon emissions during decelleration by controlling the rate of throttle closing, causing a more complete buring. The system consists of: throttle lever actuator, vacuum control valve, solenoid valve, and vacuum delay valve.

TRC COMPONENTS (FIGURE 8)

Throttle Lever Actuator

The throttle lever actuator is mounted on the intake manifold at the carburetor. This device controls the position of the primary throttle plates a preset amount in excess of curb idle when engine vacuum is applied. This actuating vacuum is controlled by a separate vacuum control valve.

The throttle lever actuator bracket is secured by two bolts torqued to 20-25 ft. lbs. The actuator is mounted to the bracket by a single nut torqued to 15-20 ft. lbs. One tab on the washer under the nut is to be bent up against side of nut after torquing.

Vacuum Control Valve

The vacuum control valve is bracket mounted to the engine and retained by a single nut torqued to 15-20 ft. lbs. This on-off valve senses engine vacuum when the solenoid valve is open, and opens above a preset high vacuum level. The valve when open allows a vacuum signal to be applied to the throttle lever actuator as long as the preset vacuum level is exceeded.

Solenoid Valve

The solenoid valve is bracket mounted to the engine by a single bolt torqued to 25-30 ft. lbs. This on-off valve opens when the transmission selector lever is in a forward drive position, allowing engine vacuum to be applied to the vacuum control valve.

Vacuum Delay Valve

The vacuum delay valve is mounted in the vacuum control valve vent line. The vacuum delay valve restricts the rate of venting of the vacuum control valve. This eliminates hunting (unsteady position) of the plunger on the throttle lever actuator when it is at less than full travel.

HOW TO CHECK AND ADJUST THE TRC SYSTEM

Vacuum Control Valve Checking Procedure

1. Disconnect vacuum control valve to solenoid valve hose at the vacuum control valve. Connect an external vacuum source (J-23738, figure 9) equipped with a vacuum gauge at valve.

2. Disconnect the valve to actuator hose at the valve and connect a vacuum gauge to the valve.

3. Remove vent hose, then place finger firmly over the end of the vent fitting.

4. Apply a minimum of 23 inches Hg vacuum to the vacuum control valve and seal off the vacuum source. The gauge on the actuator side should read the same as the source gauge. If not, then the valve needs adjustment. If the vacuum drops off on either gauge (finger still on the vent fitting), the valve is leaking and must be replaced.

NOTE: Unless accurately calibrated vacuum gauges are used, check the two gauges used in this step against each other and apply any difference observed to determine that the actuator and source vacuum readings are equal.

5. With a minimum of 23 inches Hg vacuum level in the valve, remove finger from vent fitting. The vacuum reading on the actuator side will drop to zero and the reading on the source gauge will drop to 20.0-21.0 inches Hg (valve set point). If the reading is not within these limits, the valve must be adjusted by using the following procedure.

Vacuum Control Valve Adjusting Procedure (Figure 10)

1. Disconnect vacuum control valve to solenoid valve hose at the vacuum control valve. Connect an external vacuum source equipped with a vacuum gauge (figure 9).

2. Disconnect the valve to actuator hose at the valve and connect a vacuum gauge to the valve.

3. Remove vent hose, then place finger firmly over the end of the vent fitting.

4. Apply 23 inches Hg vacuum to the control valve and seal off the valve. Remove finger from vent fitting. The vacuum reading on the actuator side will drop to zero and the reading on the source gauge will drop to a value which is designated as the valve set point. If this reading is not 20-21 inches of Hg, adjust the valve set point.

5. To adjust the valve set point:

a. Gently pry off the conical plastic cover.

b. Loosen jam nut and turn the adjusting nut in (clockwise) to raise the set point or out (counterclockwise) to lower the set point valve.

c. Recheck the valve set point per steps 3 and 4.

d. Repeat steps (b) and (c) as necessary with jam nut tightened to obtain 20-21 inches of Hg.

e. Reinstall plastic cover.

f. If the valve cannot be adjusted within limits of step (d), replace valve.

Throttle Lever Actuator Checking Procedure

1. Disconnect vacuum control valve to actuator hose at the actuator and connect to an external vacuum source equipped with a vacuum gauge (figure 9).
2. Apply 20 inches Hg vacuum to the actuator and seal off the vacuum source. If the vacuum gauge reading drops, then the actuator is leaking and must be replaced. Release vacuum to actuator.
3. Check the throttle lever, shaft, and linkage to be sure that these components operate freely without binding or sticking.
4. Start engine and run until warmed up and idle is stable. If equipped with air conditioning, turn controls to off position. Place transmission selector lever in "PARK" or "N" (neutral). Note idle rpm.
5. Apply 20 inches Hg vacuum to the actuator. Manually open the throttle slightly and allow to close against the extended actuator plunger. Note the engine rpm.
6. Release and reapply 20 inches Hg vacuum to the actuator and note the rpm to which the engine speed increases (do not assist the actuator).
7. If the rpm obtained in step 6 is not within 150 rpm of that obtained in step 5, then the actuator plunger may be binding due to dirt, corrosion, varnish, etc., or the actuator diaphragm may be too weak. If binding is not indicated or cannot be corrected, then the actuator must be replaced.
8. Release the vacuum from the actuator and the engine speed should return to within 50 rpm of the idle speed noted in step 4. If it does not the plunger may be binding due to dirt, corrosion, varnish, etc. If the problem cannot be corrected, the actuator must be replaced.

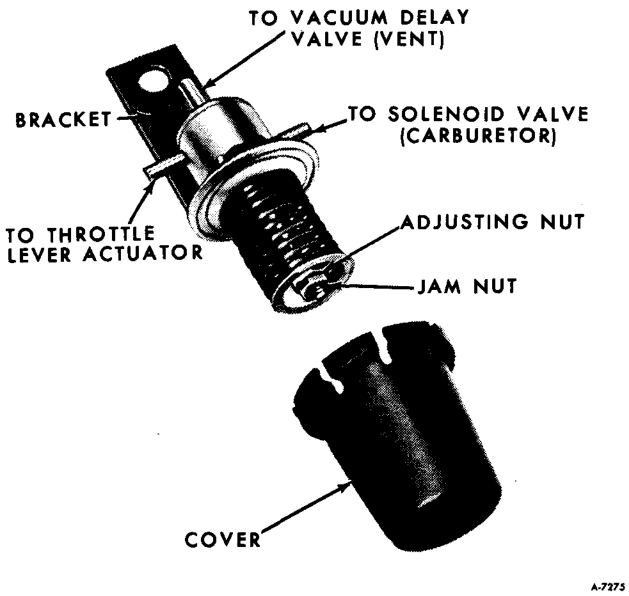


Figure 10—Vacuum Control Valve

Throttle Lever Actuator Adjusting Procedure

1. Throttle lever should rest on curb idle screw (choke fully open).
2. Adjust stem of actuator to provide 0.020 inch clearance between actuator stem and throttle lever.

Vacuum Delay Valve Checking Procedure

1. Remove vacuum delay valve (figure 8) from control valve vent line.
2. Install hand operated vacuum source equipped with a vacuum gauge (figure 9) to port marked "SOL".
3. Seal port marked "DIST" with finger. Apply 15 inches Hg vacuum to "SOL" port. Vacuum gauge should hold steady. If gauge drops to zero (with "DIST" port sealed) valve is leaking and must be replaced.
4. Remove finger from "DIST" port. Vacuum should fall slowly to zero. (15 inches Hg drops to 5 inches Hg in 4-7 seconds.)

a. If vacuum remains steady or drops at a slower rate than 10 inches Hg in 7 seconds, valve is plugged and should be replaced.

b. If vacuum falls at a faster rate than 10 inches Hg in 4 seconds, replace valve.

SPECIAL TOOLS

J-5421	Thermometer
J-23738	Hand Operated Vacuum Pump

SECTION 6Y
ENGINE ELECTRICAL

The information described in Maintenance Manual X-7525 under the heading ENGINE ELECTRICAL (SEC. 6Y) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

The following "Caution" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology "CAUTION: See "Caution" on page two of this section".

CAUTION: 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 EXPENSE. IT MUST BE REPLACED WITH ONE OF 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. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

BATTERIES

1977 and 1978 Motorhome and TransMode vehicles are equipped with two batteries: the main (automotive) battery and an auxiliary battery. TransMode vehicles equipped with the optional motor generator also have a third or cranking battery located in the motor generator (storage) compartment

MOTORHOME: The main (chassis) battery in the 1977 and 1978 Motorhome is a maintenance-free battery identified by the absence of vent plugs on the cover. The auxiliary (living area) battery may be either a maintenance-free battery or a flame arrestor-type filler vent cap battery.

TRANSMODE: 1977 and 1978 TransMode vehicles have maintenance-free main and auxiliary batteries. TransModes equipped with the motor generator option include a maintenance-free cranking battery for the motor generator.

BATTERIES WITH FLAME ARRESTOR VENT CAPS

See ENGINE ELECTRICAL (SEC. 6Y) in Maintenance Manual X-7525 for information on batteries with flame arrestor vent caps.

MAINTENANCE-FREE BATTERIES

DESCRIPTION

The maintenance-free battery (figure 1) is identified by the absence of vent plugs on the cover. The side-mounted positive and negative terminals are tightly sealed to retard possible leakage. Except for the small vent holes located on each side, the battery is completely sealed. The vent holes should be free from obstruction because they allow gases produced in the battery to escape. At normal charging voltages, the amount of these gases is extremely small, due to the special chemical composition in the battery grid design. Water never needs to be added to the maintenance-free battery.

TEST INDICATOR

A test indicator in the battery cover provides a visual inspection area for testing purposes only. It is not to be used to determine if the battery is good or bad, charged or discharged. Correct use of this feature is important. Refer to "Testing Maintenance-Free Batteries" below. Refer also to figure 1 in this section.

BATTERY MAINTENANCE

The battery carrier and holddown should be clean and free from corrosion prior to battery replacement. The carrier should also be in sound mechanical condition so that it will support the battery securely and keep it level.

To prevent the battery from shaking in its carrier, the wing nuts should be tight. However, the wing nuts should not be tightened to the point where the battery case or cover will be placed under severe strain.

The external condition of the battery should be checked periodically for damage such as cracked cover, case and vent plugs or for the presence of dirt and corrosion. The battery should be kept clean. An accumulation of acid film and dirt may permit current to flow between the terminals, which will slowly discharge the battery. For best results when cleaning batteries, wash first with a diluted ammonia or a soda solution to neutralize any acid present; then flush with clean water.

BATTERY DIAGNOSIS

A battery has three major functions in the chassis electrical system. First, it provides a source of 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 used exceeds the output of the generator.

The battery is not designed to last indefinitely; however, with proper care it will provide many years of service.

If the battery tests good but fails to perform satisfactorily in service for no apparent reason, one or more of the following factors may be the cause of the trouble:

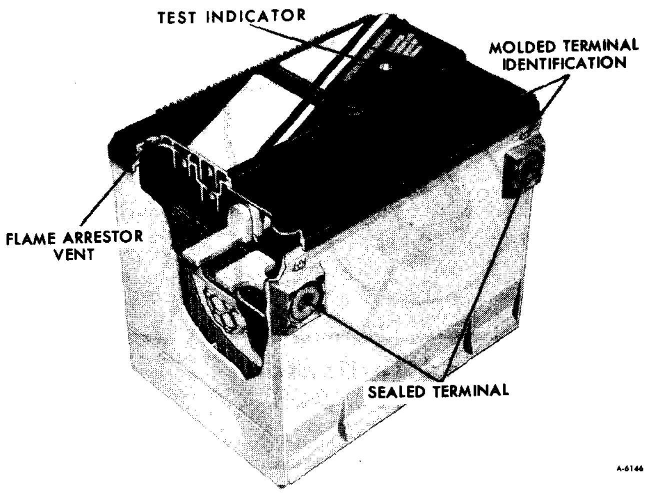
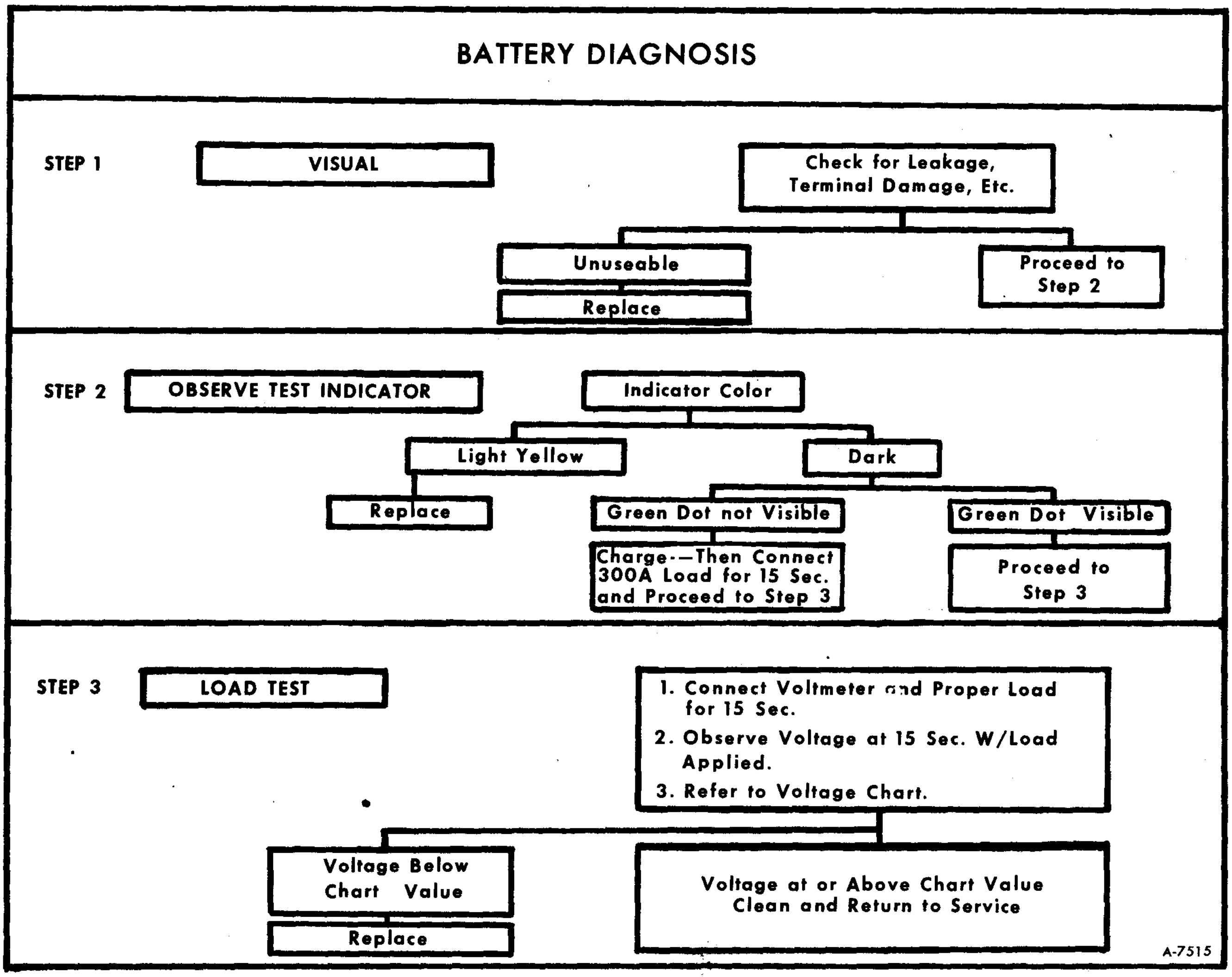


Figure 1—Maintenance-Free Battery

1. Vehicle accessories inadvertently left on overnight.
2. Slow-speed driving for short duration.
3. Vehicle electrical load exceeding the generator capacity, particularly if a lot of



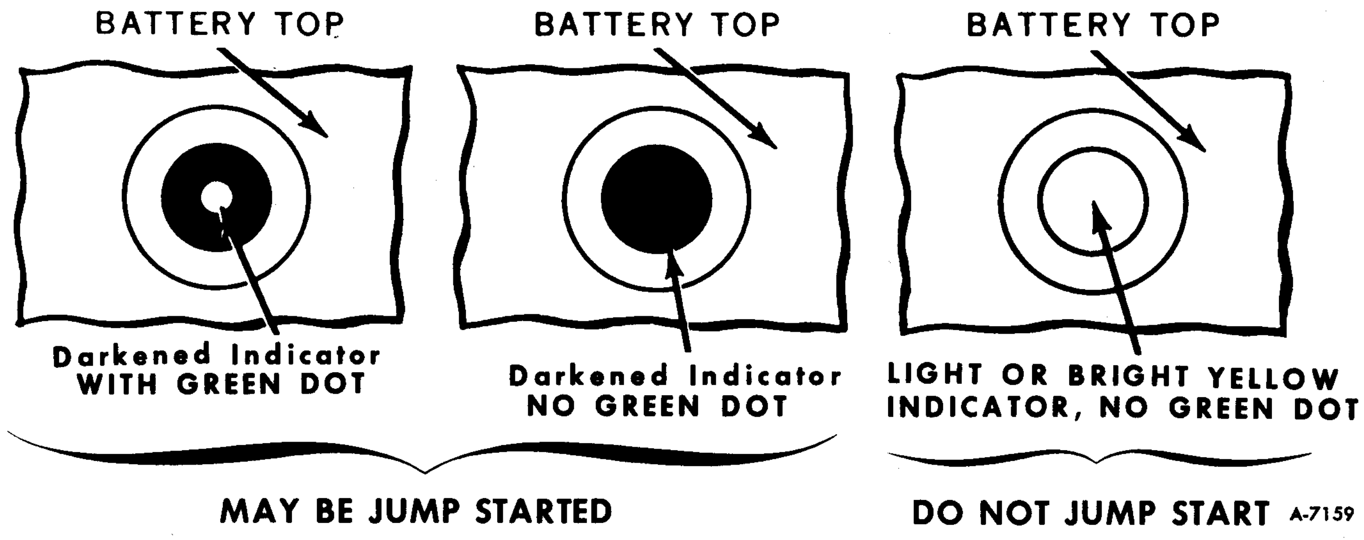


Figure 2—Test Indicator Conditions (Maintenance Free Battery)

special equipment has been added to the system.

4. Defects in the charging system such as high resistance connections, slipping fan belt, faulty generator or voltage regulator.

5. Battery abuse, which includes the failure to keep the battery cable terminals clean and tight, or, loose battery hold-down.

6. Mechanical defects in the electrical system, such as shorted or pinched wires.

TESTING MAINTENANCE-FREE BATTERIES

STEP 1 - VISUAL INSPECTION

Check for obvious damage, such as cracked or broken case or cover that could permit loss of electrolyte. If obvious physical damage is noted, replace battery. Determine cause of damage and correct as necessary.

STEP 2 - TEST INDICATOR (FIGURE 2)

The test indicator, built into the top cover, provides a visual inspection area for battery testing only. This test indicator is to be used only with accepted diagnostic procedures. It is not to be used by itself to determine if the battery is good or bad, or charged or discharged. The indicator includes a plastic rod that extends into the electrolyte. At the bottom of the rod, a green plastic ball is suspended in a cage. When the electrolyte specific gravity is about 1.225 or above, the green ball floats against the end of the rod and becomes visible so that the indicator appears GREEN. At this 1.225 specific gravity, the battery is approximately 3/4 full charge. When the battery is less than about 3/4 fully charged, the green ball sinks and the indicator appears DARK. When the electrolyte level drops below a minimum level, i.e., below the pointed tip of the rod, the indicator window changes to YELLOW or CLEAR. In this case the charging system should be checked. Although the battery is capable of further service, if a cranking complaint has been reported, replace the battery. DO NOT CHARGE, TEST OR JUMP START.

It is important when observing the test indicator that the battery be relatively level and have a clean top so that the correct indication may be seen. A light may be required in some poorly lit areas. Following are the possible test indicator readings:

A. GREEN DOT VISIBLE.

Any green appearance is interpreted as a "green dot" and the battery is ready for testing. Proceed to step 3.

B. DARK—GREEN DOT NOT VISIBLE.

Battery must be charged before testing. Refer to "Charging Procedure" later in this section.

NOTE: Battery should be charged until green dot appears, but not more than 60 ampere hours (for example - 15 amperes for four hours). Do not charge a battery if the green dot is visible. (On rare occasions immediately following periods of prolonged cranking, the green dot may still remain visible. If left alone, the dot will disappear in a short time. Should this occur, a boost-charge of 20 ampere-hours is recommended.)

C. LIGHT

DO NOT attempt charging or testing when charge indicator is light. Check charging system.

CAUTION: *To avoid explosion hazard, never attempt to charge or jump start a maintenance-free battery which exhibits a light indicator condition. Departures from this procedure could result in serious personal injury or property damage.*

STEP 3 - REMOVE SURFACE CHARGE

Connect 300-ampere load across terminals for 15 seconds to remove surface charge from the battery. Be sure and stop the load after 15 seconds.

If battery is in the vehicle, connection may be made to existing terminals. If battery is out of vehicle, adapters for the side terminals are required.

STEP 4 - LOAD TEST

A. Connect voltmeter and proper ampere load across terminals. Refer to the following "Load Chart" for the proper ampere load as used for a specific battery.

AMPERE LOAD CHART

PART NUMBER	MODEL NUMBER	AMPERE LOAD
1980400	R85-5	170A
1980402	R89-5	230A

B. Read voltage after 15 seconds with load connected, then disconnect load.

C. If minimum voltage is 9.6* or more, battery is good.

D. If minimum voltage is less than 9.6*, replace battery.

*This volatge (9.6) is to be used for battery ambient temperatures of 70°F (21°C) and above. For temperatures below 70°F refer to "Voltage and Temperature Chart" below.

VOLTAGE AND TEMPERATURE CHART

AMBIENT TEMPERATURE	MINIMUM VOLTAGE
70°F & Above (21°C)	9.6
60°F (16°C)	9.5
50°F (10°C)	9.4
40°F (4°C)	9.3
30°F (-1°C)	9.1
20°F (-7°C)	8.9
10°F (-12°C)	8.7
0°F (-18°C)	8.5

CHARGING PROCEDURE

The maintenance-free battery can be fast charged or slow charged with ordinary chargers in the same manner as for conventional batteries. Either method will restore the battery to full charge. However, the time required for full charge depends upon battery state of charge, capacity, temperature and charger capability.

On rare occasions following a prolonged cranking, the green dot in the test indicator may still be visible as shown in figure 2. Should this occur, a boost charge of 20-ampere hours (maximum) is permissible. When there has been a cranking complaint and the test indicator is completely dark in appearance, charge the battery (50-75 ampere hours) and then proceed to test the battery.

DO NOT CHARGE OR LOAD TEST a maintenance-free battery when the test indicator is completely light yellow or clear in appearance. When this occurs, replace the battery.

CHARGING OR TESTING ADAPTERS

Batteries may be charged or tested either in or out of the vehicle. However, if the batteries are charged or tested out of the vehicle, terminal adapters are necessary to facilitate the procedures.

CHARGING GUIDELINES

Typical charging guidelines that apply to all batteries, including maintenance-free, are as follows:

1. Discontinue charge if spewing of electrolyte occurs, or if battery temperature exceeds 125°F.
2. Do not charge if electrolyte level is low . (light yellow indication).
3. Allow suspected "frozen" battery to warm up 4 to 6 hours before charging.
4. A cold, discharged battery requires more ampere-hours of charge than a warm battery; usually about 25% more.
5. A battery that has set in a "completely" discharged condition for a prolonged time, or is extremely cold, may not accept current for several hours after initially starting the charger.

Satisfactory recharge is indicated either by the attainment of the specified ampere-hours of charge or by the appearance of the green dot.

Charging periods to obtain up to 50-75 ampere hours are recommended for the most satisfactory results. Remember that charging may be stopped when the GREEN DOT APPEARS. The battery is sufficiently charged after 50-75 ampere hours even though the GREEN DOT MAY NOT YET APPEAR.

Remember that if the charge rate in amperes tapers or decreases to lower values with time, the charging time in hours would have to be increased to obtain the required number of ampere-hours. (A partially charged battery would require less time to recharge.)

BATTERY CHARGING GUIDE

MODEL	R 89-5			
SLOW RATE	5 A	@	15	HRS.
	10 A	@	7½	HRS.
FAST RATE	20 A	@	3-3/4	HRS.
	30 A	@	2½	HRS.
	40 A	@	2	HRS.
	50 A	@	1½	HRS.

MODEL	R 85-5			
SLOW RATE	5 A	@	10	HRS.
	10 A	@	5	HRS.
FAST RATE	20 A	@	2½	HRS.
	30 A	@	1½	HRS.

JUMP STARTING WITH AUXILIARY (BOOSTER) BATTERY

NOTE: Do not push or tow this vehicle to start it. Under some conditions this may damage certain parts of the vehicle.

If only the main (automotive) battery is discharged, hold battery switch on instrument panel momentarily in "BAT BOOST". This supplies current from the auxiliary battery (or batteries). After use, switch is designed to return to the "BAT NORMAL" position.

If the vehicle has discharged batteries, it can be jump started from another battery.

Both booster and discharged battery should be treated carefully when using jumper cables. Follow exactly the procedure outlined below, being careful not to cause sparks:

CAUTION: *The instructions below must be followed EXACTLY or personal injury (particularly to eyes) or property damage may result from battery explosion, battery acid, or electrical (short circuit) burns.*

THE MAJOR SAFETY PRECAUTION IS TO MAKE THE FINAL CONNECTION TO GROUND AT THE RADIATOR RIGHT MOUNTING BRACKET (PASSENGER SIDE OF VEHICLE). THIS HELPS REDUCE THE CHANCE OF AN EXPLOSION DUE TO SPARKS.

To lessen the chance of an explosion, never expose the battery to open flames or electric sparks. Also do not smoke near the battery. Batteries give off a gas which is flammable and explosive.

To lessen the risk of injury in case an explosion does occur, WEAR EYE PROTECTION or shield your eyes when working near either battery. Do not lean over a battery.

Do not allow battery fluid to contact eyes, skin, fabrics or painted surfaces because battery fluid is a corrosive acid. FLUSH ANY CONTACTED AREA WITH WATER IMMEDIATELY AND THOROUGHLY. ALSO GET MEDICAL HELP IF EYES ARE AFFECTED.

To lessen the risk of a short circuit, remove rings, metal watch bands and other metal jewelry. Also do not allow metal tools to contact:

The positive terminal junction block stud in this vehicle, marked "VEHICLE BATTERY POSITIVE", or

The positive battery terminal on either vehicle, or

Metal in contact with either positive terminal.

Also, make certain when attaching the jumper cable clamps to the junction block stud, and to the positive terminal of the other battery, that neither clamp contacts any other metal.

JUMP START PROCEDURE

1. This vehicle has a 12-volt automotive battery and a negative ground electrical system. Make sure that the other vehicle also has a 12-volt battery and negative ground. Its owner's manual may provide that information. If unsure of voltage (or if the voltage and

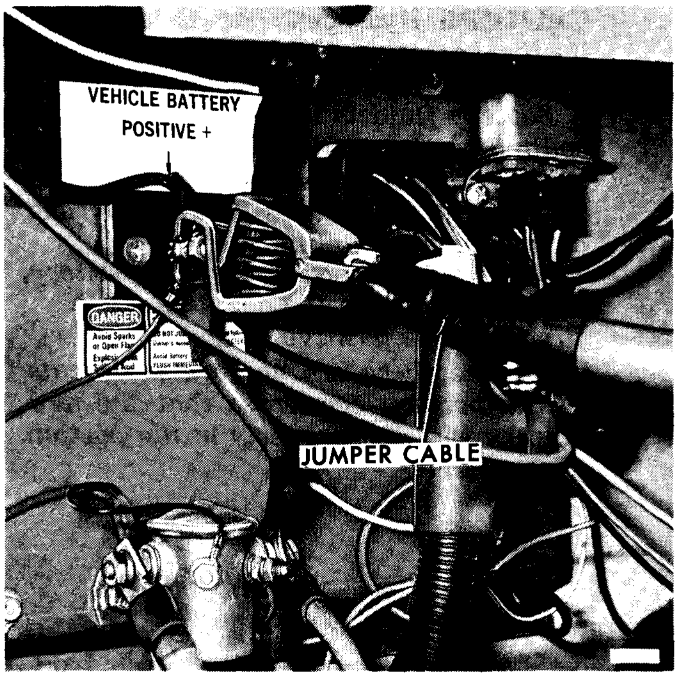


Figure 3—Connecting Jumper Cable to "Vehicle Battery Positive" Stud

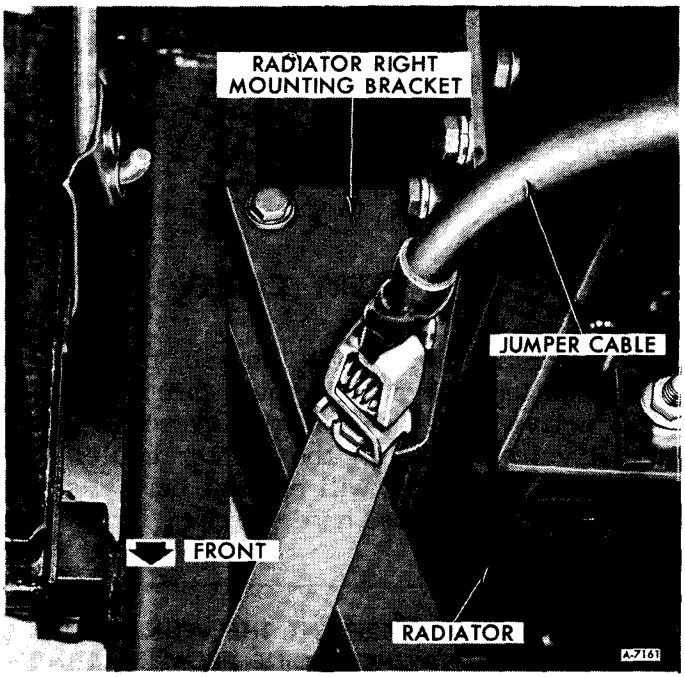


Figure 4—Connecting Jumper Cable To Radiator Right Mounting Bracket (Passenger Side)

ground are different from this vehicle), do not attempt to jump start, as personal injury or severe damage to electrical and electronic parts may result.

2. Position the other vehicle with the good (charged) battery so that the jump starting cables will reach this vehicle's battery. Do not allow the vehicles to touch, and check to see that the bumpers do not touch.

3. Turn off all electrical motors and accessories in both vehicles. Turn off all lights except those needed to protect the vehicle or illuminate the work area. Turn off the ignition, apply the parking brake firmly, and put the automatic transmission in "PARK" (manual transmission "NEUTRAL") in both vehicles.

4. If the discharged battery has filler caps, check the fluid level. (Do not use an open flame to check and do not smoke.) Add clear drinking water to the proper level if low, and replace caps before jump starting. If the battery is a sealed-type, do not attempt to jump start the vehicle, or charge or test the battery if the center of the test indicator in the battery is bright or light yellow (figure 2). Instead, install a new battery.

5. Jumper Cable Connection Instructions (See Illustrations).

- Connect the first jumper cable from the positive "+" (red) terminal on the battery in the other vehicle to the positive terminal junction block stud in this vehicle, marked "VEHICLE BATTERY POSITIVE" (figure 3). This is located behind the right access door above the main (automotive battery). Never connect "+" (red) to "-" (black), or "-" to "+".
- Next, connect one end of the second cable to the grounded negative "–" (black) terminal of the OTHER vehicle's battery, regardless of which vehicle has the discharged battery.
- Lastly, connect the other end of the second jumper cable to the radiator right mounting bracket (passenger side) in THIS vehicle (figure 4). Do not connect the cable to pulleys, fans, or other parts that move. Beware of touching hot manifolds which can cuase severe burns.

6. Start the engine in the vehicle with the good (charged) battery and run the engine at a moderate speed.

NOTE: If the discharged battery is completely dead, it may be necessary to run the engine of the vehicle with the charged battery for a few minutes at a moderate speed to slightly charge the discharged battery. This will help when cranking the engine in the vehicle with the discharged battery, especially when outside temperatures are very low.

7. Start the engine of the vehicle that has the discharged battery.

8. Remove the battery cables by reversing the above sequence EXACTLY. Start by removing the cable from the radiator right mounting bracket in THIS vehicle as the FIRST step.

BATTERY CABLES

Excessive resistance caused by terminal connection and partial short circuits through defective cable insulation will result in abnormal voltage drop in the starter cable. Low voltage at starter will prevent normal starter operation and cause hard starting.

> **WARNING: TO PREVENT THE VEHICLE FROM MOVING AND THE ENGINE FROM STARTING WHILE PERFORMING THESE CHECKS, ENGAGE THE PARKING BRAKE AND PLACE THE TRANSMISSION IN "NEUTRAL" POSITION.**

1. Check voltage drop between engine block and negative battery terminal. Place one prod of test voltmeter on engine block and the other on negative battery terminal. Operate starter and note the voltage reading.

2. Check voltage drop between ungrounded (+) battery terminal and starter terminal stud with starter operating.

3. Check voltage drop between starter housing and frame with starter operating.

4. If the voltage drop in any of the above is more than 1.0 volt, there is excessive resistance in the circuit. To eliminate resistance, the cables should be disconnected and connections cleaned. If cables are frayed or the clamps excessively corroded the cables should be replaced. When selecting new cables, be sure they are at least as large as the ones being replaced.

BATTERY REPLACEMENT

When handling a battery, the following cautions must be observed:

CAUTION: *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.

When removing or replacing a battery, always disconnect the negative cable first then the positive cable.

Be sure there are no foreign objects in the battery carrier so that the new battery will rest properly in the bottom of the carrier.

REMOVAL

1. Disconnect the negative cable from the radiator right mounting bracket.
2. Disconnect the positive cable from the positive terminal junction block stud, marked "VEHICLE BATTERY POSITIVE".
3. Loosen the battery hold-down and remove it from the carrier. Remove the battery from the vehicle.

INSPECTION

Inspect the battery for physical damage such as cracked top or battery case which would permit the loss of electrolyte. If any damage is noted, correct the cause.

INSTALLATION

1. Be sure there are no foreign objects in the carrier, so that the replacement battery will rest properly in the bottom of the carrier.
2. Install battery and tighten hold-down evenly until snug. Do not draw down tight enough to distort or crack the case or cover.
3. Be sure the cables are in good condition. Install positive battery terminal to the positive terminal junction block stud marked "VEHICLE BATTERY POSITIVE." Then connect the ground cable to the radiator right mounting bracket.
4. Torque cable connections at battery to 60-90 in. lb. Do not over-torque.
5. Check polarity to be sure the battery is not reversed with respect to the charging system.

MAINTENANCE-FREE BATTERY SPECIFICATIONS

PART NO.	VOLTS	WATT RATING @ 0^{o}F. (-18^{o}C)	MINUTES RESERVE CAPACITY @ 25 AMPS	COLD CRANKING RATING (AMPS) 0^{o}F (-18^{o}C)	COLD CRANKING RATING (AMPS) -20^{o}F (-29^{o}C)	LOAD TEST AMPS LOAD
1980400*	12	3200	80	350	270	170
1980402+	12	4000	125	465	375	230

* R-85-5: Used for Motor Generator Cranking Battery (optional) in TRANSMODE vehicles.

+ R-89-5: Main (automotive) battery in MOTORHOME vehicle. Main and auxiliary battery in TRANSMODE vehicles.

GENERATING SYSTEM

GENERATOR MOUNTING

Vehicles equipped with 403 cubic inch engine have a new generator mounting. Refer to figure 5.

GENERATOR QUICK CHECK

When generator tell-tale light is on, following procedure will aid in determining cause of problem:

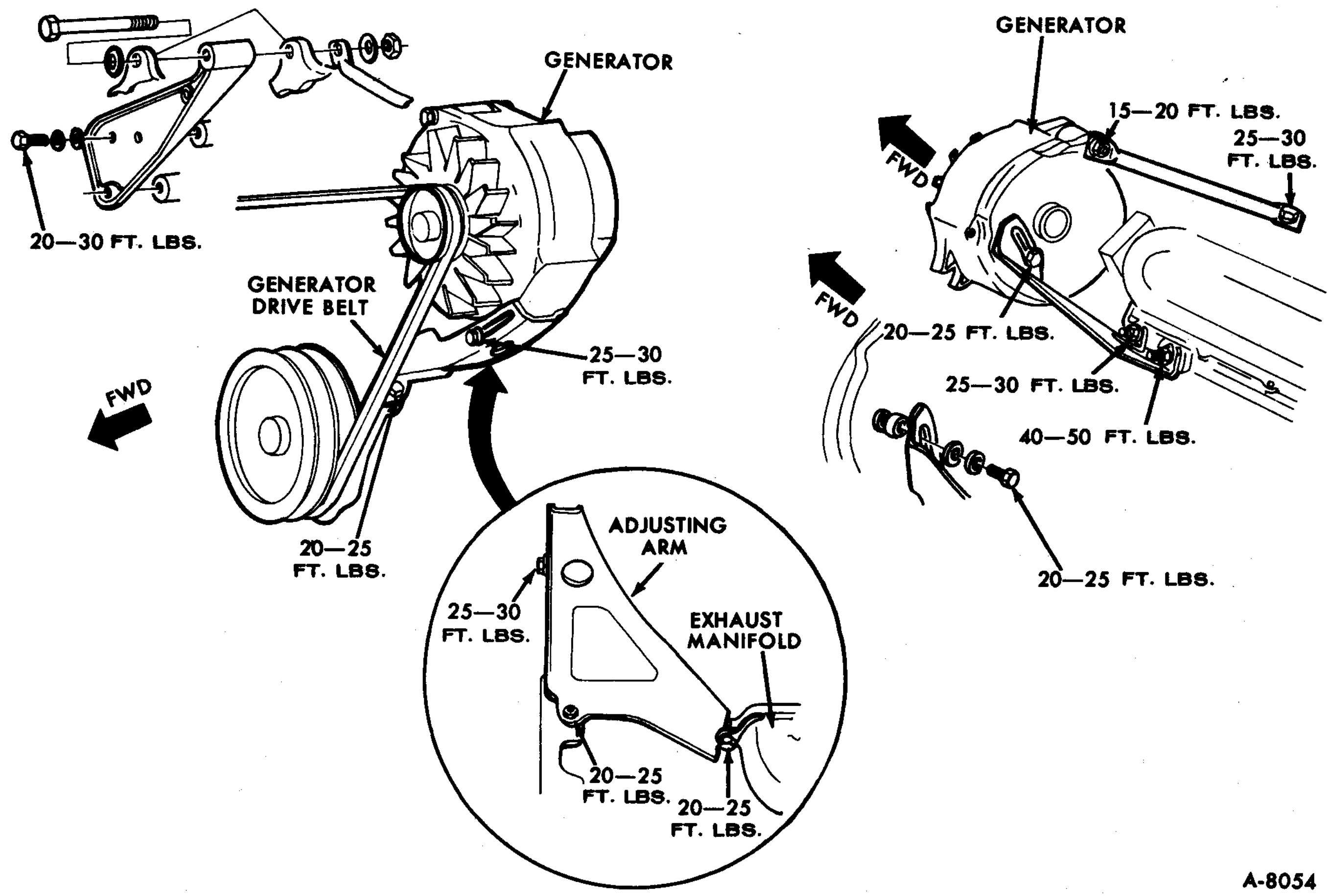


Figure 5—Generator Mounting

UNDERCHARGED BATTERY

This condition, as evidenced by slow cranking and low specific gravity readings, can be caused by one or more of the following conditions even though the indicator lamp may be operating normally. The following procedure also applies to circuits with an ammeter:

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension.
3. If a battery defect is suspected, see "Battery Service And Diagnosis" in this section.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the generator and firewall, and the cable clamps and battery posts.
5. Check operation of diode assembly as follows:

   With the engine operating at fast idle, use a voltmeter to measure voltage at the three terminals of the diode assembly. Attach the positive lead to the indicated terminal, the negative lead to chassis ground.

   a. With positive lead to generator terminal on diode assembly and negative lead to ground, reading should be 13.1 to 15.5 volts. If reading at generator terminal is zero volts, check wiring to generator for open connection.
   b. With positive lead to bat. No. 1 terminal on diode assembly and negative lead to ground, reading should be 12.1 to 14.5 volts.
   c. With positive lead to bat. No. 2 terminal and negative lead to ground, reading should be 12.1 to 14.5 volts.

   If reading on bat. terminal No. 1 or No. 2 is zero volts, replace diode assembly. Reading at battery terminals No. 1 and No. 2 should be approximately 1.0 volts less than reading at generator terminal. If reading at bat. terminals is more than 1.0 volts less than generator terminal reading, replace diode assembly.

   If readings at generator terminal and bat. terminals are identical, see "Discharged Batteries" in this chart.
6. With engine running, connect a voltmeter from:
   a. Generator "BAT" terminal to ground.
   b. Generator No. 1 terminal to ground.
   c. Generator No. 2 terminal to ground.

   A zero reading indicates an open between voltmeter connection and battery.
7. If previous Steps 1 through 6 check satisfactorily, check generator as follows:
   a. Disconnect battery ground cable.
   b. Connect an ammeter in the circuit at the "BAT" terminal of the generator.
   c. Reconnect battery ground cable.
   d. Turn on radio, windshield wipers, lights high beam and blower motor high speed. Connect a carbon pile across the battery.
   e. Operate engine at moderate speed as required, and adjust carbon pile as required, to obtain maximum current output.

If ampere output is within 10 amps of rated output as stamped on generator frame, generator is not defective; recheck Steps 1 through 6.

If amperes output is not within 10 amps of rated output, determine if test hole is accessible.

If test hole is accessible, ground the field winding by inserting a screwdriver into the test hole.

CAUTION: Tab is within 3/4-inch of casting surface. Do not force screwdriver deeper than 1-inch into end frame.

Operate engine at moderate speed as required, and adjust carbon pile as required to obtain maximum current output.

If test hole is not accessible, disassemble generator and make tests listed in "GENERATOR REPAIR", Maintenance Manual X-7525.

If output is not within 10 amps of rated output, check the field winding, diode trio, rectifier bridge, and stator as covered in "GENERATOR REPAIR", Maintenance Manual X-7525.

If output is within 10 amps of rated output, test regulator with an approved regulator tester, and check field winding as covered in "GENERATOR REPAIR", Maintenance Manual X-7525.

OVERCHARGED BATTERY

1. To determine battery condition, see "Battery Service And Diagnosis" in this section.
2. Connect a voltmeter from generator No. 2 terminal to ground. If reading is zero, No. 2 lead circuit is open.
3. If battery and No. 2 lead circuit check good, but an obvious overcharge condition exists as evidenced by excessive battery water usage, proceed as follows:
   a. Separate end frames as covered in "Disassembly" under Heading of "GENERATOR REPAIR" in Maintenance Manual X-7525. Check field winding for grounds and shorts. If defective, replace rotor and test regulator with an approved regulator tester.
   b. Connect ohmmeter using lowest range scale from brush lead clip to end frame; then reverse lead connections.
   c. If both readings are zero, either the brush lead clip is grounded or regulator may be defective.
   d. A grounded brush lead clip can result from omission of insulating washer, omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve. If satisfactory, test regulator with an approved regulator tester.

DISCHARGED BATTERIES

This condition could exist if a failed diode assembly allows the vehicle automotive battery or living area battery to be discharged by the other circuit (i.e., no isolation between battery circuits) during times when the engine is not in operation. To check diode continuity and resistance:

1. Disconnect all leads to diode assembly.
2. Connect ohmmeter leads to generator terminal and bat. No. 1 terminal at diode assembly. Using appropriate scale, observe reading. Reverse lead connections to terminals and observe reading using appropriate scale. If both readings are the same, replace diode assembly. A good diode section will give one high and one low reading.
3. Repeat above procedure with ohmmeter leads connected to generator terminal and bat. No. 2 terminal. Using appropriate scale, observe reading. Reverse lead connections to terminals and observe reading using appropriate scale. If this test gives one high and one low reading, diode assembly is good. If both readings are the same, replace diode assembly.

A-7104

Figure 6—Generating System Diagnosis

FAULTY INDICATOR LAMP OPERATION

Check the indicator lamp for normal operation as shown below:

Switch	Lamp	Engine
OFF	OFF	STOPPED
ON	ON	STOPPED
ON	OFF	RUNNING

If the indicator lamp operates normally, proceed to "UNDERCHARGED BATTERY" or "OVERCHARGED BATTERY" in the "GENERATING SYSTEM DIAGNOSIS CHART" in this section. Otherwise, proceed to either one of the following three abnormal conditions:

<ins>Switch On, Lamp Off, Engine Stopped</ins> - This condition can be caused by the defects listed under "Switch Off, Lamp On" or by an open in the circuit.

<ins>Switch Off, Lamp On</ins> - In this case, disconnect the two leads from the generator No. 1 and No. 2 terminals. If the lamp stays on, there is a short between these two leads. If the lamp goes out, replace the rectifier bridge as covered in "GENERATOR REPAIR", Section 6Y, Maintenance Manual X-7525. This condition will cause an undercharged battery.

<ins>Switch On, Lamp On, Engine Running</ins> - Check for a blown fuse (where used) between indicator lamp and switch. The other possible causes of this condition are covered in "UNDERCHARGED BATTERY" in the "GENERATING SYSTEM DIAGNOSIS CHART" in this section.

To determine where an open exists, check for a blown fuse, a burned out bulb, defective bulb socket, or an open in No. 1 lead circuit between generator and ignition switch.

If no defects are found, proceed to "UNDERCHARGED BATTERY" in the "GENERATING SYSTEM DIAGNOSIS CHART" in this section.

A-7198

Figure 7—Faulty Indicator Lamp Operation

1. With vehicle not running, attach voltmeter leads across automotive battery terminals, the red lead to the battery positive (+) terminal and the black lead to the battery ground (-) terminal.
2. Check voltage reading. If battery is fully charged, voltage reading should be approximately 12.6 volts. If battery is discharged, voltage will be less.
3. Crank the engine. With engine running at fast idle, there should be an immediate voltage rise to approximately 13.6 to 14.2 volts. This indicates that the generator is functioning. If voltage does not rise when engine is started, then problem exists in generator circuit itself. To check, refer to "Generating System Trouble Symptoms," Sec. 6Y, Maintenance Manual X-7525.

If voltage rises to 13.6 volts or above when engine is started, but tell-tale light remains on, then problem exists in tell-tale circuit. Proceed to check tell-tale warning circuit.

HIGH ENERGY IGNITION SYSTEM

All vehicles covered by this supplement are equipped with High Energy Ignition Systems. Information following applies to both 455 cubic inch engine (1977) and 403 cubic inch engine (1977 and 1978). High energy ignition system specifications are listed at the end of this section.

GENERAL DESCRIPTION

The eight cylinder HEI distributor (figure 8) combines all ignition components in one unit. The ignition coil is on the distributor cap and connects to the rotor. HEI performs basically the same function as a conventional ignition system, except the module and pick-up coil of the HEI system do electronically what the contact points of the conventional system do mechanically.

The high energy ignition system is a pulse triggered, transistor - controlled, inductive discharge ignition system. This system features a built-in ignition coil, an electronic module and a magnetic pick-assembly. This assembly, located inside the distributor, contains a permanent magnet, a pole piece with internal teeth, and a pick-up coil. When the teeth of the timer core rotating on the distributor shaft inside the pole piece approach the teeth of the pole piece, voltage is induced in the pick-up coil. The electronic module then turns the ignition coil primary current "on". As the teeth align and then separate, a reversal in voltage potential signals the module to open the ignition coil primary circuit. When the primary, circuit opens, a high voltage induced in the ignition coil secondary winding is directed through the rotor and high voltage leads to fire the spark plugs. The capacitor in the distributor is for noise suppression.

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

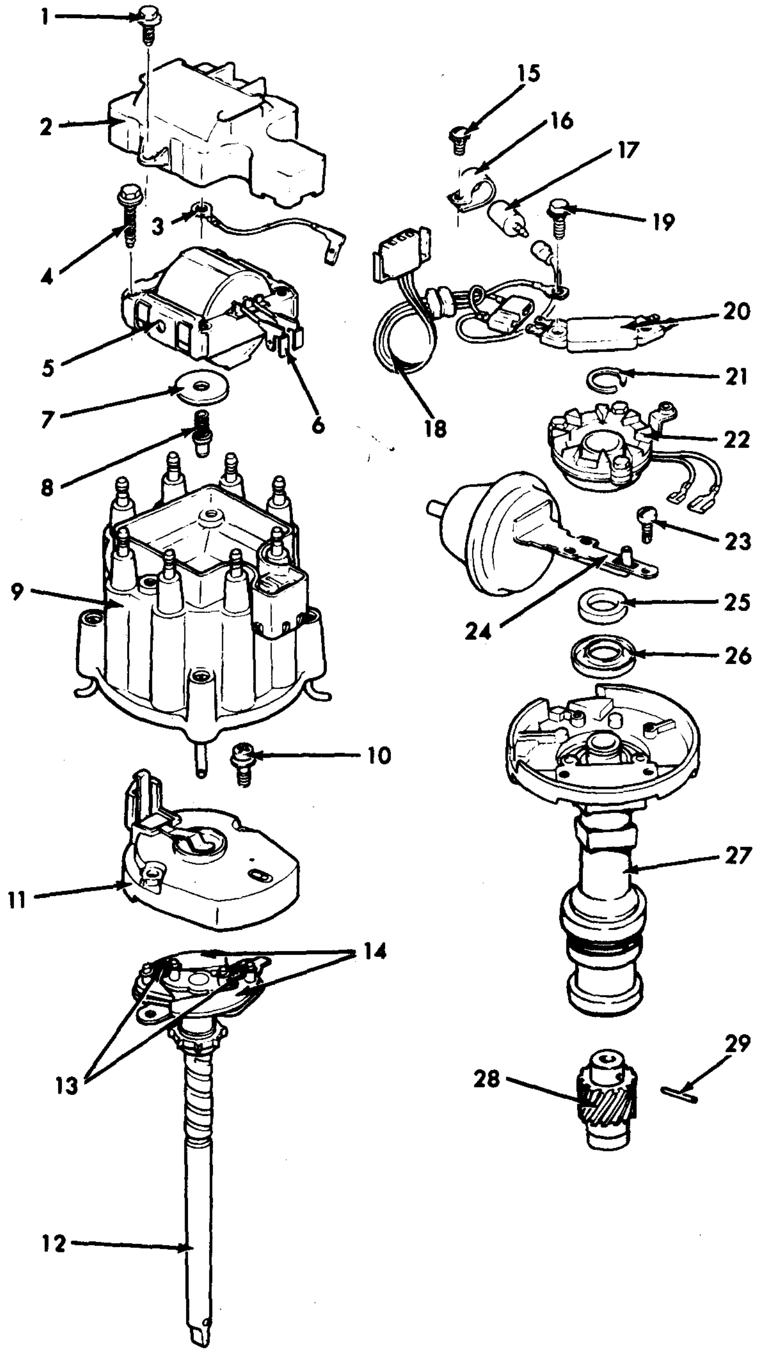
THEORY OF OPERATION

The pick-up coil is connected to the electronic module, which in turn is connected to the primary winding in the ignition coil. There is a magnetic field surrounding the permanent magnet and pick-up coil, which increases in the strength as the teeth of the timer core approach alignment with the teeth of the pole piece.

This increasing magnetic field induces a voltage in the pick-up coil, and current then flows to the ignition coil primary winding. When the teeth are exactly aligned and start to separate, the polarity of the pick-up coil voltage is reversed.

It is this reversal of voltage potential which signals the module to electronically shut off the ignition coil primary circuit. This in turn collapses the coil magnetic field and induces high voltage in the ignition coil secondary, firing one spark plug. A typical HEI schematic is shown in figure 9.

The electronic module delivers full battery voltage to the ignition coil, which is limited to 5.0 to 5.5 amps. There is no primary calibrated resistance wire in the HEI system. The electronic module acts as an "ON-OFF" switch for primary current, triggered by changing polarity of pick-up coil voltage. There is no energy lost due to breaker point arching or capacitor charging time lag. The capacitor in the HEI unit funcitons only as a radio noise suppressor.



1. Cover Attaching Screw (2)
2. Cover
3. Ground Lead
4. Coil Attaching Screw (4)
5. Ignition Coil
6. Coil Terminals
7. Rubber Seal
8. Brush (Spring and Button)
9. Cap
10. Rotor Attaching Screw (2)
11. Rotor
12. Shaft Assembly
13. Springs
14. Weights
15. Bracket Attaching Screw
16. Capacitator Bracket
17. Capacitator
18. Wiring Harness
19. Module Attaching Screw (2)
20. Electronic Module
21. Retainer (Thin "C" Washer)
22. Pole Piece and Plate Assembly (Pick-up Coil)
23. Vacuum Advance Attaching Screw (2)
24. Vacuum Advance Control
25. Felt Washer
26. Plastic Seal
27. Housing
28. Gear
29. Pin

A-4001

Figure 8—HEI Distributor Components

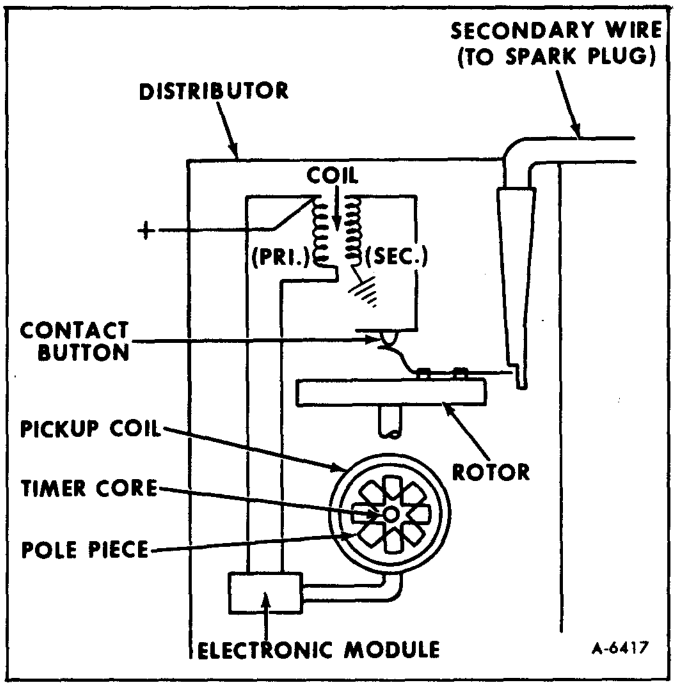


Figure 9—HEI Schematic

The higher current and instantaneous circuit triggering enables the HEI system to deliver up to approximately 35,000 volts through the secondary wiring to the spark plugs.

An exploded view of the HEI system is shown in figure 8.

HEI DISTRIBUTOR COMPONENTS

IGNITION COIL

In the eight cylinder HEI system, the ignition coil is built into the distributor cap. The coil is somewhat smaller physically than a conventional coil, but has more primary and secondary windings. It is built more like a true transformer with the windings surrounded by the laminated iron core. A conventional coil has the iron core inside the windings. Although the HEI coil operates in basically the same way as a conventional coil, it is more effective in generating higher secondary voltage when the primary circuit is broken.

ELECTRONIC MODULE

The electronic module (contained within the distributor) is a solid state unit containing five complete circuits.

These circuits control spark triggering, switching, current limiting, dwell control and distributor pick-up. Dwell angle is controlled by a transistor circuit within the module and is varied in direct relation to engine speed.

POLE PIECE AND PLATE ASSEMBLY

The pole piece and plate assembly (often referred to as the pick-up coil assembly) consists of the following:

1. A stationary pole piece with internal teeth.

2. A pick-up coil and magnet which are located between the pole piece and a bottom plate.

CENTRIFUGAL AND VACUUM ADVANCE

The centrifugal and vacuum advance mechanisms are basically the same types of units that provide spark advance in the breaker-type system. Centrifugal advance is achieved through the rotation of the timer core in relation to the distributor shaft. Vacuum advance is achieved by attaching the pick-up coil and pole piece to the vacuum advance unit actuating arm.

OTHER IGNITION COMPONENTS

BATTERY

Chassis batteries available on 1977 and 1978 Motorhome and TransMode vehicles are maintenancefree batteries. These batteries are completely sealed and are identified by the absense of vent plugs on the cover. Additional battery information can be found at the beginning of this section.

IGNITION SWITCH

The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly. For a complete explanation of the key and lock cylinder, and the actuator rod assembly, refer to the Steering Section (SEC. 9) of Maintenance Manual X-7525.

The ignition switch is key operated through the actuator rod assembly to close the ignition primary circuit and to energize the starting motor solenoid for cranking. The ignition switch has five positions: OFF, LOCK, ACCESSORY, RUN and START. OFF is the center position of the key-lock cylinder, and LOCK is the next position to the left. ACCESSORY is located one more detent to the left of LOCK. Turning the key to the right of the OFF position until spring pressure is felt will put the ignition switch in the RUN position, and when turned fully to the right against spring pressure, the switch will be in the START position.

All ignition switch have five terminals which are connected in different combinations for each of the three operating positions. A brass plate inside the switch has three contacts which connect these terminals . There is also a ground pin in the switch which contacts the "ground" terminal when the ignition switch is in the START position. This pin contacts the IGN. terminal when in the OFF position.

Ignition Start and Run Circuit

The ignition switch is fed from a junction at the horn relay to Bat. terminal of the switch. When the ignition switch is in the OFF position, no current flows through the switch. When the ignition switch is turned to the ACC. position, the BAT. terminal is connected to the ACC. terminal. This permits operation of accessories when the engine is not running.

When the ignition switch is turned to the START position, the BAT. terminal is connected to the SOL. and IGN. terminals. When the clutch or automatic transmission neutral start switches are closed, current flows to the starter solenoid. This energizes the solenoid windings. The solenoid has two sets of windings: a "pull-in winding and a "hold-in" winding. Both windings are used to create the magnetic field to actuate the solenoid plunger and move the starter pinion into engagement with the flywheel. As the solenoid plunger reaches the end of its travel, it closes a switch which connects battery voltage to the starter motor. With battery voltage applied to both terminals of the "pull-in" windings, the "pull-in" winding is no longer energized, so that only "hold-in" winding keeps the starter solenoid engaged.

During cranking, current is directed from the battery through the brass disc in the starter solenoid housing to the "B" terminal on the solenoid and then to the ignition coil.

NOTE: The instrument panel warning lights are fed from the ignition terminal of the ignition switch and have battery voltage applied to them when the ignitoin switch is in the START and RUN position. These circuits are explained in "Chassis Electrical" (Section 12) Maintenance Manual X7525.

When the ignition switch is released from the START to the RUN position, the BAT. terminal is connected to the IGN. terminal and the ACC terminal. This permits operation of all accessories and the ignition system.

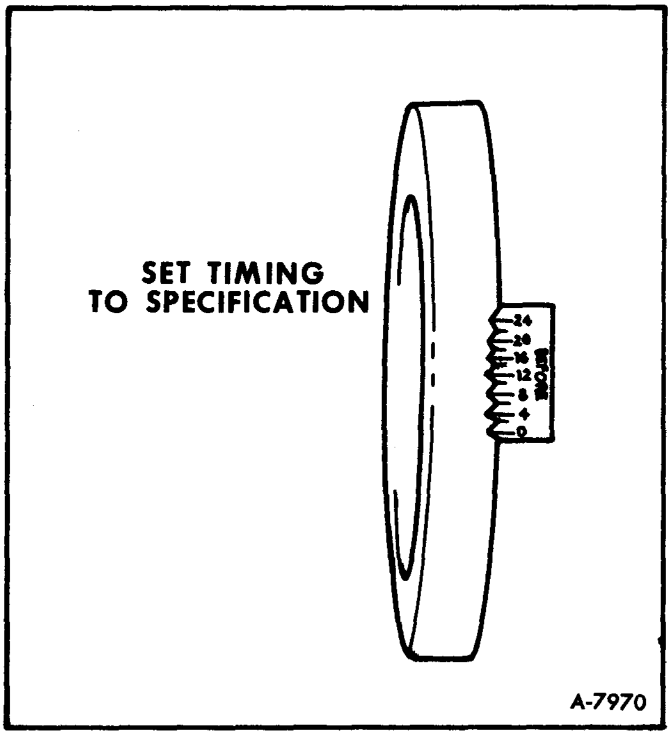


Figure 10—Timing Marks

IGNITION TIMING

The ignition timing marks are located on the engine front cover. A saw slot on the harmonic balancer indicates engine top dead center (figure 10).

Timing Light Connections

The spark plug wiring used with the HEI system is a carbon impregnated cord conductor encased in an 8mm diameter silicone rubber jacket. The silicone spark plug boots form a tight seal on the plug and the boot should be twisted 1/2 turn before removing. Care should also be exercised when connecting a timing light or other pick-up equipment.

When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type pick-up. Do not pierce the plug lead because once the insulation of the spark plug cable has been broken, voltage will jump to the nearest ground and the spark plug will not fire correctly.

Tachometer Connections

There is a mechanics tachometer pick-up lead which may be used when setting ignition timing. Most tachometers can be used; however, be sure the equipment is compatible with the HEI system.

CAUTION: *Grounding the distributor tachometer terminal could damage the HEI electronic module.*

When using tachometer connect tachometer to the tach. pick-up terminal, then connect the tachometer to ground. Follow tachometer manufacturer's instructions.

TIMING PROCEDURE

To adjust ignition timing, proceed as follows:

NOTE: Air conditioning controls in instrument panel must be "OFF" when setting ignition timing.

1. Remove air cleaner and plug manifold vacuum fitting.
2. Disconnect distributor vacuum lines and plug vacuum source fittings.
3. Connect tachometer and adjust engine speed to correct rpm as listed on the vehicle emissions label located either on the engine rocker cover or on the air cleaner. 1977 model vehicles with 455 cu. in. engine must be set at 1100 rpm with transmission in "PARK";1977 and 1978 model vehicles with 403 cu. in. engine must be set as follows: California certified engines at 2,000 rpm with transmission in "PARK", Federal certified engines at 1,100 rpm with transmission in "PARK".
4. With the use of a timing light, set timing to 8^{o}DTCD (455 cu. in. engine) or 12^{o}BTDC (403 cu. in. engine) by loosening the distributor clamp bolt and rotating the distributor until the specification is obtained.

NOTE: The indicator has four "V" slots, each representing 4^{o}.

5. Tighten the distributor clamp bolt and recheck timing to make sure distributor was not moved during tightening of bolt.

6. Remove plug from vacuum source fittings and reconnect hoses to distributor and/or carburetor. Remove plug from manifold fitting, connect vacuum hose and install air cleaner.

SPARK PLUGS

Resistor-type, special gap spark plugs are used in engines covered by this manual.

Spark plugs are protected by an insulating boot made of special heat-resistant material which covers the spark plug terminal and extends downward over a portion of the plug insulator. The boots prevent flash-over with resultant missing of the engine, even though a film is allowed to accumulate on exposed portion of plug insulators.

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 clear 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.

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. This burns away any excess deposits of carbon or oxide that may have accumulated from frequent idling, continual stop-and-go or slow-speed driving.

Factory installed spark plugs have a type number on the insulator which designates thread size as well as relative position of the plug in the Heat Range. Type numbers starting with 4 are 14 MM thread size.

The last digit of the type number indicates the Heat Range Position of the plug in the Heat Range System. These numbers are read the same as a thermometer—the higher the last digit, the hotter the plug will operate in the engine; the lower the last digit, the cooler the plug will operate.

Spark plug life is governed to a large extent by operating conditions, and plug life varies accordingly.

Worn and dirty plugs may give satisfactory operation at idling speed, but under operating conditions they frequently fail. Faulty plugs are evident in a number of ways such as wasting gas, power loss, loss of speed, hard starting, and general poor engine performance.

Spark plug failure, in addition to normal wear, may be due to dirty or leaded plugs, excessive gap, or broken insulator.

Dirty or leaded plugs may be evident by black carbon deposits, or red, brown, yellow, or blistered oxide deposits on the plugs. The black deposits are usually the result of slow speed driving and short runs where sufficient engine operating temperature is seldom reached. Worn piston rings, faulty ignition, over-rich fuel mixture and spark plugs which are too "cold" will also result in carbon deposits. Red, brown, or yellow oxide deposits, a consequence of the combustion of leaded fuel, usually result in spark plug failure under severe operating conditions.

The oxides have no adverse affect on plug operation as long as they remain in a powdery state. But, under high speed or hard pull, the powder oxide deposits melt and form a heavy glaze coating on the insulator which, when hot, acts as a good electrical conductor, allowing current to follow the deposits and short out of the plug.

Excessive gap wear on plugs of low mileage usually indicates the engine is operating at speeds or loads that are consistently greater than normal or that a plug which is too "hot" is being used.

Too lean a fuel mixture will also result in excessive electrode wear.

Spark plug life will also be affected by incorrect timing of the engine which results in excessively high operating temperature.

Broken insulators are usually the result of improper installation or carelessness. 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. This type of a break may result from the plug operating too "hot" such as encountered in sustained periods of high speed operation or under extremely heavy loads, especially if not installed correctly. When regapping a spark plug, to avoid lower insulator breakage, always make the gap adjustment by bending the ground (side) electrode (figure 11). Spark plugs with broken insulators should always be replaced.

Spark plugs, to give good performance in a particular engine, must operate within a certain temperature range, neither too hot nor too cool. If the spark plug remains too "cool", oil, soot, carbon, and lead components will deposit on the insulator, causing FOULING and MISSING. If the plug runs to "hot", the deposits accumulated on the insulator surface during continuous slow or stop-and-go driving may become blistered, electrodes will wear rapidly, and under extreme conditions, premature ignition (preignition) of the fuel mixture result. Either condition will seriously affect the performance of the engine.

The use of spark plugs in the proper heat range is of vital importance to good engine performance. Frequently, the wrong type of spark plug, one with an improper heat range for the engine, may have been installed when replacing spark plugs originally fitted by the engine manufacturer. Such misapplication may lead to poor performance.

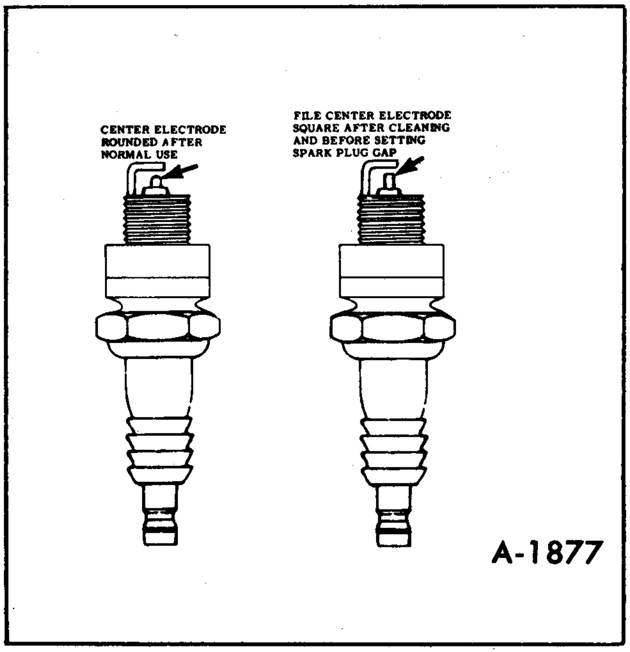


Figure 11—Spark Plug Electrodes

SPARK PLUG REPLACEMENT

Removal

Before removing any spark plug, blow all dirt and any foreign matter out of plug sockets in cylinder head.

1. Use care when removing spark plug wire boots from spark plugs. (Refer to "Spark Plug Wires" in this section.) Before removing, twist the boot 1/2 turn, and only pull on the boot to remove the wire.
2. Using a suitable spark plug wrench socket, remove spark plug. Ordinary wrenches may damage porcelain on plugs.

Inspection And Cleaning

Inspect plugs for cracked porcelain and burned electrodes, and check spark plug gap. Also check for loose terminals. Replace plugs which have excessively burned electrodes or cracked porcelain. Plugs should be cleaned with an abrasive- type cleaner. If porcelain is badly glazed or blistered, the spark plugs should be replaced. All spark plugs must be of the same make and number of heat range. Use a wire feeler gauge when checking spark plug gap.

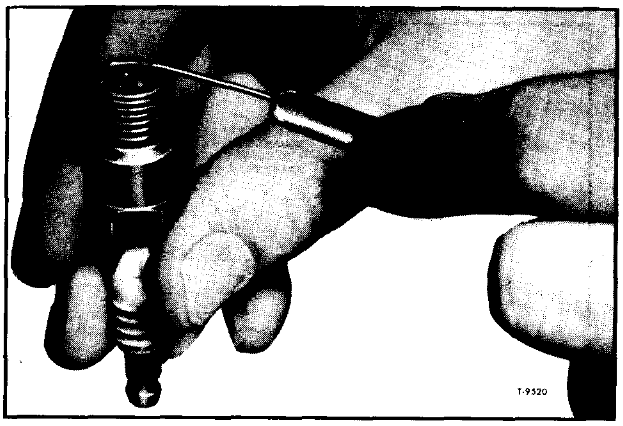


Figure 12—Checking Spark Plug Gap

Spark Plug Gap Adjustment

Setting spark plug gap is a precision operation and should be treated as such. Refer to "Specifications", at end of this section for proper gap dimensions. All plugs must be set to the same dimension, using a standard round feeler gauge (figure 12).

CAUTION: *Before adjusting gap, file center electrode flat (used plugs only). In adjusting the spark plug gap, never bend the center electrode which extends through the porcelain center as this may break the lower insulator. Always make adjustment by bending the grounding or side electrode.*

Installation

It is extremely important when replacing plug wires to route the wires correctly and through the proper retainers. Failure to route the wires properly will cause radio ignition noise, crossfiring of plugs or shorting of the leads to ground.

Improper installation is one of the greatest single causes of unsatisfactory spark plug performance and is the result of one or more of the following practices:

1. Installation of plugs using excessive torque which changes the gap setting.
2. Installation of plugs using insufficient torque to fully seat the plug.
3. Installation of plugs into corroded spark plug hole threads.

Failure to install plugs properly will cause them to operate at excessively high temperatures and result in reduced operating life under mild operation or complete destruction under severe operation where the intense heat cannot be dissipated rapidly enough.

Also, check to be sure that spark plug threads and cylinder head threads are not dirty or damaged. Dirty or damaged threads cause a faulty torque reading, resulting in incorrect installation and consequent poor spark plug life and faulty operation.

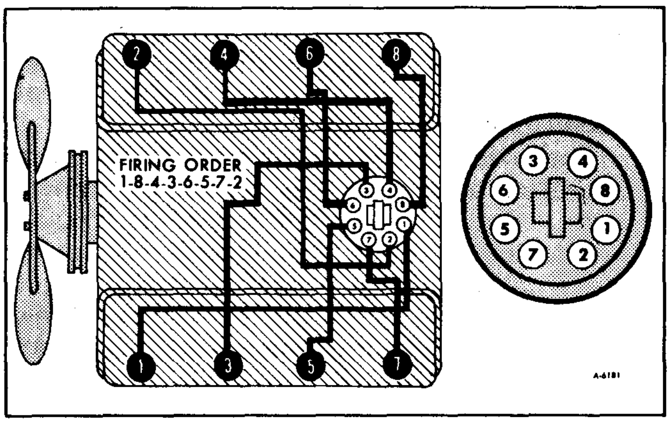


Figure 13—Secondary Wiring

1. Install spark plugs in the engine and tighten finger tight.

CAUTION: *Refer to "Caution" on page one of this section.*

2. Using a suitable spark plug wrench socket and torque wrench, tighten plugs to 26 ft. lbs. torque. The proper socket must be used in torquing plugs because an ordinary socket will bind against the cylinder head and give a false torque reading.

Spark plugs which are not tightened properly will result in too high an operating temperature (if too loose) or distortion of the spark plug body and gap setting (if too tight).

SPARK PLUG WIRES
(FIGURES 13 and 14)

Because of the higher voltage, the HEI system has larger diameter (8 millimeter) spark plug wires with silicone insulation. This silicone wire is gray in color, more heat resistant than standard black wire and less vulnerable to deterioration. However, silicone insulation is soft and very pliable, so that scuffing and cutting is easier than on standard black wires. It is important that these more pliable cables not be mishandled and that they be routed correctly to prevent chafing or cutting.

The silicone spark plug wire boots seal more tightly to the spark plugs than ordinary boots. Removal of boots from spark plugs must be done with care. The old practice of pulling them by the wires or with pliers will almost always cause damage to the boot or wire joint. It is recommended that the boot be twisted about a half turn in either direction to break the seal before pulling on the boot to remove the wire.

The spark plug cable retainer is designed to hold the wires firmly to prevent chafing or cutting. The wires in the retainer cannot be repositioned until the cable retainer is unlocked. Any attempt to pull the spark plug wires with the retainer in lock position could result in damage to the plug wires. To unlock the cable retainer, use a small screwdriver between the tab and the lock.

To remove wiring harness from cap, release wiring harness from latch and remove wiring harness, both right and left side (refer to figure 14).

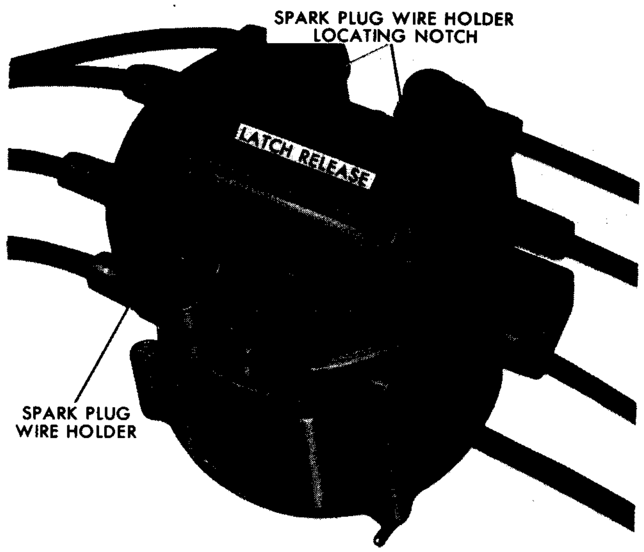


Figure 14—Distributor Cap Wiring

WARNING: DO NOT REMOVE SPARK PLUG WIRES WITH THE ENGINE RUNNING. THE HIGHER SECONDARY VOLTAGE IS CAPABLE OF JUMPING AN ARC OF GREATER DISTANCE AND COULD CAUSE AN ELECTRIC SHOCK. OPERATING THE ENGINE WITH ONE OR MORE SPARK PLUG WIRES DISCONNECTED CAN ALSO RESULT IN DAMAGE TO THE DISTRIBUTOR CAP.

Checking Spark Plug Wires

For information on checking of spark plug wires, refer to "DIAGNOSIS OF SPARK PLUG WIRES" in this section.

HEI SYSTEM DIAGNOSIS

SPARK PLUG WIRE DIAGNOSIS

Resistance specifications for both 7mm wires used with standard systems and 8mm wires used with HEI systems are identical (3,000 to 5,000 ohms per foot). Inspect all spark plug wires for high resistance and continuity with an ohmmeter.

OHMMETER TEST

NOTE: For proper operation, it is necessary to keep ignition wires and distributor clean and free of any dirt or corrosion.

1. Disconnect both ends of ignition cable being tested and clean terminals.
2. Set ohmmeter on high scale and connect ohmmeter to each end of cable being tested. Twist cable gently while observing ohmmeter.
3. If ohmmeter reads above 25,000 ohms or fluctuates from infinity to any value, replace cable being tested.
4. If the resistance of each cable is not within the following bands, replace the cable being tested: (for example)

0 to 15" cable - 3,000/10,000 ohms
15 to 25" cable - 4,000/15,000 ohms
25 to 35" cable - 6,000/25,000 ohms

INSULATION TEST

If the engine periodically runs rough, stalls, or won't start, the problem could be related to precipitation, condensation, or road splash situation which coats the ignition system with moisture. To determine if this is the trouble, the following procedure can be used:

1. Carefully remove the distributor spark plug and coil wire retaining cap (hard hat) from the distributor. Then remove the spark plug and coil nipples from the retainer and reconnect them to the distributor.
2. Connect a ground probe to the engine. (The probe can be made by attaching one end of a 3-foot insulated wire to a screwdriver blade and the other end to a suitable engine ground.)
3. Start the engine and let it idle at the hot rpm specification.
4. Use a water spray bottle (household cleaning solution bottle with manual spray pump) to wet the insulation, simulating the conditions it might encounter in wet weather driving.

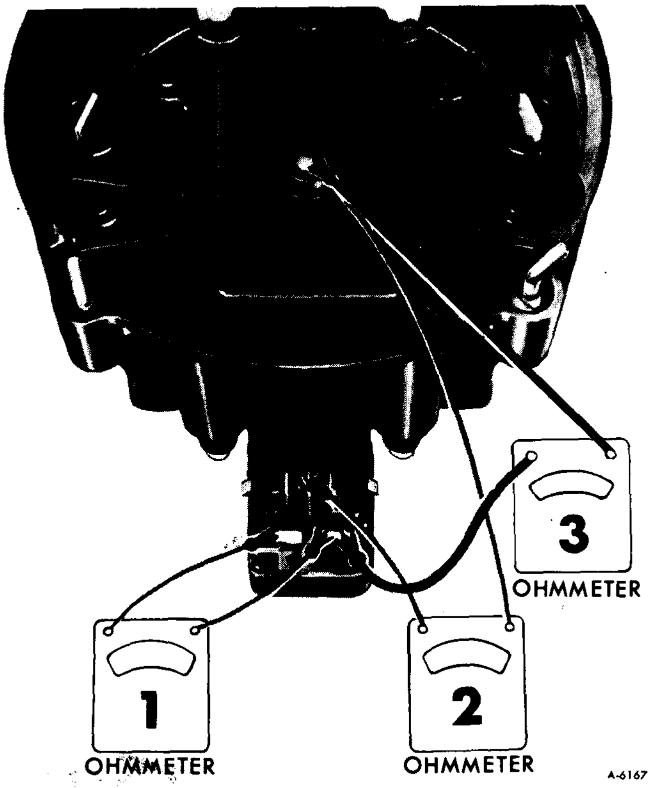


Figure 15—Ohmmeter Check of Ignition Coil

5. Starting at either end of the suspect wire, thoroughly trace the insulation of the wire, boot and nipple, observing for spark jumping through the insulation to the test probe.

6. Use particular care to probe the underside and lower edges of the spark plug boot. Also, carefully probe the joint areas where the wire enters the boot and nipple.

7. Test the suspect wire(s) for internal conductor damage using the ohmmeter procedure described previously.

It is recommended that the aforementioned procedure be performed in subdued light. It should be noted, however, that a faint arcing or "corona phenomena" (a faint glow adjacent to the surface of an electrical conductor at high voltage) will always be present in various degrees of intensity, dependent on humidity and lighting conditions. This condition is not usually indicative of enough leakage to produce the subject complaint unless the engine falters noticeably.

If a strong arc or any opening in the insulation of wire, boot or nipple is observed and the engine falters noticeably, the wires(s) should be replaced.

CAUTION: *Plug wires are damaged by Refrigerant-12. When charging air conditioning system, avoid Refrigerant-12 contact with spark plug wires. If air*

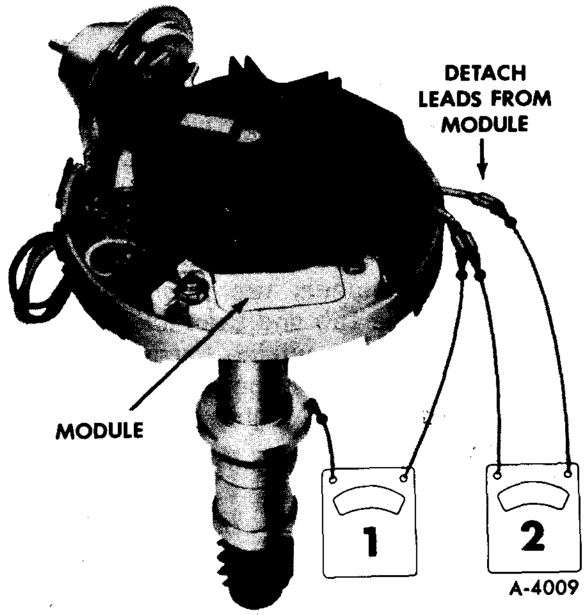


Figure 16—Ohmmeter Check of Pick-Up Coil

conditioning system has had a leakage failure, check spark plug wires as described above.

DISTRIBUTOR COMPONENT DIAGNOSIS USING OHMMETER

IGNITION COIL TEST

1. Remove distributor cap and coil assembly by disengaging the four locking latches.

2. Inspect the distributor cap and coil assembly. Inspect rotor for spark arc-over.

3. Check primary coil. Connect ohmmeter as shown in figure 15, step 1. Use low ohmmeter scale and the reading should be zero; however, if it is not, replace the coil.

4. Check the secondary of the coil by connecting an ohmmeter as shown in figure 15, step 2. Using the high scale of the ohmmeter, the reading should be high but not infinite. If the reading is infinite, check the distributor cap and carbon button for arced or burned condition. If the cap and rotor button are not defective, replace ignition coil.

5. As shown in figure 15, step 3, check the primary and secondary in order to determine if they are shorted together. The ohmmeter reading should be infinite. Refer to figure 8 for additional information.

PICK-UP COIL TEST

1. In order to test the pick-up coil for an open, connect an ohmmeter as shown in figure 16, step 1. Use the ohmmeter middle scale. If the ohmmeter reads less than 500 ohms or

more than 1500 ohms while flexing the leads, replace the pick-up coil.

2. If the pick-up coil does not have an open, check the pick-up coil for ground as shown in figure 16,step 2. If the reading on the high scale is infinite, the pick-up coil is good.

HIGH ENERGY IGNITION SYSTEM DIAGNOSIS WITH TESTER J-24642

If engine will not start, perform this on-vehicle test of the ignition system BEFORE checking HEI module with tester J-24642:

1. Insure that wiring connector is properly attached to connector at side of distributor.
2. Check that all spark plug leads are properly connected at distributor (figure 17) and spark plugs.
3. Connect voltmeter or test light from "BAT" terminal lead on distributor to ground (figure 5).
4. Turn on ignition switch. If voltage is zero or test light does not come on, repair open circuit between "BAT" terminal and battery.
5. When reading is battery voltage, or test light lights, remove one spark plug lead by twisting spark plug boot to loosen. Insert extension, hold spark plug lead with insulated pliers so extension is 1/4" away from dry area of engine block while cranking engine, or install any good spark plug with proper gap in lead and lay on engine block while cranking engine.
6. If sparking occurs trouble is not ignition distributor. Check fuel system and spark plugs. Check timing. Distributor may have shifted.
7. If no spark, make test No. 1 with Module Tester J-24642 or equivalent.

TESTING TESTER J-24642

Before module tester J-24642 is used, proper operation of tester can be verified by the use of special tool J-24642-101, Tester Verification Kit.

The series of checks in the verification procedure are performed with the following items:

1. A test resistor-connector J-24642-101 (100 Ohms $\pm$ 5%, 2 Watts).
2. A known good HEI module.
3. A fully charged 12-volt automotive battery.
4. A jumper wire (18 ga. x 20" is adequate).
5. The J-24642 tester.

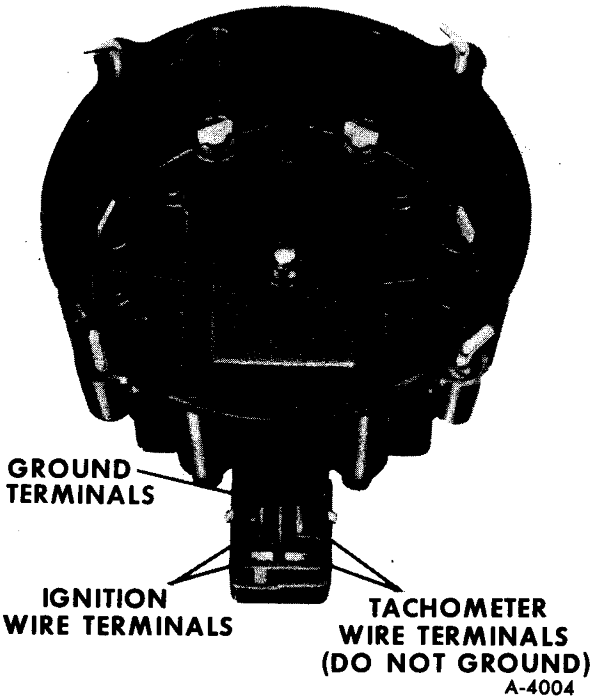


Figure 17—Terminals on Distributor Cap

Check. No. 1

1. Connect the tester's battery cable to a fully charged automotive battery (11-1/2 to 12-1/2 volts), with red lead of tester to battery positive terminal (+) and black lead of tester to battery negative terminal (-). Make no other connections to the tester.

Observe both indicator lights. If either or both lights are on, the module tester is defective.

2. Press the "TEST" button and observe the lights.

RED "REPLACE" light should come on and stay on.

GREEN "GOOD" light should remain off.

The tester is defective if these two conditions are not met.

Check No. 2

1. Connect the tester and a known good HEI module in the following manner:

A. Connect the two-way connector of the tester to the module.

B. Connect the green and white tester leads to the corresponding "G" and "W" terminals of the module.

C. Connect red lead of tester to 12-volt automotive battery positive (+) terminal and black lead of tester to battery negative (-) terminal.

D. Connect ground lead of tester to HEI module ground terminal. The module ground is located at the mounting screw hold-down nearest two-way connector terminals.

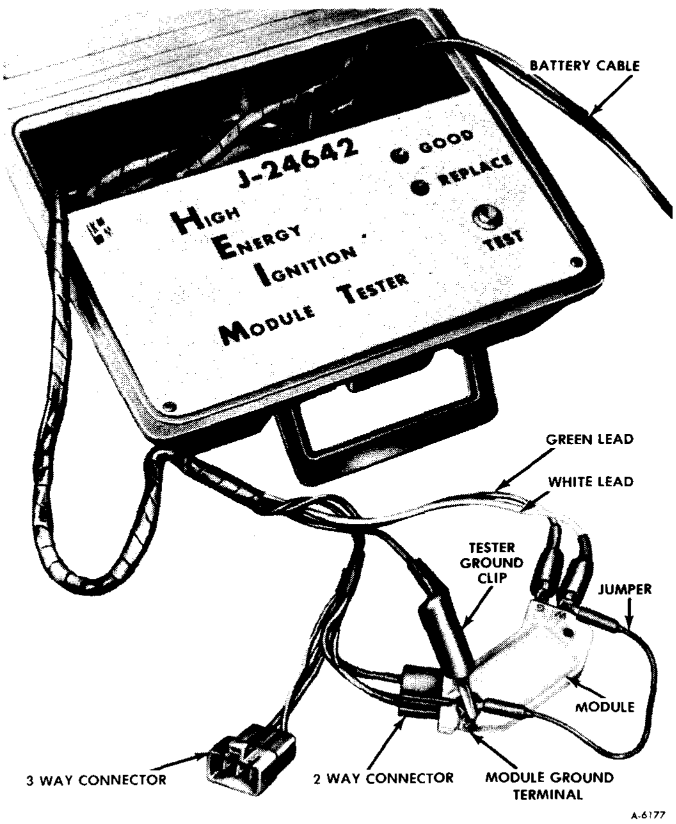


Figure 18—Check No. 3 with Tester J-24642-101

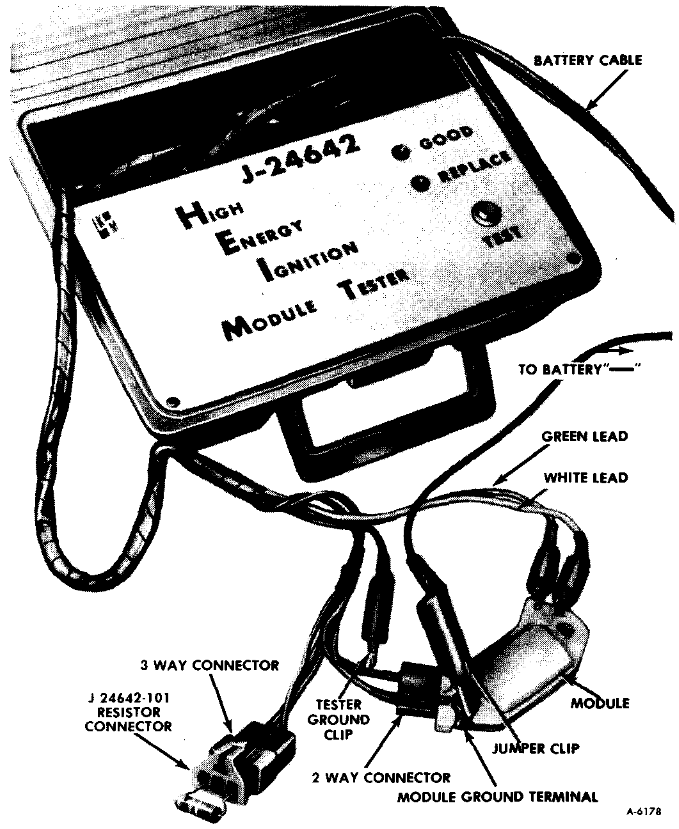


Figure 19—Check No. 4 With Tester J-24642-101

2. Press "TEST" button and observe the lights.

RED "REPLACE" light should come on momentarily and then go out.

GREEN "GOOD" light should come one and stay on.

If not, the tester is defective.

Check No. 3

1. To the setup of Check 2, add a jumper wire connecting the "W" and ground "G" terminal of the module as shown in figure 18.

NOTE: Do not connect the jumper from the "G" terminal of the HEI module to ground as damage to the tester will result.

2. Press "TEST" button and observe the lights.

RED "REPLACE" light should come on and stay on as long as button is held down.

GREEN "GOOD" light should remain off.

Tester is defective if these two conditions are not met.

Check No. 4

1. From the setup of Check 3, remove the jumper wire. Disconnect the tester ground lead from the module ground terminal. Using a jumper wire, connect the module ground lead to the negative terminal of the battery. Plug the J-24642-101 resistor-connector (or equivalent) into the 3-way connector as shown in figure 19.

2. Press the "TEST" button and observe the lights.

RED "REPLACE" light should come on and stay on.

If GREEN "GOOD" light comes on while the button is pressed, the tester is defective.

When the tester has passed these four checks, its proper operation is verified. You may now begin diagnosis of the high energy ignition system.

TESTING PROCEDURE FOR HEI MODULE USING TESTER J-24642

The module tester provides the means of checking the HEI module in or out of the vehicle. It operates by generating a signal equivalent to the pick-up coil signal, measuring the output of the HEI module and determining whether or not it is within the specified range. There are three tests and some subtests performed by the tester. TEST 1 is used if the vehicle does not run, TEST 2 if the vehicle runs but not satisfactorily, and TEST 3 if the module is out of the vehicle and must be checked. In all tests, the battery must be fully charged. Low voltage or slow cranking speeds will result in a false "REPLACE" indication.

Test No. 1 - CRANK TEST, Distributor Cap in Place (Engine does not run) (Figure 20)

1. Disconnect (pull) module 3-way harness connector from its socket in the side of the distributor cap.
2. Connect 3-way connector of tester J-24642 to the module harness connector.

NOTE: The 3-way connector should connect only one way to the module connector. Match wire colors between module connector and tester 3-way connector.

3. Connect red lead of tester J-24642 to battery positive (+) terminal and black lead to battery negative (-) terminal.
4. Crank engine, press and hold "TEST" button.

NOTE: During cranking, battery voltage must be 9 volts or more and engine speed 100 rpm or more for tester to be accurate.

5. A momentary indication on the red "REPLACE" light and then a steady indication on the green "GOOD" light means that both the HEI module and the pick-up coil are good. Proceed to step 6. A steady indication of the red "REPLACE" light means that either the pick-up coil or the HEI module is defective. Check the HEI module with TEST 2 and check the pick-up coil with ohmmeter (see chart on diagnosing the HEI system without use of module tester).

NOTE: A tester check is complete within a few seconds. Prolonged holding of the "TEST" button in excess of 15 seconds will cause the module and/or the resistor to heat and may produce erratic test results or damage to the resistor, module or tester.

6. If pick-up coil and module test good, remove distributor cap and coil assembly by turning four latches.
7. Check primary of ignition coil in cap for continuity with an ohmmeter. (Refer to figure 15, step 1.) Reading should be zero or near zero. If not, replace ignition coil. After coil is replaced, proceed to steps 10 and 11.
8. Check secondary of coil (figure 15, step 2.) Use high scale. Reading should not be infinite. If everything checks good to this point, the HEI system is good.
9. If reading is infinite, check cap and rotor

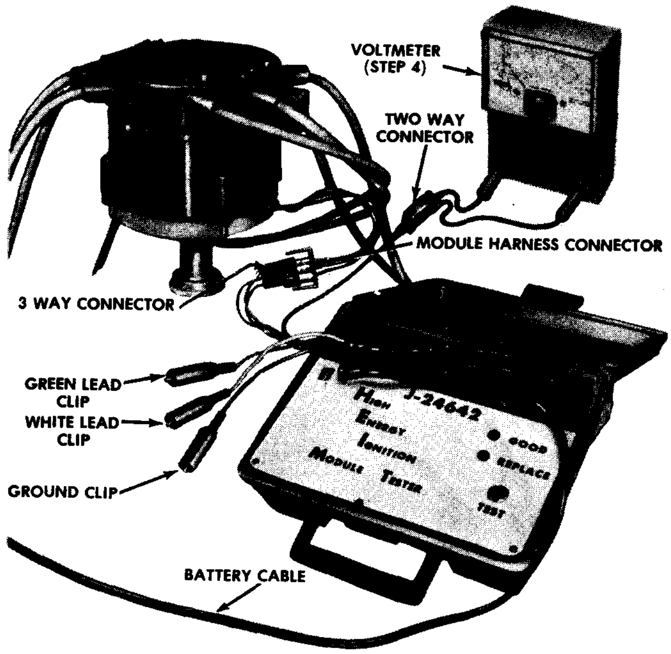


Figure 20—Test No. 1, Using Tool J-24642 (Crank Test)

button for arced or burned condition. If necessary, replace cap. If cap and carbon button do not appear defective, replace ignition coil. After ignition coil is replaced, proceed with steps 10 and 11.
10. Continue module check by connecting a voltmeter to the two-way connector, the red lead to the positive (+) terminal and the brown lead to the negative (-) terminal. Select the scale which best covers the 0-10 volt DC range. The meter should read "zero" volts.
11. Press and hold the "TEST" button. The voltmeter should continue to read "zero" volts. If the meter gives a voltage indication, the module is defective and should be replaced.

Test 2 - MODULE IN VEHICLE, Distributor Cap Removed (Engine runs Poorly) (Figure 21)

1. Perform steps 1 through 4 of TEST 1.
2. Disconnect green and white pick-up coil leads from the HEI module and attach the green and white tester leads to the "G" and "W" terminals of the module.
3. Press and hold the "TEST" button. A momentary indication on the red "REPLACE" light, then a steady indication on the green "GOOD" light means the HEI module is good. A steady indication on the red "REPLACE" light means that the module is defective and should be replaced. If the module is good, check the pick-up coil (See steps C-9 and C-10 of High Energy Ignition Diagnosis Chart later in this section.)

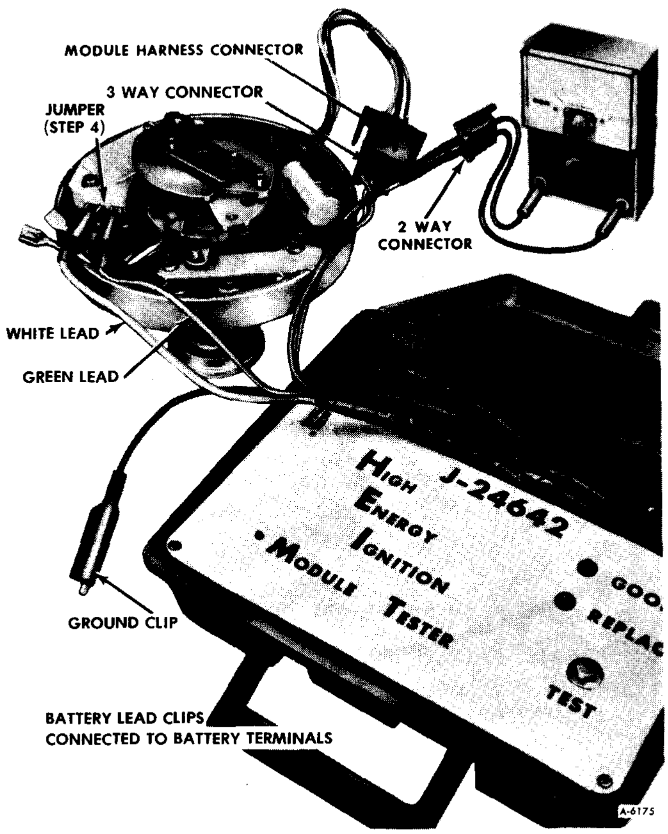


Figure 21—Test No. 2, Using Tool J-24642

4. Check the ignition coil primary for continuity with an ohmmeter (figure 15, step 1). Reading should be zero or near zero. If everything checks good to this point, the HEI system is good. If the coil is open, replace it and proceed with steps 10 and 11 of Test 1.

Test 3 - MODULE OUT OF DISTRIBUTOR (Figure 22)

1. Connect the two-way connector of the tester to the HEI module and the green and white tester leads to the corresponding "G" and "W" terminals of the module.

2. Connect red lead of tester to battery positive (+) terminal of 12-volt automotive battery, and black lead of tester to battery negative (-) terminal.

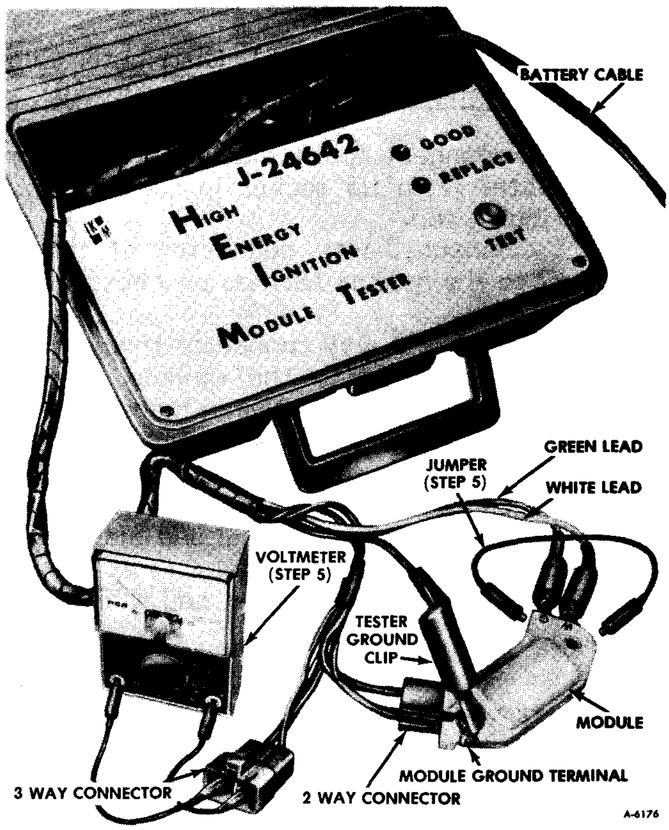


Figure 22—Test No. 3, Using Tool J-24642

3. Connect ground clip of tester to HEI module ground terminal. The module ground is located at the mounting screw hold-down nearest two-way connector terminals.

4. Press and hold the "TEST" button. A momentary indication of the red "REPLACE" light, then a steady indication of the green "GOOD" light means that the module is good. A steady indication on the red "REPLACE" light means the module is defective and should be replaced.

5. Perform steps 10 and 11 of TEST 1, except connect the voltmeter in this check to the 3-way connector, as shown in figure 22.

DIAGNOSING HIGH ENERGY IGNITION SYSTEM WITHOUT USE OF MODULE TESTER J-24642

A-7105

Careful adherence to the following procedures will lead to the location and correction of HEI system problems. Normally only a portion of the procedures need be performed.

1. Insure that wiring connector is properly attached to connector at side of distributor.
2. Insure that all spark plug leads are properly connected at distributor and spark plugs.

SYSTEM CHECKS ON THE VEHICLE

A. ENGINE WILL NOT START. USE VOLTMETER OR TESTLIGHT.

A-1. Connect voltmeter from "BAT" terminal lead on distributor to ground.

A-2. Turn on ignition switch.

A-3. If voltage is zero, repair open circuit between "BAT" terminal and battery.

A-4. If reading is Battery voltage, twist spark plug boot to loosen, remove lead, insert extension, hold spark plug lead with insulating pliers so extension is ¼" away from dry area of engine block while cranking engine or remove one spark plug lead. Install any good spark plug with proper gap in lead and lay on engine block while cranking engine.

A-5. If sparking occurs trouble is not ignition distributor.

A-6. Check fuel system and spark plugs and secondary wiring. Check timing (distributor shifted).

A-7. Proceed to Component Checks.

B. ENGINE RUNS ROUGH.

B-1. Insure that proper fuel is being delivered to carburetor.

B-2. Check all hoses for leakage.

B-3. Visually inspect and listen for sparks jumping to ground.

B-4. Check initial timing (distributor shifted).

B-5. Check centrifugal advance on engine.

B-6. Twist boots to loosen, remove all spark plugs and check for usual defects — proper gap, fouling, cracked insulators, inside and out, etc. Check secondary wiring.

B-7. If no defects are found follow procedure under Component Checks.

C. COMPONENT CHECKS USING OHMMETER.

C-1. Remove cap and coil assembly by turning four locking latches.

C-2. Inspect cap and coil assembly and rotor for spark arc-over.

C-3. Check primary coil. Connect ohmmeter, Step 1, Figure 14. Use low scale. Reading should be zero. If not, replace coil.

C-4. Check secondary of coil. Connect ohmmeter, Step 2, Figure 14. Use high scale. Reading should be high but not infinite.

C-5. If reading is infinite, check cap and carbon button for arced or burned condition. If necessary, replace cap. If cap and rotor button do not appear defective, replace ignition coil.

C-6. In Step 3, Figure 14, check that primary and secondary are not shorted together. Refer to Figure 25. Reading should be infinite.

C-7. Connect test stand vacuum source to vacuum unit.

C-8. If vacuum unit is inoperative, replace.

C-9. Check pick-up coil for broken wire or open. Connect ohmmeter, Step 1, Figure 15. Use middle scale. If ohmmeter reads less than 500 ohms or more than 1500 ohms (while flexing leads) replace pick-up coil. (C-11 below).

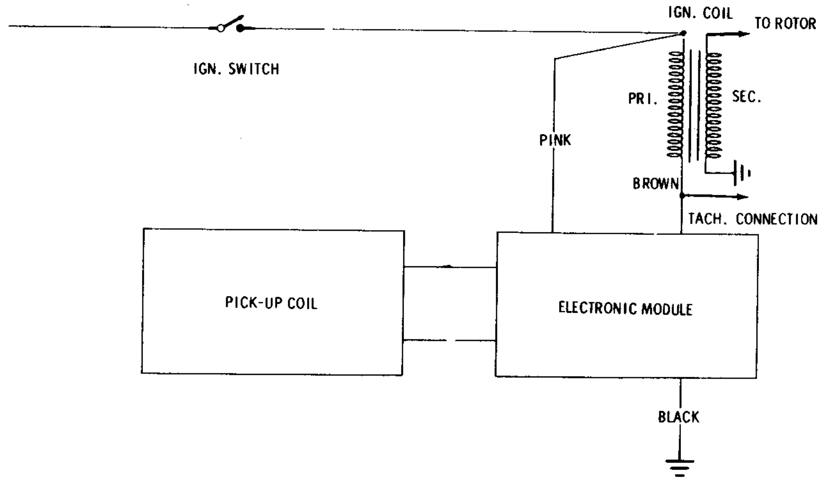
C-10. If Step 1 is ok, check pick-up coil for ground with ohmmeter, Step 2, Figure 15. Use high scale. If reading is not infinite (no deflection on meter) replace coil. (C-11 below).

C-11. Remove unit from engine, remove rotor and shaft assembly from housing and remove thin "C" washer to replace pick-up coil (refer to distributor component repair).

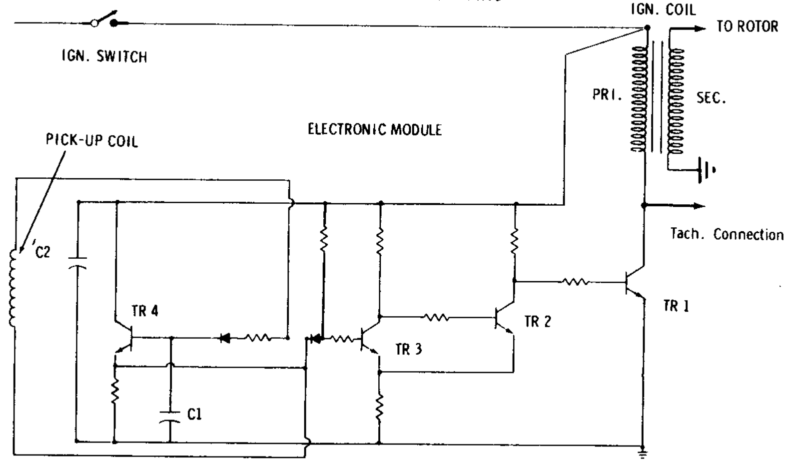
C-12. If no defects have been found, remove connector and two attaching screws and replace module.

Figure 23—Diagnosing High Energy Ignition System Without Use of Module Tester J-24642

HIGH ENERGY IGNITION DIAGNOSIS WITH OSCILLOSCOPE



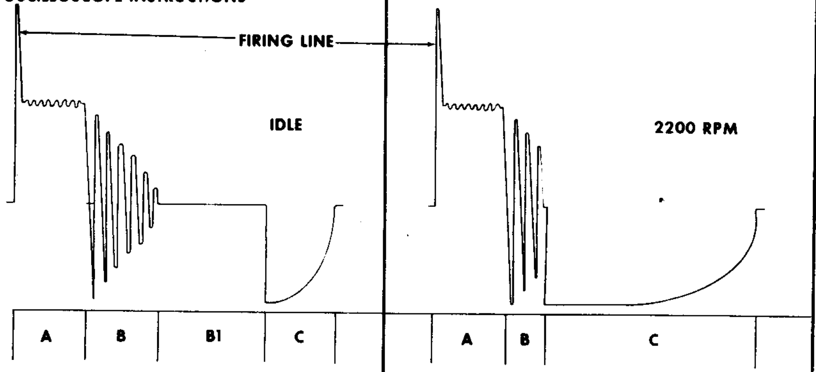
SIMPLIFIED MODULE SCHEMATIC



Dwell mode - TR1 - ON; TR2 - OFF; TR3 - ON. Signal at Pick-up Coil turns TR3 OFF, charges C1 and turns on TR4. This results in Firing Mode: TR1 - OFF; TR2 - ON, and TR3 - OFF. The reduced primary current induces a high voltage in the secondary windings firing the spark plug.

TR4 stays on until C1 is discharged. When C1 is discharged TR3 turns on returning to Dwell Mode. At higher engine speeds, C1 charges less and less, resulting in reduced firing times, and thus longer Dwell periods. This is how the Dwell Zone expands. C2 is capacitor in distributor for radio suppression.

OSCILLOSCOPE INSTRUCTIONS



PATTERN FOR ONE CYLINDER ONLY

Scope Instructions:

1. Scope secondary pick-up can not be connected since center coil terminal is inside distributor.
2. Connect pick-up to #1 spark plug as usual.
3. Connect primary pick-up to "Tach" terminal of distributor.

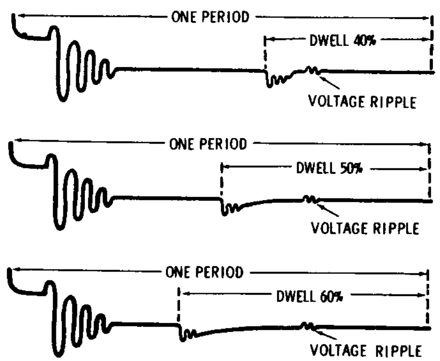
This will display primary pattern in parade only. (NOTE: A special adapter placed on top of the coil-cap assembly may be used with some scopes to view the Secondary pattern. The output voltage will read low with the adapter; this is normal.)

Scope pattern

A. Spark Zone - spark plug arcing
B. Coil - Condenser Zone
B1. Firing Zone - no plug arc
C. Dwell Zone - module on, current through coil primary

TYPICAL SCOPE PATTERNS

(SEE YOUR EQUIPMENT MFG. FOR ACTUAL PATTERNS)



SECONDARY VOLTAGE PATTERNS

It is normal if dwell time varies from cylinder to cylinder. A 40% to 60% variation is shown, it could be more or less. The voltage ripple shown may or may not be seen, either is normal. Variation in dwell time or voltage ripple as shown does NOT indicate a bad module.

A-7144

Figure 24—HEI Distributor Scope Pattern Information

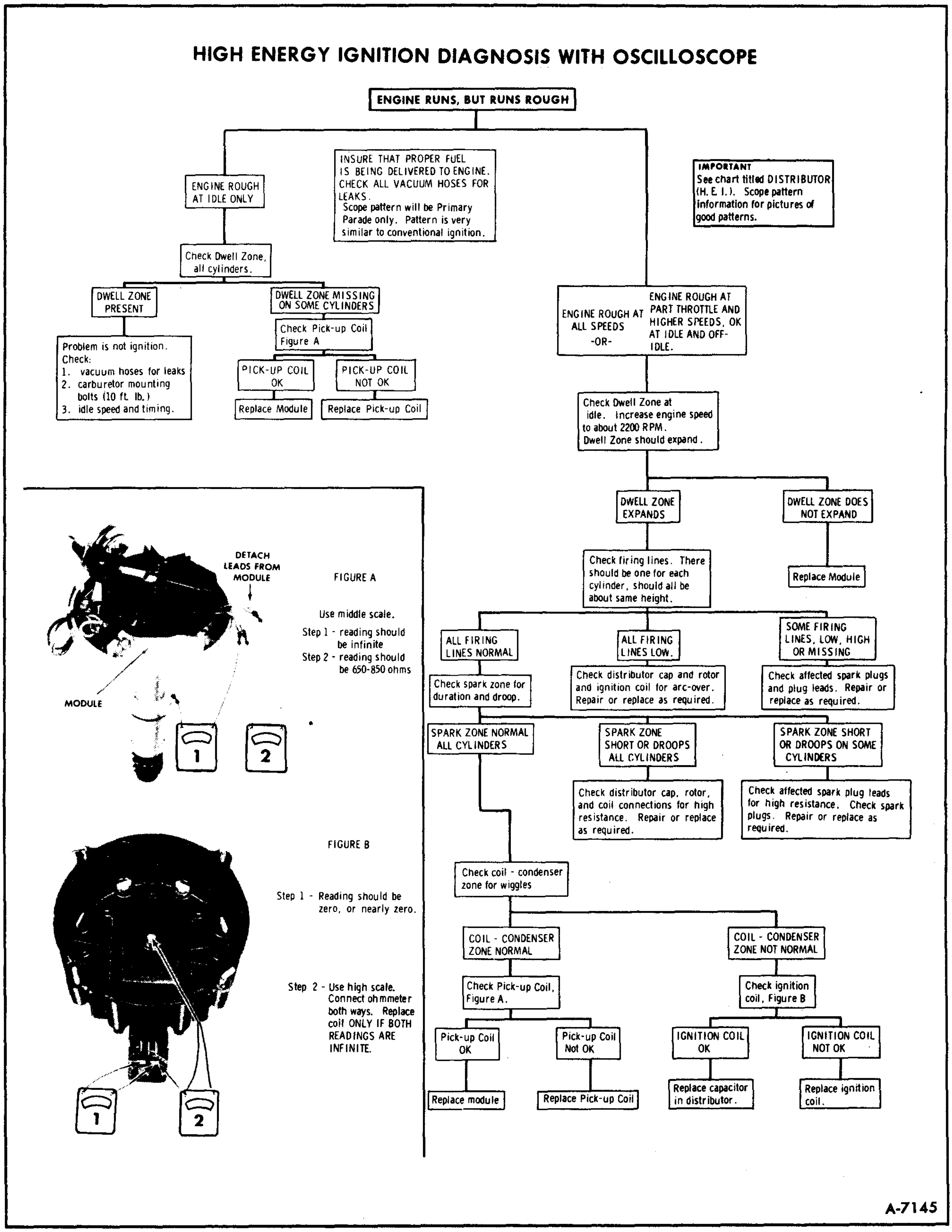


Figure 25—High Energy Ignition Diagnosis With Oscilliscope

HEI SYSTEM SERVICE

SERVICING PRECAUTIONS

NOTE: For HEI systems, engine diagnostic analyzers using oscilliscopes will require a special adapter and distributor machines will also require modifications. Major manufacturers of such equipment have instructions on how such modificatoins can be performed on their equipment.

The HEI system is capable of producing up to 35,000 volts as compared to 25,000 volts with conventional systems. Use care when working with these higher voltages to avoid contact with high voltage points such as spark plug leads.

Care should be taken when connecting timing light or other pick-up equipment. Use proper adapters. Do not force contacts between the boot and secondary wiring and do not puncture the silicone jackets (the high voltage available will cause arcing from the puncture point to ground).

If secondary wiring is punctured or burned, it must be replaced to prevent misfiring. If boots and nipples on the spark plug wires are damaged, the arc will also go to ground, causing misfiring.

Care should be used when connecting battery or in jump starting with the battery. Reversing the connections or polarity could cause damage to electronic module.

Also do not operate the engine with one or more spark plugs wires disconnected. (To do so may cause arcing to occur in the distributor cap and cause carbon tracking.)

Do not ground the tachometer connection. This could cause damage to the electronic module. (Make certain that tachometer is designed for HEI operation.)

When making compression checks, the ignition switch connector should be disconnected from the HEI distributor.

ELECTRONIC MODULE

The electronic module is serviced by complete replacement only. When replacing the module, small "dabs" of special silicone grease MUST be applied to the flat portion of the module which will rest on the metal mounting surface. If this grease is not applied the module will not cool properly, which can cause the module to malfunction. A tube of this special silicone grease is supplied with each replacement module. Make certain the replacement module is the correct part number.

CAUTION: *When connecting battery, as in jump starting, reversing connections or polarity can result in damage to the electronic module.*

POLE PIECE AND PLATE ASSEMBLY

The pole piece and plate assembly (often referred to as the pick-up coil assembly) is also serviced by complete replacement only. Make certain the replacement assembly is the correct part number. Production vehicles contain pick-up coils with leads that terminate in a yellow connector body that attaches to the module. The pole piece and plate assembly should not be unnecessarily disassembled as the polarity of the assembly could be changed and affect proper operation of the vehicle.

SPARK PLUG WIRES

HEI system spark plug wires are soft and very pliable, so that scuffing and cutting is easier than on standard black wires. When servicing the HEI system, do not mishandle these cables.

Use care when removing spark plug wire boots from spark plugs. The silicone spark plug wire boots seal more tightly to the spark plugs than ordinary boots. Twist the boot about 1/2 turn in each direction before removing, and pull on the boot only to remove the wire.

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.

If it is necessary to remove an individual wire from the wiring harness assembly, hold grommet of wire down and press retainer tab out of wire holder. To reinstall, lightly lubricate tab end of spark plug wire with silicone. Rotate wire until seated in holder.

COMPONENT REPLACEMENT

DISTRIBUTOR REPLACEMENT

REMOVAL

1. Disconnect wiring harness connectors at distributor cap terminals.
2. Remove distributor cap from housing by releasing four cap retaining latches. Position cap out of way.

NOTE: Be careful not to damage latches. Position screwdriver at top of latch and turn.

3. Disconnect vacuum advance hose from vacuum advance mechanism.
4. Scribe a mark on engine in line with direction the rotor points. Note and mark position of distributor housing in relation to engine.

NOTE: To insure correct timing of the distributor, the distributor must be installed with the rotor correctly positioned.

5. Remove distributor clamp screw and hold-down clamp.
6. Slowly lift distributor from engine and mark position rotor points as teeth on distributor disengage from teeth on camshaft.

INSTALLATION

1. Push the distributor down into position in the engine block.
2. Install distributor hold-down clamp and tighten clamp screw snugly.
3. Move distributor housing to approximate position relative to engine as noted during removal.
4. Position distributor cap to housing with tab in base of cap aligned with notch in housing; secure cap with four latches.
5. Connect wiring harness connector to terminals on side of distributor cap. Connector will fit only one way. Connect battery ground cable.
6. Adjust ignition timing to Specifications as described earlier in this section. Tighten hold-down clamp screw securely.

Installation—Engine Disturbed

NOTE: To insure correct timing of the distributor, the distributor must be installed with the rotor correctly positioned.

If the engine was accidentally cranked after the distributor was removed, the following procedure can be used for installing the distributor.

1. Remove No. 1 spark plug.
2. Disconnect feed wire connector at the "BAT" terminal from distributor to prevent engine from starting.
3. Place finger over No. 1 spark plug hole and crank engine slowly until compressor is felt.
4. Align timing mark on crankshaft pulley to "O" on engine timing indicator.
5. Turn rotor to point between No. 1 and No. 8 spark plug towers on distributor.
6. Install distributor and connect feed wire.
7. Install distributor cap and spark plug wires.
8. Check engine timing.

DISTRIBUTOR DISASSEMBLY

Following is the complete distributor disassembly of which part or all can be used as required.

1. Remove distributor from engine as described above.
2. Remove rotor (figure 26) from distributor shaft by removing two screws.

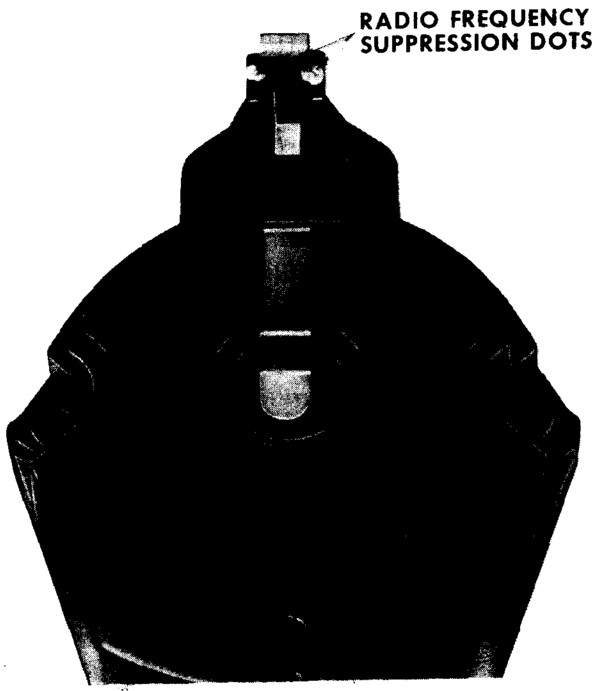


Figure 26—HEI Rotor

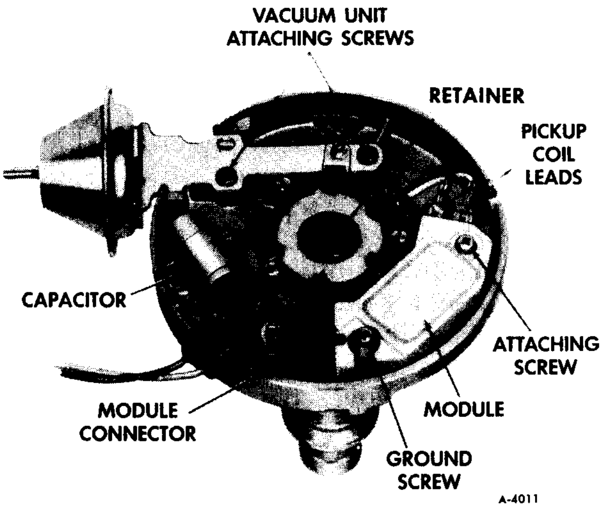


Figure 27—Top View of Distributor Housing With Shaft Removed

3. Before removing gear from distributor shaft, scratch a mark on gear and shaft for correct reassembly. If gear is assembled 180° from original position, the timing will be changed one half tooth.
4. Using a small drift, drive out roll pin retaining gear to shaft.

> CAUTION: *Distributor gear should be supported in such a way that no damage will occur to the distributor shaft while removing pin.*

5. Remove driven gear. Some distributors may have washers between gear and distributor housing, or on the housing itself. Remove and replace washers as required.
6. Check role pin hole on shaft for burrs. Remove shaft and weight assembly from housing (figure 27).
7. If necessary, remove two advance springs, weight retainer, and advance weights.
8. Remove module attaching screws and module from housing. Disconnect wiring leads from module where connector may be removed from "B" and "C" terminals. Remove wires from "W" and "G" module terminals.

> NOTE: Do not wipe lubricant from module or distributor unless replacing module. Special lubricant is provided with new modules.

9. Remove retainer from upper end of distributor housing.
10. Remove pole piece and plate assembly from housing. Do not remove three securing screws (figure 28).

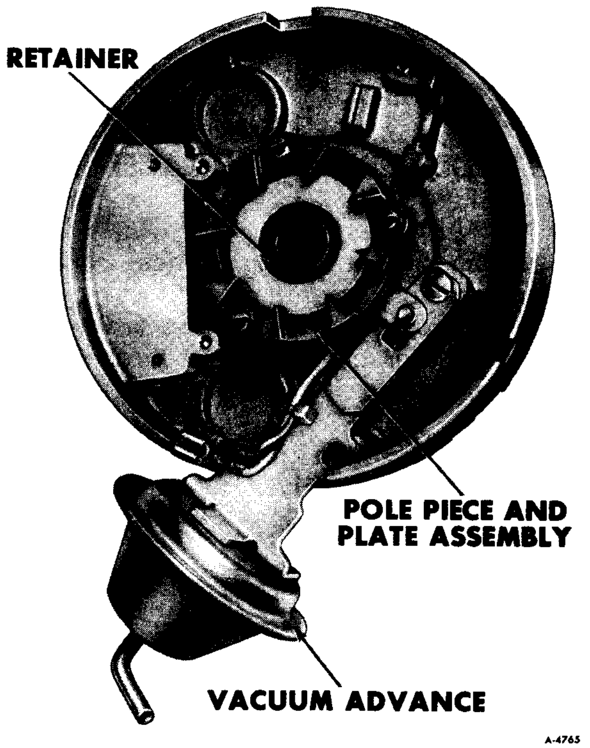


Figure 28—Pole Piece and Plate Assembly

> NOTE: Pole piece and plate assembly is serviced as an assembly. It should not be unnecessarily disassembled as the polarity of the assembly could be changed and effect proper operation of the vehicle.

11. Remove capacitor attaching screw and disconnect wiring lead. Remove capacitor and bracket from housing.
12. Remove wiring harness connector from distributor.
13. Remove felt washer and plastic seal.

> NOTE: No attempt should be made to secure the shaft bushings in the housing.

14. Inspect and replace parts as required.

DISTRIBUTOR ASSEMBLY

1. Repack lube cavity in housing with Delco Distributor lubricant or equivalent.
2. Replace plastic seal and felt washer.
3. Reinstall wiring harness assembly with grommet in distributor housing notch. Engage plastic wiring insulator to housing.
4. Attach lead wire from wiring harness to capacitator, if disassembled. Install capacitator and bracket securing ground wire from wiring harness with capacitator attaching screw.
5. Install module with two attaching screws.

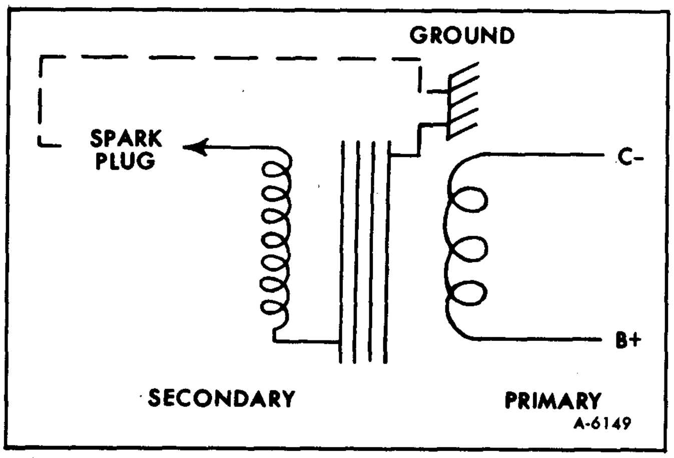


Figure 29—Ignition Coil Schematic

NOTE: Apply a layer of special silicone lubricant between module and housing to improve heat transfer. Lubricant is included with new modules. If installing a new module, be sure part number is correct for this particular distributor.

6. Install vacuum advance unit, pin side up, with two attaching screws.
7. Position pole piece and plate assembly with arm over pin of vacuum advance unit.

NOTE: If arm of pole piece and plate assembly is not properly installed on pin of vacuum adavance unit, the arm can float and cause timing to vary. If installing a new pole piece and plate assembly, be sure part number is correct for this particular distributor.

8. Install retainer to secure position of pole piece and plate assembly.
9. Install connector to "B" and "C" terminals on module with tab on top. Connect green wire to "G" terminal and white wire to "W" terminal.
10. Install distributor shaft and rotate to check for even clearance all around between teeth on pick-up coil of pole piece and plate assembly and teeth on distributor shaft.

NOTE: If necessary to adjust for proper clearance, loosen three screws on pole piece and plate assembly. Move pole piece teeth to provide even clearance. Tighten three screws (figure 28).

11. Install washers between gear and housing, if distributor is so equipped. Slide gear onto shaft in same position as marked when removed.
12. Install roll pin into gear and shaft.

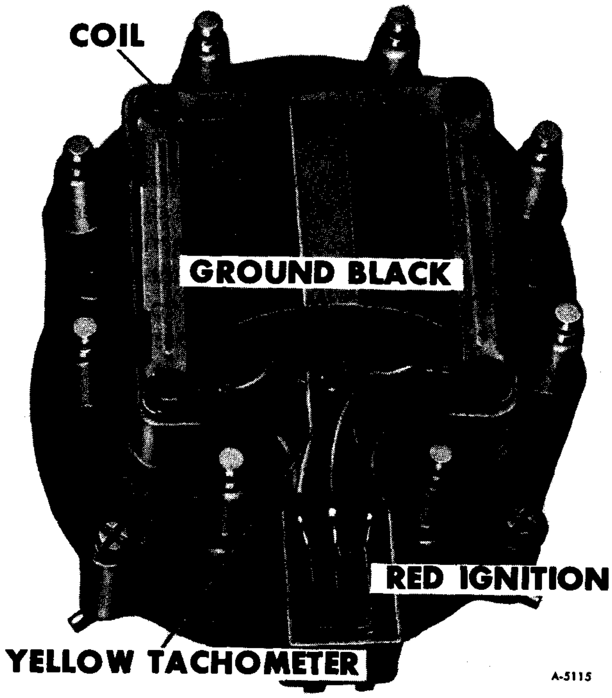


Figure 30—Ignition Coil

NOTE: To prevent damage to the permanent magnet in the pole piece and plate assembly, suport the driven gear when installing the roll pin.

13. If removed, carefully reassemble advance weights and springs on advance weight plate.
14. Position rotor to advance weight plate and tighten retaining screws.

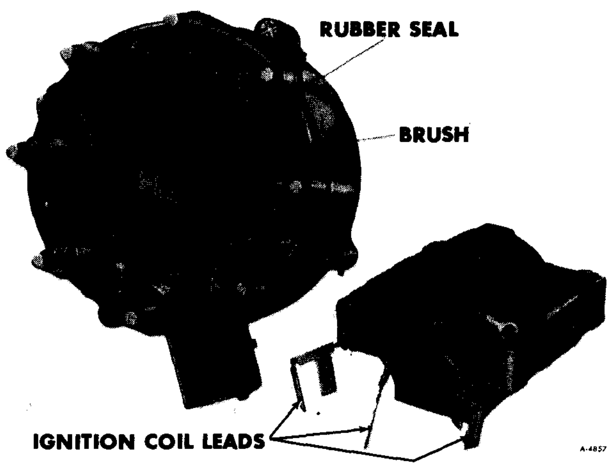


Figure 31—Ignition Coil And Seal (Typical)

15. Position cap on housing making sure cap is properly seated (notch in housing matches tab in cap). Engage four locking latches.

IGNITION COIL REPLACEMENT

REMOVAL (REFER TO FIGURES 29 AND 30)

1. Disconnect battery ground cable from atutomotive battery.
2. Disconnect spark plug wire holder from distributor cap terminals; disconnect ignition/tachometer wiring harness connector from ignition coil terminal connector.

   NOTE: Use care not to damage ignition/tachometer wiring harness connector latches.
3. Remove three screws securing coil cover to distributor cap.
4. Remove four screws securing ignition coil to distributor cap, and remove two ground wires.
5. Disengage yellow and red coil wire terminals by pushing coil leads from underside of connector, and remove ignition coil from distributor cap.

   NOTE: The yellow and red wires are both primary. The two black wires are ground for secondary. The primary and secondary coil windings are isolated, as shown in figure 29.
6. Check condition of seal and resistor brush (spring and button). (Refer to figure 8).

   NOTE: Do not wipe silicone lubricant from seal.

INSTALLATION (REFER TO FIGURES 30 AND 31)

1. Position resistor brush (spring and button) and seal in distributor cap.

   NOTE: Make sure seal is coated with silicone lubricant and properly positioned in place.
2. Position coil into distributor cap with terminals over connector at side of cap.

   NOTE: If replacing ignition coil, be sure part number is correct.
3. Push coil lead wires into connector on side of cap (figure 30).
4. Install two ground wires and four coil attaching screws.
5. Install coil cover onto distributor cap with attaching screws.
6. Position distributor cap on housing, making sure cap is seated properly, and engage four locking latches.
7. Connect ignition/tachometer wiring harness connector at ignition coil terminal; connect spark plug wire holder at distributor cap terminal.

ELECTRONIC MODULE REPLACEMENT

REMOVAL

1. Disconnect ignition/tachometer wiring harness connector at ignition coil terminal connector.
2. Disconnect spark plug wire holder from distributor cap terminals.
3. After releasing four lock latches, remove distributor cap and position out of way.
4. Remove rotor from distributor shaft by loosening two screws.
5. Remove two module attaching screws and lift module from housing. Disconnect wiring leads from module where connector attaches to module "B" and "C" terminals, and remove two leads from "W" and "G" module terminals.

   NOTE: Do not wipe lubricant from module or distributor housing unless replacing the module. A tube of special silicone grease is supplied with each replacement module. When installing module, be sure module has "dabs" of silicone grease on back of module where module rests on metal mounting surface. If not applied, the module will not cool properly, which can cause the module to malfunction.

INSTALLATION

1. Install module with two attaching screws
2. Install connector to "B" and "C" terminals on module with tab on top and connect green wire to "G" terminal and white wire to "W" terminal.
3. Install rotor to advance weight plate and tighten retaining screws.
4. Position distributor cap to housing with tab in base of cap aligned with notch in housing, and secure with four latches.
5. Connect wiring harness connector to terminals on side of distributor cap.

VACUUM ADVANCE UNIT REPLACEMENT

REMOVAL

1. Remove distributor cap and rotor.
2. Remove two vacuum advance attaching screws.
3. Turn pick-up coil clockwise and push rod end of the vacuum advance down so that it will disengage and clear the pick-up coil plate.

INSTALLATION

To install, reverse removal procedure.

HIGH ENERGY IGNITION SYSTEM SPECIFICATIONS— 455 CUBIC INCH ENGINE (1977)

DISTRIBUTOR	FEDERAL
Make	Delco-Remy
Model No.	1112893
Rotation (Viewed at Rotor)	Clockwise
Dwell	Electronic
Centrifugal Advance*	
Start Distributor	
(Degrees)	0
RPM	900
Intermediate Distributor	
(Degrees)	9
RPM	2000
Maximum Distributor	
(Degrees)	16
RPM	3400
Firing Order	1-8-4-3-6-5-7-2

(*) Set with Vacuum Disconnected

IGNITION TIMING*	
Idle Speed (RPM)	
(Transmission in "PARK")	1100
Distributor Setting	8° BTDC

*With Distributor Vacuum Ports on Carburetor Plugged

DISTRIBUTOR VACUUM CONTROL	
Model No.	1973523
Inches of Mercury to Start Advance	8-10
Inches of Mercury for Maximum Advance	19-20
Maximum Advance	
(Engine Degrees)*	24°

*Plus or Minus One Degree

SPARK PLUGS	RJ18YC8
Make	AC
Type	R46SX
Size	14MM
Point Gap	.080"
Torque (Ft. Lbs.)	25
Hex Size	13/16
Distributor Clamp to Block Bolt (Ft. Lbs.)	17

HIGH ENERGY IGNITION SYSTEM SPECIFICATIONS —403 CUBIC INCH ENGINE (1977 AND 1978)

DISTRIBUTOR	FEDERAL	CALIFORNIA
Make	Delco-Remy	Delco-Remy
Model No.	1103267	1103309
Rotation (Viewed at Rotor)	Clockwise	Clockwise
Dwell	Electronic	Electronic
Centrifugal Advance *		
Start Distributor— (Degrees)	0	0
RPM	1100	2200
Intermediate Distributor (Degrees)	9	11
RPM	2000	2600
Maximum Distributor (Degrees)	16	16
RPM	3400	3400
Firing Order	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2
(*) Set with Vacuum disconnected		
IGNITION TIMING*		
Idle Speed (RPM) (Transmission in "PARK")	1100	2000
Distributor Setting	12^o BDTC	12^o BDTC
*With Distributor Vacuum Ports on Carburetor Plugged.		
DISTRIBUTOR VACUUM CONTROL		
Model No.	1973609	1973634
Inches of Mercury to Start Advance	4-5	11
Inches of Mercury for Maximum Advance	7-8	14
Maximum Advance (Engine Degrees)*	8^o	10^o
*Plus or Minus one Degree.		
SPARK PLUGS		
Make	AC	AC
Type	R46SZ	R46SX
Size	14MM	14MM
Point Gap	.060"	.080"
Torque (Ft. Lbs.)	25	25
Hex Size	13/16	13/16
Distributor Clamp to Block Bolt (Ft. Lbs.)	17	17

SECTION 8

FUEL TANK AND EXHAUST

The information described in Maintenance Manual X-7525 under the heading FUEL TANK AND EXHAUST (SEC. 8) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

EVAPORATION CONTROL SYSTEM (ECS) (1978 CALIFORNIA VEHICLES ONLY)

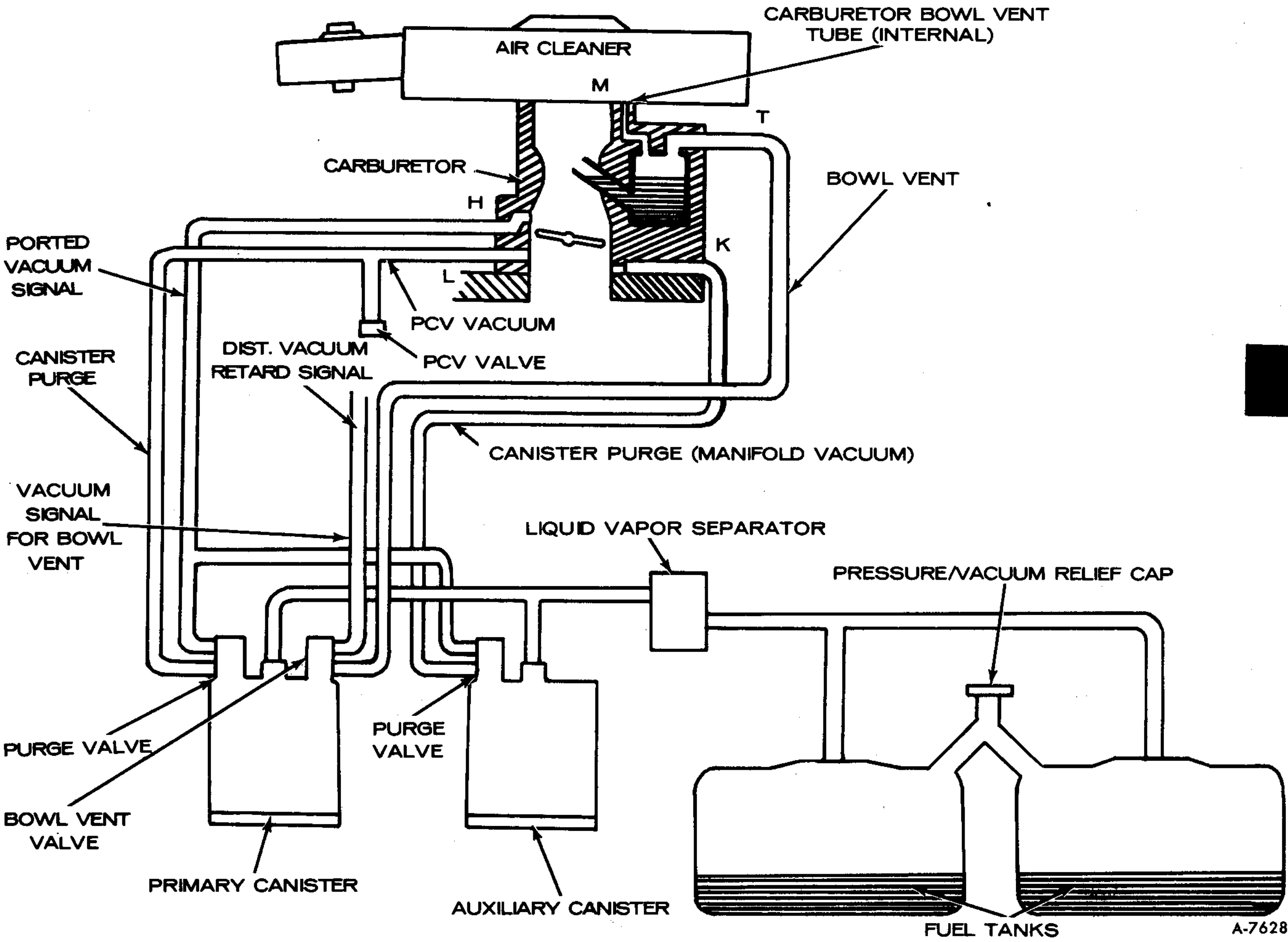


Figure 1—Evaporation Control System (ECS) Schematic

DESCRIPTION

The ECS system used on 1978 California vehicles (figure 1) designed to limit the discharge of gasoline vapors into the atmosphere. The following features are incorporated into the system. Special fuel tanks, filler cap, liquid-vapor separator, hoses, carbor canisters (figures 2 and 3) and carburetor modifications are included in the system. Vapors generated by the evaporation of fuel in the fuel tanks and carburetor float bowl are now stored in the carbon canisters. During periods of engine operation, the fuel vapors are fed into the engine for consumption. The amount of vapor drawn into the engine from the carbon canisters is too small to have any effect on fuel economy or engine operation.

NOTE: The vacuum hose routings for 1978 California emission systems is shown in figure 4.

DIAGNOSIS OF ECS

PROBLEM	POSSIBLE CAUSE	CORRECTION
EVIDENCE OF FUEL LOSS OR FUEL VAPOR ODOR		
A) From Area Fuel Tank Or Fuel Cap Perform Pressure Check To Determine Possible Causes	1. Leaking or plugged fuel or EVAP hoses.	1. Repair or replace hoses as necessary.
	2. Leaking fuel cap.	2. Repair or replace cap as necessary.
	3. Leaking fuel filler neck or hoses.	3. Repair or replace as necessary.
	4. Fuel filler neck gasket surface nicked, burred or dented.	4. Repair or replace as necessary.
	5. Leaking sending unit(s) or gasket.	5. Repair or replace as necessary.
	6. Leaking fuel tank switching solenoid valve.	6. Replace solenoid valve.
	7. Inoperative fuel tank switch.	7. Replace switch.
B) From Engine Compartment - Perform Pressure Check To Determine Possible Causes	1. Liquid fuel leaking from fuel lines, fuel pump or carburetor.	1. Tighten fuel lines, repair or replace fuel pump or carburetor as necessary.
	2. Cracked or damaged canisters.	2. Repair or replace canisters as necessary.
	3. Inoperative bowl vent valve (see Bowl Vent Check Procedures).	3. Repair or replace hoses. Replace canister.
	4. Inoperative purge valve (see Purge Valve Check Procedures).	4. Repair or replace hoses. Replace canister.
	5. Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses or control hoses.	5. Check for proper connections, and check routing as well as condition. Correct as necessary.
	6. Bowl vent hose misrouted.	6. Reroute hose without low spots.
	7. Air cleaner or air cleaner gasket improperly seated.	7. Reinstall air cleaner and/or replace gasket.
POOR IDLE OR DRIVEABILITY SLUGGISH	1. Inoperative purge valve (see Purge Valve Check Procedures).	1. Replace or repair hoses. Replace canister.
	2. Inoperative bowl vent valve (see Bowl Vent Check Procedures).	2. Repair or replace hoses. Replace canister.
	3. Disconnected or misrouted vapor or vacuum control hoses.	3. Check for proper connection and routing. Correct as necessary.
COLLAPSED FUEL TANK (LOSS OF TANK CAPACITY)	1. Plugged or pinched vapor pipe or hoses and defective fuel tank cap.	1. Check all lines from tank to canister and replace cap.
	2. Canister filter plugged and defective fuel tank cap.	2. Replace filter in canister and cap.

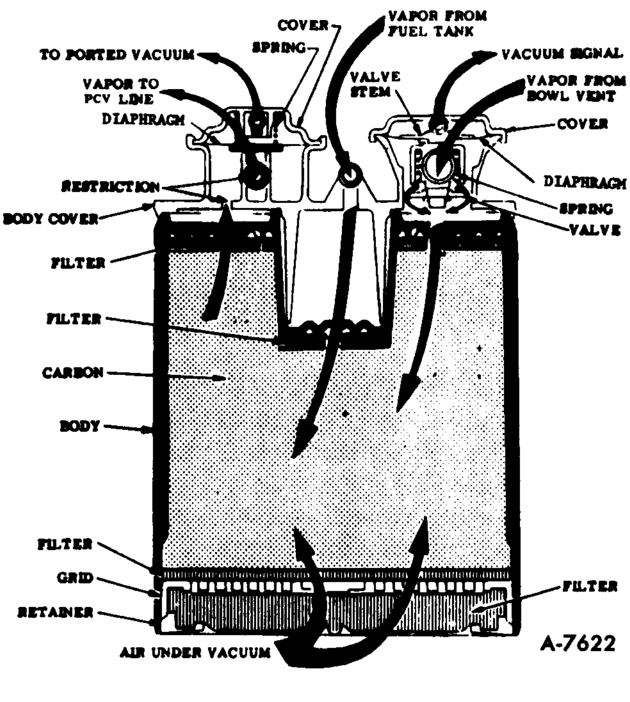


Figure 2—Primary Canister

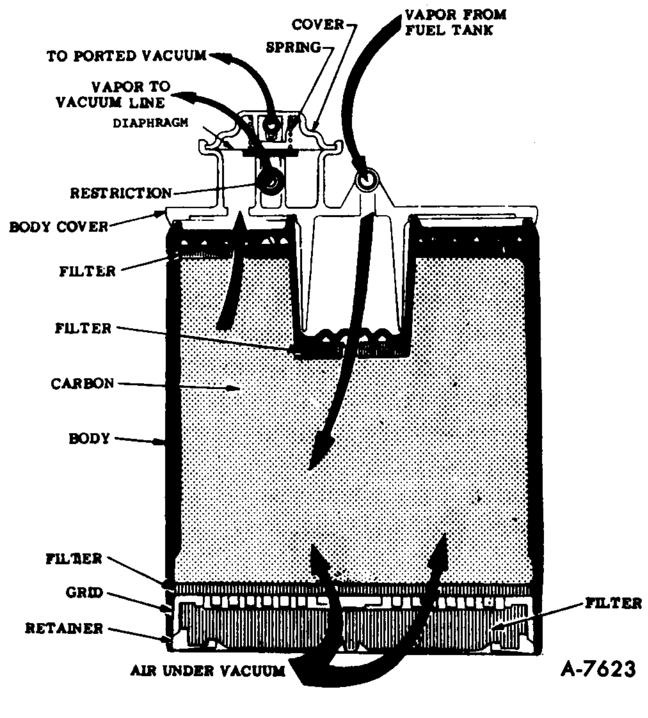


Figure 3—Auxiliary Canister

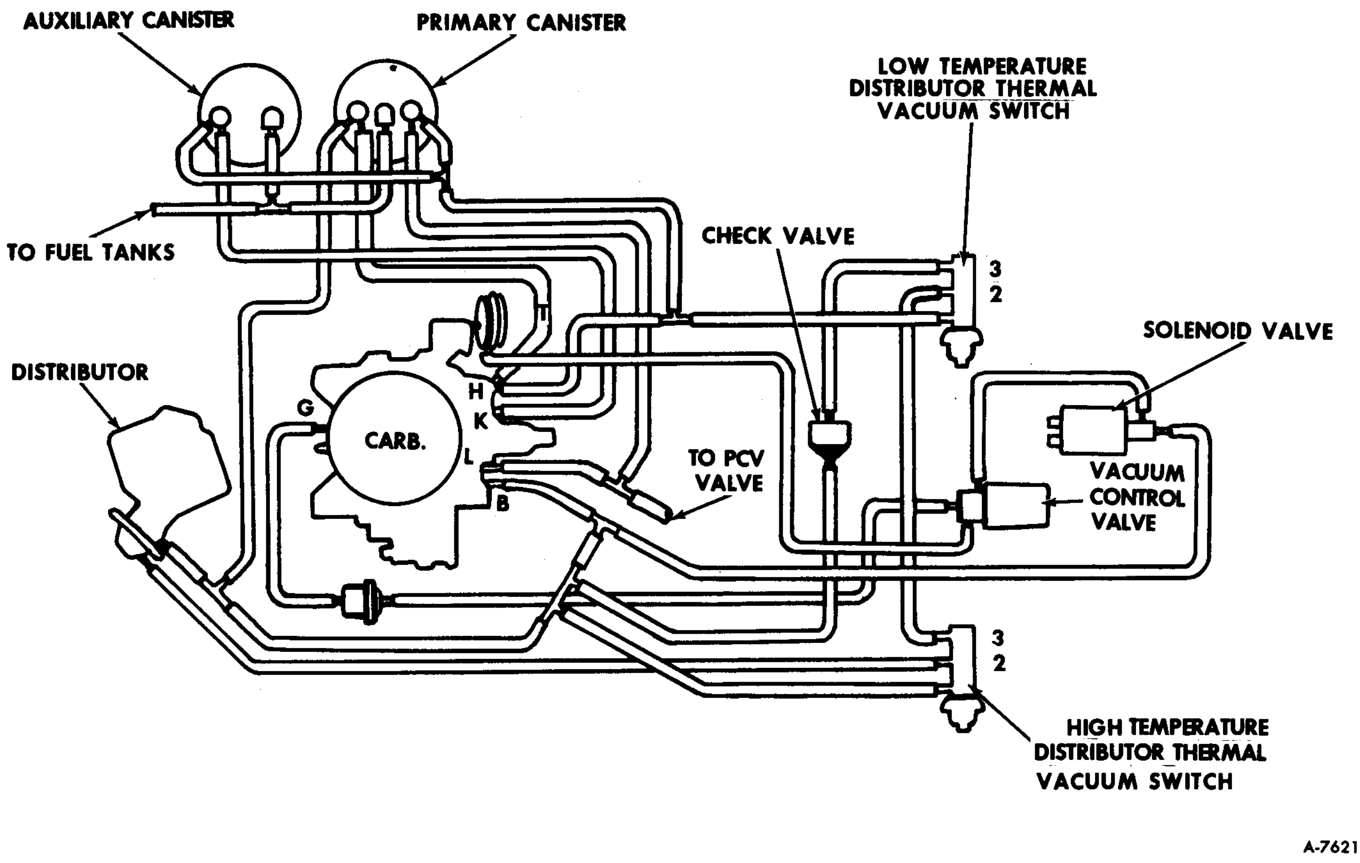


Figure 4—Emission Control Vacuum Hose Schematic

ON-VEHICLE SERVICE

PRESSURE CHECKING ECS

1. Stabilize vehicle by operating until warmed up.
2. Remove tank line at canister and observe for liquid in the line.
3. Apply 15" H_2O pressure to the fuel vapor line.
   a. Observe for excessive loss of pressure.
   b. If negligible pressure loss occurs observe for fuel vapor smell or fuel loss at points listed in Diagnostics under Possible Cause.
   c. Remove fuel filler cap and observe for pressure in tank(s).
4. Remove fuel filler cap and blow on vent line to check for obstructions.

CHECKING CARBURETOR BOWL VENT VALVE

1. Remove the bowl vent vapor hose from the carburetor.
2. Check the open condition of the valve by placing this hose against the mouth and blowing. There should only be a light resistance to flow.
3. If a high resistance or plugged system is found, check for a plugged or restricted hose. Hose may be cleared with compressed air. If the hose is clear, remove the canister filter. If the restriction persists, replace the canister.
4. A simple check of the valve closed condition can be obtained with the same procedure as in Step 2, but with the engine operating at operating temperature. Manifold vacuum will be applied to the valve through the control line. The bowl vent line should exhibit a plugged condition.
5. If the valve is not closed, remove the control vacuum line and check for vacuum. If no vacuum is present, check hose for restriction or vacuum leak. Repair or replace as required. If vacuum is present, replace canister.

CHECKING CANISTER PURGE VALVE

1. Remove purge valve control vacuum line. Check for a vacuum signal with engine operating above idle (1500 RPM).
2. Apply an external vacuum source to the purge valve control diaphragm. A good valve will hold vacuum.
3. If the valve will not hold vacuum, replace canister.
4. If valve holds vacuum, remove purge line and check for vacuum. If no vacuum, check PCV hoses and system. Repair or replace as necessary. If there is vacuum, blow into canister purge valve. If restriction persists, replace canister.

COMPONENT REPLACEMENT

Component replacement procedures are the same as described under "Evaporation Control System" in FUEL TANK AND EXHAUST (SEC. 8) of maintenance manual X-7525.

SECTION 9
STEERING

The following "Caution" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology: See "Caution" on page one of this section.

CAUTION: 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 OF 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. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

The information described in Maintenance Manual X-7525 under the heading STEERING (SEC. 9) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

STEERING SYSTEM DIAGNOSIS

Wear, looseness or binding of any of the moving parts of the steering system and suspension system will affect vehicle alignment. Accurate alignment cannot be achieved as long as such conditions go uncorrected.

For detailed diagnosis of front suspension and steering system problems (such as hard steering, poor directional stability, excessive play in system, and other problems) refer to FRONT SUSPENSION (SEC. 3A) in this supplement.

STEERING LINKAGE

NOTE: Effective with Vehicle Identification Numbers TZE167V101401 (Motorhome), TZE337V101429 (23' TransMode) and TZE367V101393 (26' TransMode), Motorhome and TransMode vehicles are equipped with METRIC TIE ROD CLAMPS. The new torque specification for these clamps is 16-22 N•m (12-16 ft. lbs.). Replacement clamps and fasteners must be tightened to proper torque specification.

Refer to FRONT SUSPENSION (SEC. 3A) of this manual for toe-in adjustment procedure.

POWER STEERING PUMP

Power steering pump mounting and hose routing has been revised on vehicles equipped with 403 cubic inch engines. This revision is effective with Vehicle Identification Numbers TZE167V101285 (Motorhome), TZE337V101287 (23' TransMode) and TZE367V101312 (26' TransMode). Refer to figures 1 and 2 for pump installation and hose routing.

REMOVAL
(FIGURE 1)

1. Disconnect negative battery cable.
2. Loosen power steering and generator belts.
3. Disconnect pressure line and return hose from pump. (Install caps at both pump fittings to prevent drainage of oil from pump).
4. Remove power steering pump mounting bolts and nuts.
5. Remove power steering pump with adjusting link attached.
6. Remove adjusting link from pump.
7. Remove pulley from shaft using puller tool J-25034 (figure 3).

CAUTION: *Do not hammer pulley off shaft as this will damage pump.*

INSTALLATION
(FIGURE 1)

CAUTION: *See "Caution" on page one of this section.*

1. Install adjusting link on pump.
2. Install pulley on shaft using Tool J-25033.

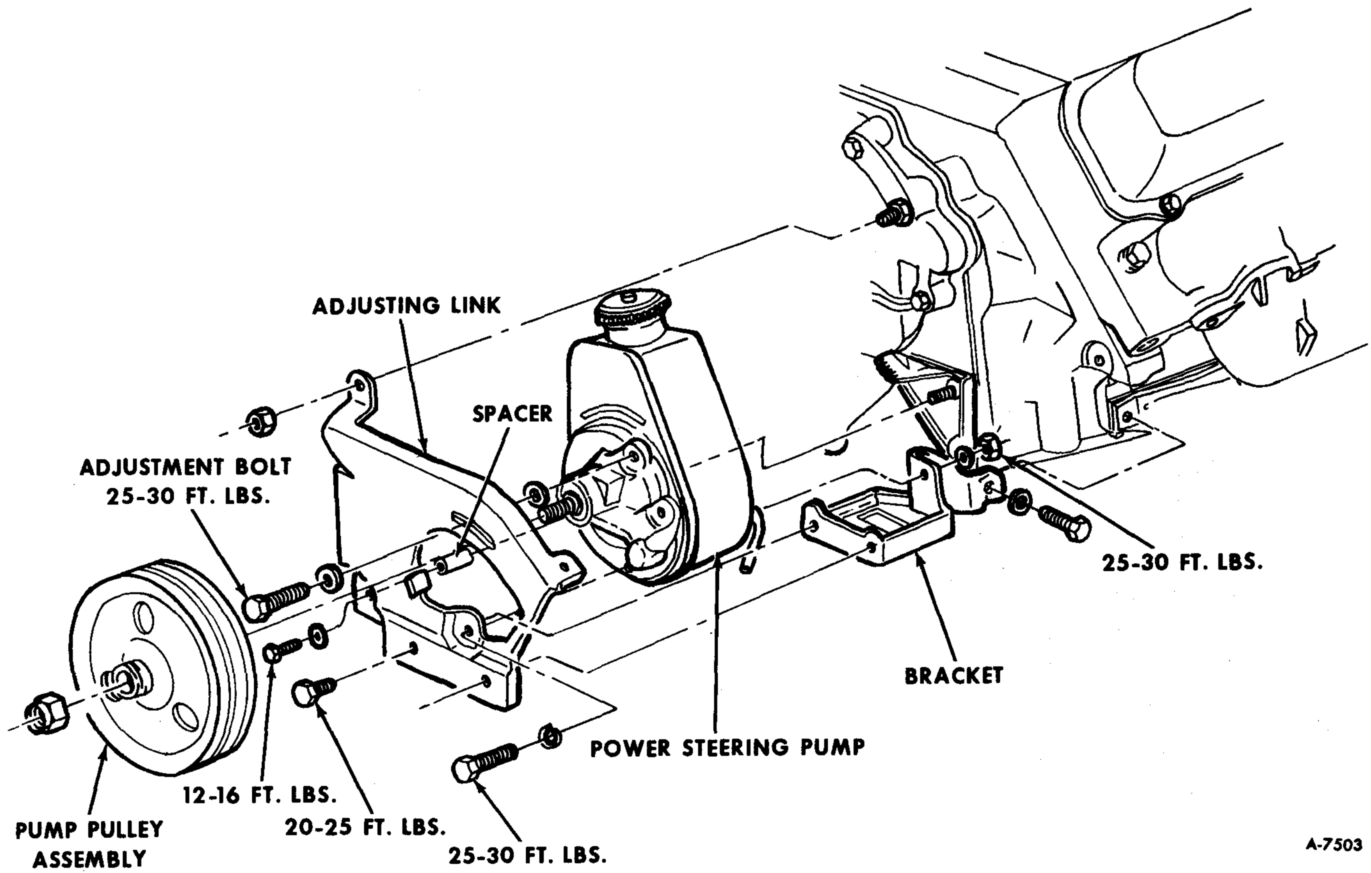


Figure 1—Pump Installation

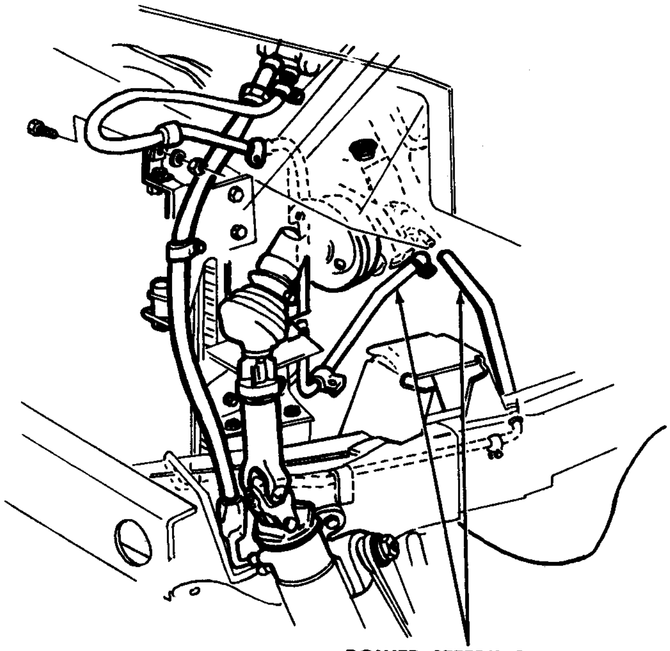


Figure 2—Power Steering Pump Hose Routing

CAUTION: *Do not hammer pulley on, as this will damage internal pump parts (figure 4).*

3. Install pump assembly on engine and secure with bolts and nuts (torque to 25-30 ft. lbs.).

CAUTION: *Correct routing of the power steering hoses is very important. Although sequence of assembly is not vital, the power steering hoses, when installed, must not be twisted, kinked or tightly bent. The hoses should have sufficient natural curvature in the routing to absorb movement and hose shortening in operation. They should also be free of twist under strain. When poor hose assembly routing exists, hose and assemblies should not be bent or mutilated by pulling on them. The situation should be corrected by loosening the fittings and properly repositioning the hose assembly before retightening nuts. All fittings must be held while tightening or loosening nuts.*

4. Connect and tighten hose fittings to 30-40 ft. lbs.

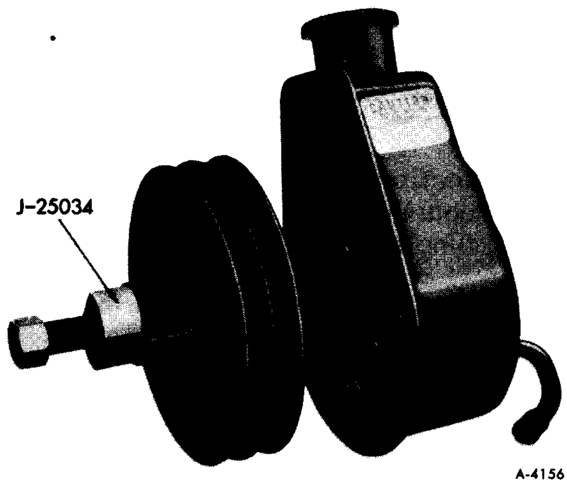


Figure 3—Pulley Removal—Special Tool J-25034

5. Fill reservoir with fluid. Bleed pump by turning pulley backward (counterclockwise as viewed from front) until air bubbles cease to appear.

6. Install pump belts over pulley.

7. Move pump until belts are tight, then tighten adjusting screws. Do not pry on reservoir or pull on filler neck.

8. Adjust belts and bleed system. (Refer to ADJUSTMENTS, Section 9 Maintenance Manual X-7525).

9. Connect battery ground cable.

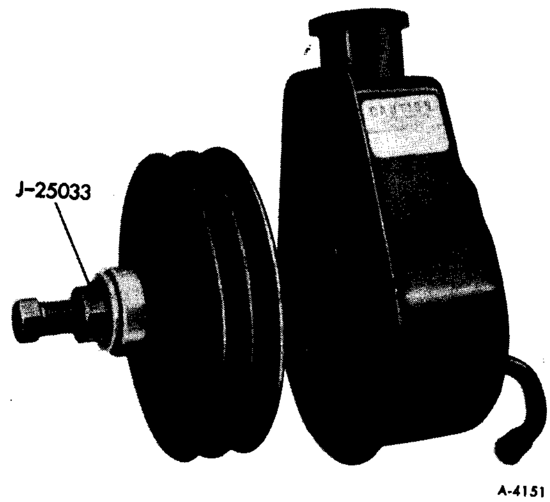


Figure 4—Pulley Installation—Special Tool J-25033

STEERING COLUMN

GENERAL INFORMATION AND OPERATION

The function-locking steering column includes important features in addition to the steering function:

1. The ignition switch and lock are mounted conveniently on the column.
2. With the column-mounted lock, the ignition, steering and gearshifting operation can be locked to inhibit theft of the vehicle.

The tilt function-locking columns are designed for ease of entry and driver comfort. These columns have seven different steering wheel angle positions.

The tilt mechanism consists of an upper and lower steering shaft assembly with a universal joint between them. A support assembly is held to the mast jacket by a lock plate, and a steering housing assembly is positioned over the upper steering shaft and secured to the support by two pivot pins. Two lock shoes are pinned to the housing assembly and engage a pin in the support assembly. When the release lever is pulled up and the lock shoes disengage the support pin, the steering wheel is pushed up by a spring compressed between the support and housing assemblies.

The operation of the lock is the same as in other GM vehicles. To start the vehicle, you insert the key in the lock, turn the unit clockwise to "start" and let the switch return to the "on" position. The "off", "lock" and "accessory" positions are also the same as in other GM vehicles. When you engage the shift lever in "park" and lock the ignition, the steering wheel locks and the gearshift locks.

The function-locking column may be easily diassembled and reassambled. If the column is serviced, it is important that only the specified screws, bolts and nuts be used as designated. Equally as important is correçt torque of bolts and nuts.

When the column is removed, special care must be taken in handling this assembly. Only the specified wheel puller should be used. When the column is removed from the vehicle, such actions as a sharp blow on the end of the steering shaft or shift lever, leaning on the column assembly, or dropping of the assembly could shear or loosen the plastic fasteners that maintain column rigidity. It is, therefore, important that the removal and installation and the disassembly and reassembly procedures be carefully followed when servicing the assembly.

LOWER STEERING SHAFT

(FIGURE 5)

REMOVAL

1. Set front wheels in straight ahead position. This can be done by driving the vehicle a short distance on a flat surface. Block wheels fore and aft so that vehicle cannot move.
2. Mark relationship between companion flange and splined slip shaft, and between splined slip shaft and slip yoke assembly. (See figure 5.) Also mark relationship between lower steering shaft yoke end (universal joint) and steering gear input shaft.
3. Remove clamp bolt and nut attaching lower steering shaft to steering column.
4. Remove bolt and nut securing lower steering shaft to steering gear input shaft.
5. Compress splined shaft into steering slip yoke assembly, and carefully lift lower steering shaft out of vehicle.

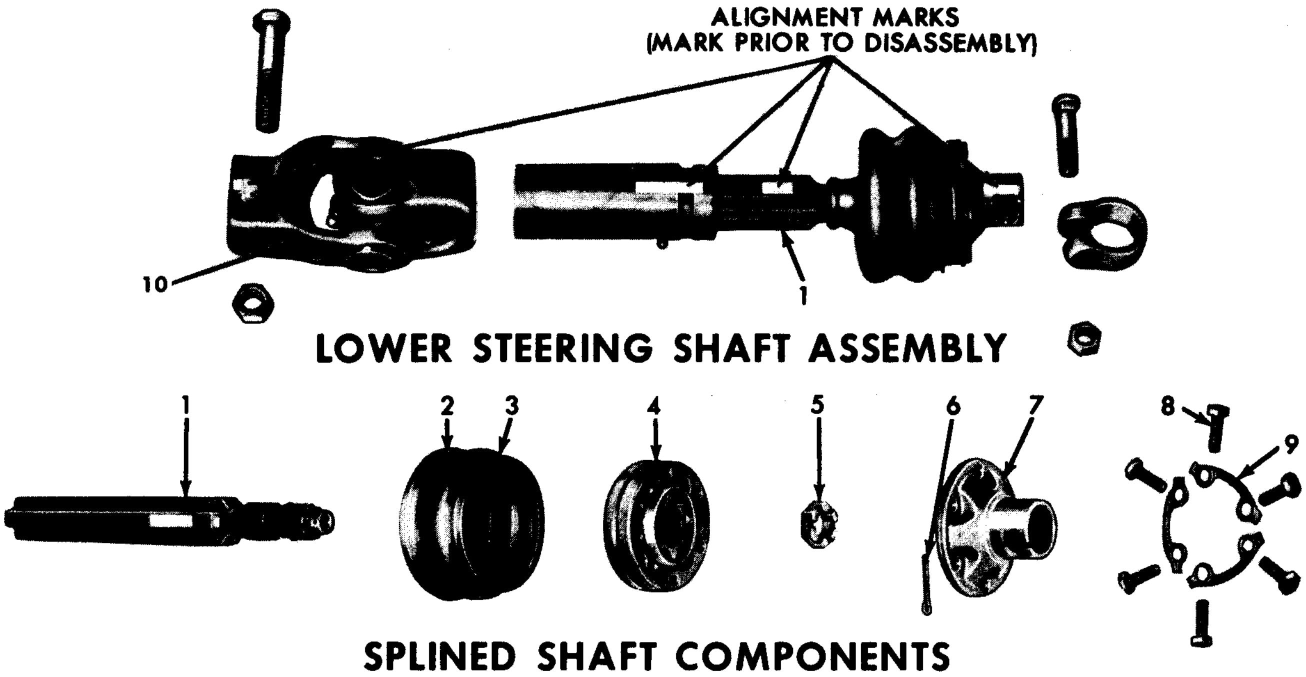
DISASSEMBLY

With lower steering shaft assembly on a bench, separate the splined shaft from the slip yoke assembly.

NOTE: Whenever steering shaft is disassembled, it is mandatory that exposed spline areas be protected from nicks, scratches, and contamination until shaft is reassembled.

CONSTANT VELOCITY (CV) JOINT DISASSEMBLY

1. Remove retainer strap holding dust boot to CV joint assembly. Slip boot off of CV joint.
2. Remove locks (lock tab washers) on companion flange. MARK RELATIONSHIP



1. Splined shaft
2. Dust Boot
3. Retainer Strap (Not Shown)
4. "CV" Joint Assembly
5. Nut
6. Cotter Pin
7. Flange
8. Screw
9. Lock Washer
10. Yoke-Universal Joint

A-6166

Figure 5—Lower Steering Shaft—Disassembled

BETWEEN COMPANION FLANGE AND SPLINED SLIP SHAFT (if not already marked). Then remove 6 bolts attaching flange to CV joint assembly (figure 5).

3. Remove cotter pin and large nut from splined shaft, then remove CV joint assembly from shaft.

NOTE: The CV joint is not to be repaired. It must be replaced as a new unit only.

YOKE DISASSEMBLY (CROSS-TYPE UNIVERSAL JOINT)

1. With steering shaft removed from vehicle, remove the snap rings from universal joint bearings. Discard snap rings.
2. Support yoke in arbor press (clamp yoke end) and drive one side of bearing until opposite bearing comes out of yoke. Use of soft drift and hammer may aid in bearing removal.
3. Turn yoke over and drive out the opposite bearing. Remove the remaining two bearings the same way. Note position of grease fitting for reassembly.
4. Remove journal cross.

ASSEMBLY

CV UNIVERSAL JOINT ASSEMBLY

1. Install new CV joint assembly on splined shaft.

CAUTION: *When tightening large nut to retain CV joint, do not hold splined shaft in coated area as damage to this surface may result.*

CAUTION: *See "CAUTION" on page one of this section.*

2. Install large nut on shaft. Torque nut. See Specifications at the end of this section for torque value. Install new cotter pin through holes in shaft. See "NOTE" in Specifications at the end of this section.
3. Pull dust boot up and into groove on side of CV joint assembly. Be sure that boot groove is free of grease prior to assembly of boot. Install new retainer strap and pull tight with a force of 40-45 pounds.

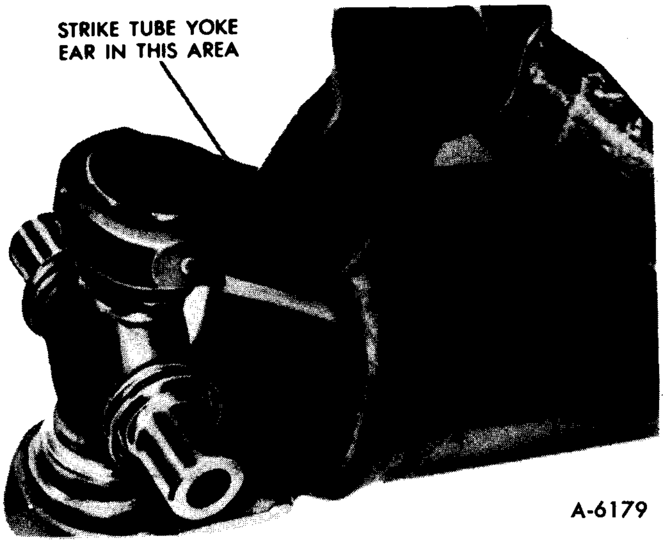


Figure 6—Seating the Snap Rings

NOTE: Before proceeding with step 4, the cavity between the flange coupling and the CV joint assembly must be packed with lubricant. (Use a Lithium-soap base grease having extreme pressure properties meeting GM 6031-M, or equivalent.)

4. Install companion flange (align marks made during disassembly for correct relationship between flange and splined slip shaft) and install six bolts with lock-tab washers.

5. Torque companion flange bolts. See Specifications at the end of this section for torque value. Then, bend up lock tabs against bolt heads.

YOKE ASSEMBLY
(CROSS-TYPE UNIVERSAL JOINT)

1. Align yoke end and steering slip shaft as marked during removal. Install journal cross into yokes with grease fitting in position as noted during removal.

2. Insert two bearings into one yoke and insert journal cross into bearing on one side. Press both bearings in far enough to install new snap rings.

NOTE: If difficulty is encountered in seating snap rings, strike the yoke firmly with a hammer to aid in seating the snap rings. This springs the yoke ears slightly (figure 6).

3. Turn shaft one-half turn and install remaining two bearings and new snap rings into adjacent yoke.

4. Lubricate universal joint at grease fitting (figure 7), using a Lithium-soap base

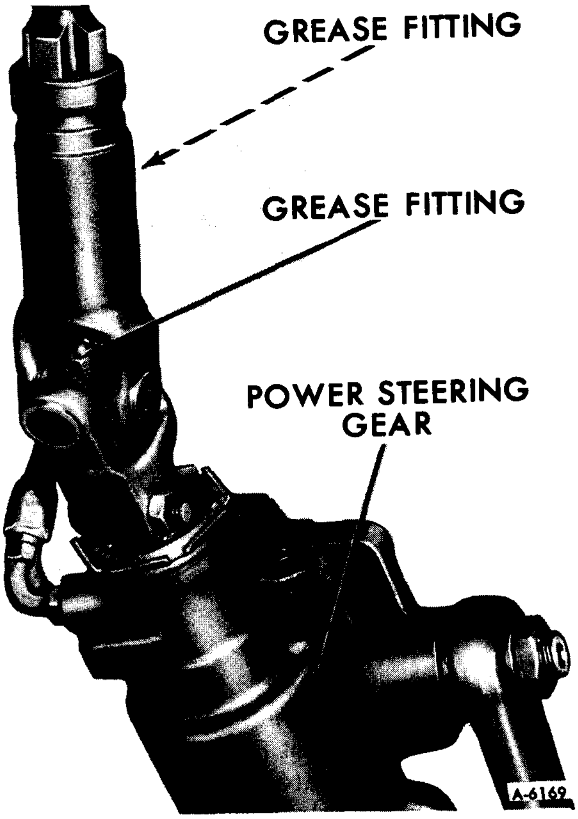


Figure 7—Lower Steering Shaft Grease Fittings

grease having extreme pressure properties meeting GM 6031-M, or equivalent.

INSTALLATION

CAUTION: *See "CAUTION" on page 1 of this section regarding the fasteners referred to in step 1 and step 3.*

1. Align marks made at removal and assemble the lower shaft yoke end (universal joint) onto the steering gear input shaft. Install clamp bolt and nut, and torque nut to Specifications listed at the end of this section.

NOTE: If alignment marks have not been made, or if new parts are being used, be certain that steering gear input shaft is in high point of travel (centered position) before clamp bolt and nut are installed.

2. Raise lower steering shaft into position and guide companion flange (CV joint end) onto the steering column.

3. Install steering clamp bolt and nut, and torque nut to Specifications listed at the end of this section.

STEERING WHEEL HORN ASSEMBLY
(FIGURE 8)

REMOVAL

1. To remove horn assembly from steering wheel, loosen and remove mounting screws (3) securing horn assembly to shroud.

2. Disconnect horn electrical connection at center of shroud.

3. Lift off horn assembly.

INSTALLATION

To install, reverse removal procedure.

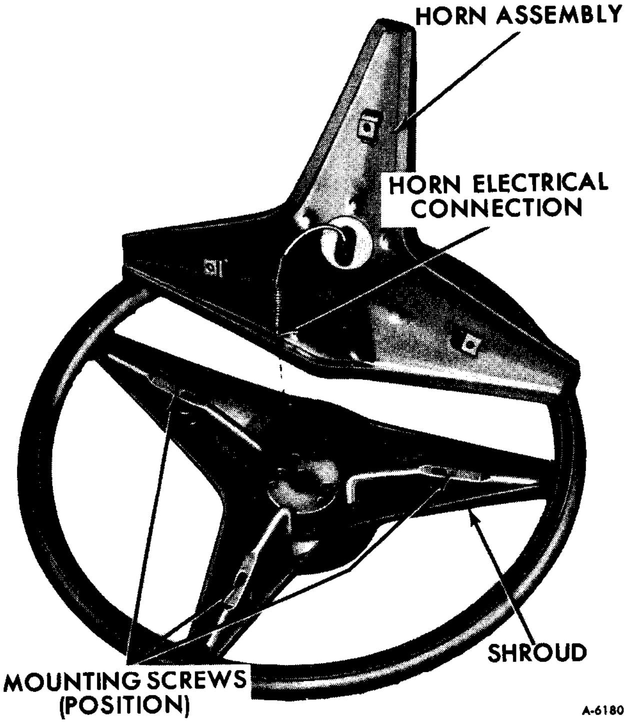


Figure 8—Horn Assembly

SPECIFICATIONS

LOWER STEERING SHAFT	TORQUE
CV Joint Nut *	
(CV Joint to Splined Steering Shaft)	20 -30 ft. lbs.
Companion Flange Bolts (6)	8 -12 ft. lbs.
Shaft Bolt Nut	
(Universal Joint to Steering Gear)	40 -45 ft. lbs.
Steering Clamp Bolt Nut	
(Companion Flange to Steering Column)	40 -45 ft. lbs.

*NOTE: After reaching minimum torque required, nut must always be tightened to insert cotter pin. Never back nut off.

SECTION 10
WHEELS AND TIRES

The information described in Maintenance Manual X-7525 under the heading WHEELS AND TIRES (SEC. 10) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

RADIAL TIRES

Steel-belted bias-ply tires are standard equipment on 1977 model vehicles. Optional equipment for 1977 models includes steel-belted radial tires. Steel-belted radial tires are standard equipment on all 1978 model vehicles. (NOTE: Bias-ply nylon tires are also available as optional equipment on the 1978 TransMode vehicles only.)

Tire size is either 8.75-16.5 LT or 8.75 R-16.5 LT, load range "D". Cold inflation pressure rating for bias-belted tires is 60 psi; radial tires should be inflated to 65 psi. For continuous high speed operation over 65 mph (105 km/h), cold inflation pressure should be increased 10 psi above the recommended cold inflation pressure.

NOTE: Radial tires may have the appearance of being under-inflated when at recommended cold inflation pressure. Refer to figure 1 for view of properly inflated radial tire.

TIRE REPLACEMENT

CAUTION: *Do not mix different construction types of tires on the vehicle such as radial , bias, and bias-belted tires, because vehicle handling may be seriously affected.*

When replacing radial tires, you should use size 8.75R-16.5 LT, load range "D". If bias-ply steel belted tires are used (or bias-ply nylon on a TransMode) use tire size 8.75-16.5LT, load range "D". Construction type must be steel-belted radial, bias-ply steel belted or bias-ply nylon. Use of any other size, load range or other construction type of tires may seriously 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 vehicle.

WHEEL REPLACEMENT

Wheels must be replaced if they are bent, heavily rusted, if they leak air or if lug nuts continually loosen. Do not straighten bent wheels or use inner tubes in leaking wheels used with tubeless tires.

When replacing wheels for any reason, the replacement wheels should be equivalent in load capacity, inflation pressure capacity, diameter, width, offset and mounting consideration to those originally installed on the vehicle. Be sure the word "RADIAL" is stamped on the rim.

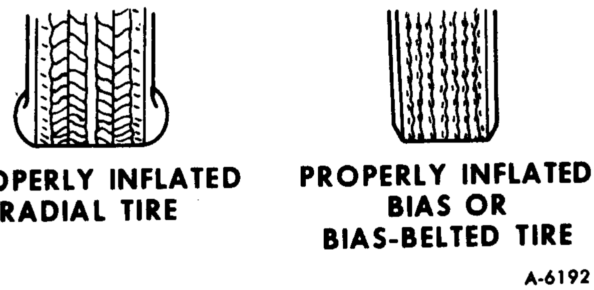


Figure 1—Tire Inflation

SECTION 12
CHASSIS ELECTRICAL

The information described in Maintenance Manual X-7525 under the heading CHASSIS ELECTRICAL (SEC. 12) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

INSTRUMENT PANEL

The instrument panel is new in 1977 (see figures 1 and 2). This new panel includes the ash tray (formerly mounted to the side trim panel) and air conditioning ducts mounted in new locations. However, the major parts of the instrument panel remain the same, including cluster cowl panel (sometimes called "rear cover"), foam ring panel and cluster bezel, valence panel, right hand instrument panel, glove box and glove box reinforcement.

All instruments and gauges are installed in the instrument cluster as shown in figure 3.

The instrument panel gauges utilize printed circuits. They are connected to the vehicle wiring through multiple terminal connectors which are plugged into the back side of the gauges. The cluster cowl, cluster bezel and all instruments and gauges can be serviced in the vehicle as described in CHASSIS ELECTRICAL (SEC. 12), Maintenance Manual X-7525.

Illumination and indicator lamps can be replaced without removing the gauges and are of a 1/2 turn locking type with printed circuit connections. Regular maintenance is not required on the instrument cluster other than maintaining clean, tight electrical connections and replacing defective parts. Foam ring cluster mounting is shown in figure 4. Valence panel and ash tray mounting is shown in figure 2. Glove box stop is shown in figure 1.

SPEEDOMETER AND GAUGE CLUSTER
(Figure 5)

"Face" changes have taken place on the

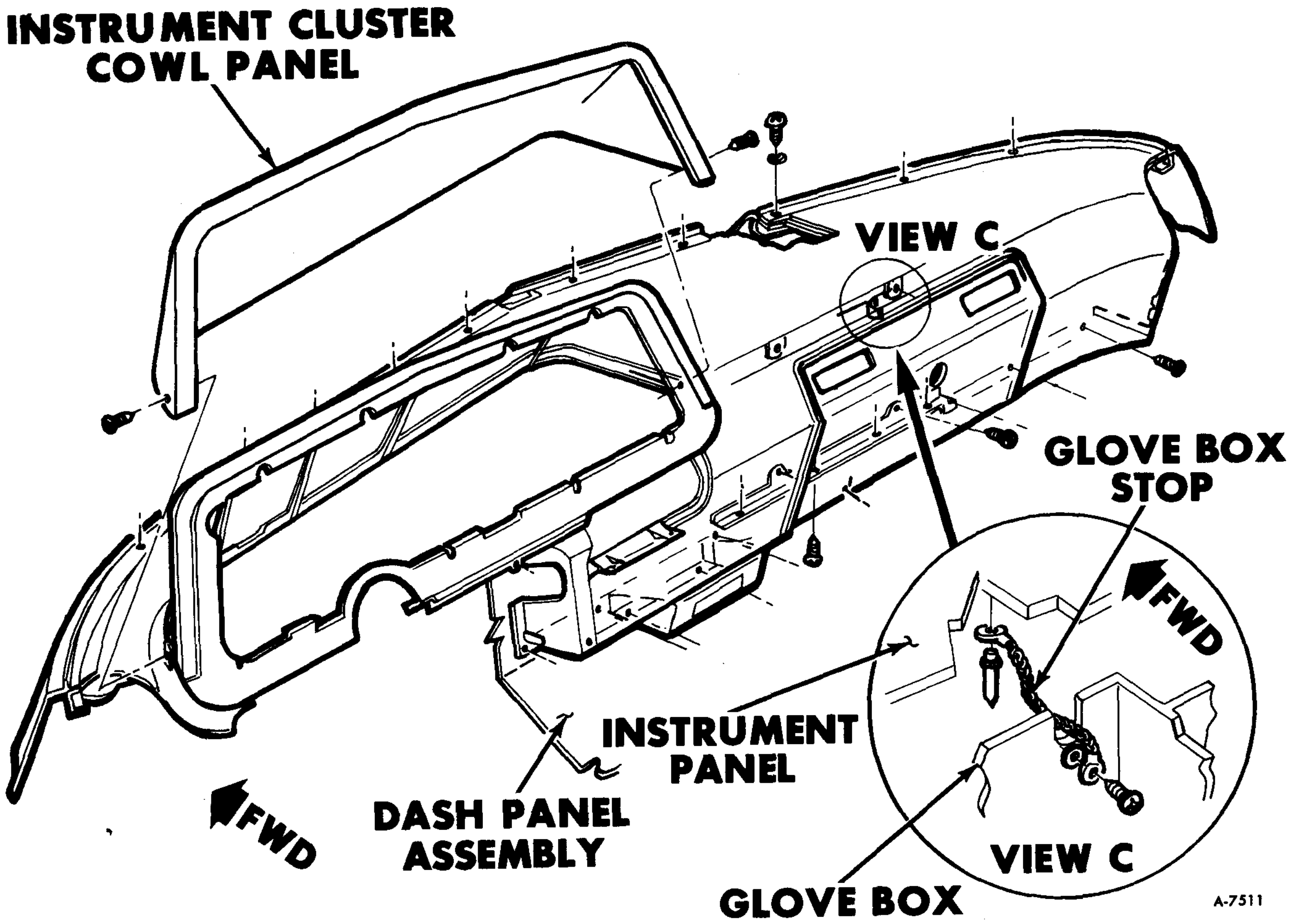


Figure 1—Instrument Panel

speedometer head and gauge cluster. The speedometer now includes kilometers per hour as well as miles per hour. However, both components are serviced in the bezel as before.

PRINTED CIRCUITS

Tell-tale printed circuit (figure 6) provides electrical contacts for illumination of various warning lights. Bulbs used in the tell-tale panel are listed in Specifications at the end of this section. Check various tell-tale circuits as described in CHASSIS ELECTRICAL (SEC. 12), Maintenance Manual X-7525. "Engine Water" (Low Coolant) tell-tale circuit can be checked as shown under "Engine Water Indicator" immediately following.

ENGINE WATER INDICATOR ("LOW COOLANT")

(FIGURE 7)

All vehicles are equipped with a coolant level warning light, "Engine Water," which illuminates in the printed circuit tell-tale panel (see figure 7) when a cooling system low

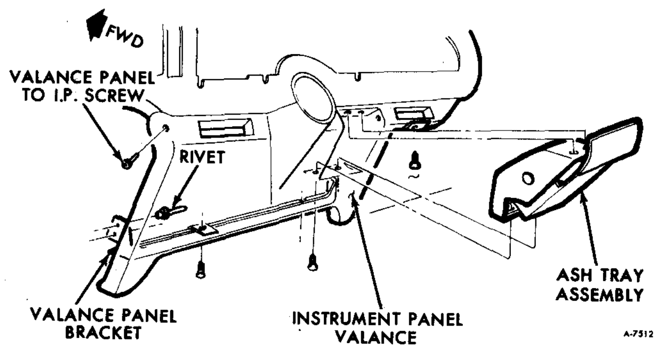


Figure 2—Instrument Panel Valence

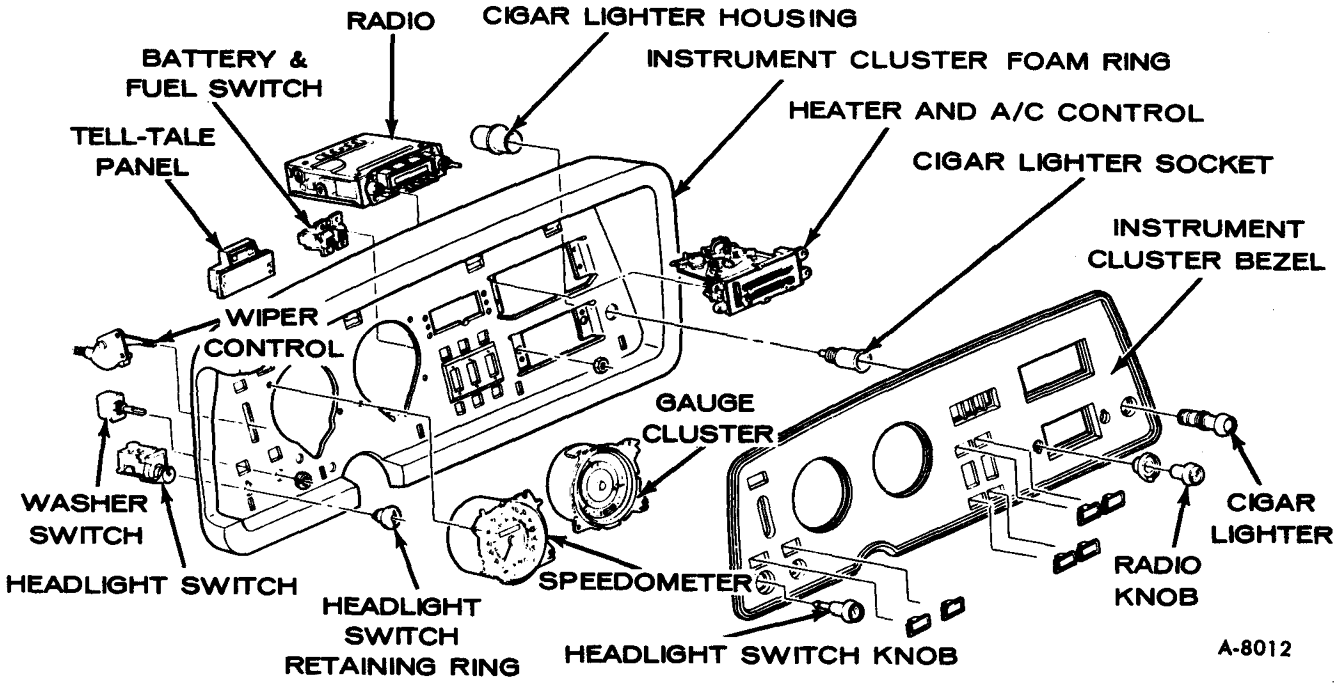


Figure 3—Left Hand Instrument Panel Assembly Components

water condition occurs in the radiator of the vehicle. The indicator module is located in the instrument panel wiring harness beneath the speedometer connector. If "Engine Water" indicator system malfunctions, refer to "Coolant Level Indicator Diagnosis Chart", Sec. 12, Maintenance Manual X-7525. See servicing details before refilling coolant as discussed in Sec. 13, RADIATOR AND COOLANT RECOVERY SYSTEM, Maintenance Manual X-7525.

SYSTEM OPERATION (FIGURE 8)

The engine water (low coolant) indicator system is a D.C. powered, transistorized circuit utilizing a stainless steel probe to sense the presence of coolant in the vehicle cooling system. When coolant level in radiator is satisfactory, the 16/Yellow wire is grounded through the radiator probe. When fluid level in the radiator drops below the probe, probe resistance increases. If probe resistance is high enough to trigger the integrated circuit of the module, a ground path is provided for the tell-tale panel, turning the "ENGINE WATER" light on.

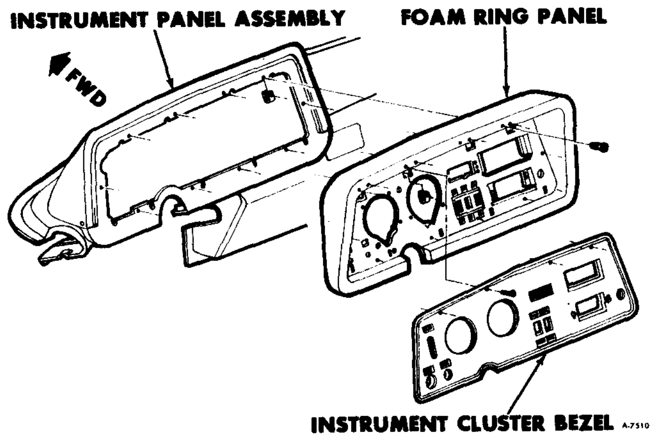


Figure 4—Instrument Cluster Assembly and Bezel

"ENGINE WATER" TELL-TALE CIRCUIT CHECK

1. Remove instrument panel rear cover.
2. Remove tell-tale light panel connector and remove the tell-tale panel.

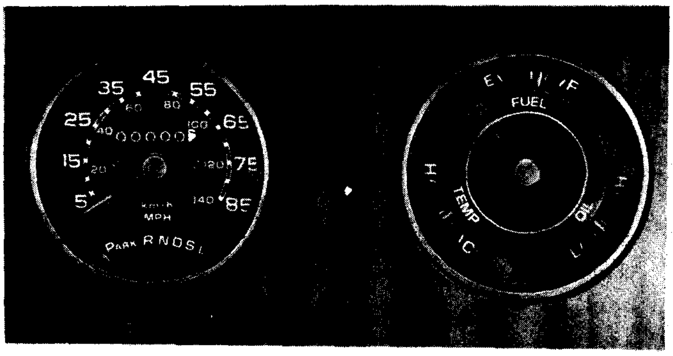
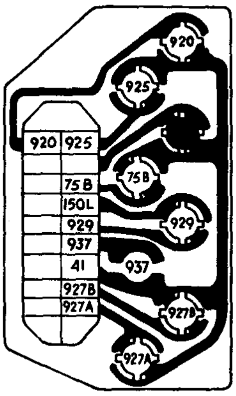


Figure 5—Speedometer and Gauge Cluster



LEGEND-CIRCUIT CONNECTOR	
925	DOOR
	LOW AIR
75B	PARK BRAKE
150L	GROUND (LOW FUEL)
929	LOW FUEL
937	ENGINE WATER
41	FEED (ACC. BUS BAR)
927B	SET LEVEL
927A	TO TRAVEL AUTO
920	CRUISE

A-7210

Figure 6—Tell Tale Printed Circuit

3. With a continuity light, connect one probe of test light to "41" of the printed circuit ("FEED") and the other probe to "937".

If the test light lights, bulb and circuit are good. If the test light does not light, remove the "937" bulb and check bulb. If bulb is good, problem is in the printed circuit board.

NOTE: There is no "low air" warning system on circuit "900".

ENGINE WATER MODULE REPLACEMENT

The engine water (low coolant) module is replaced from the rear of the instrument panel. The module is taped to the instrument panel wiring below the speedometer connector (see "Instrument Panel Wiring" later in this section for location), and is connected to the wiring harness through a 5-wire connector. (See figure 8).

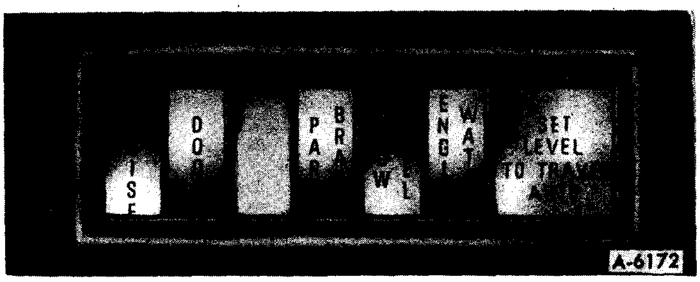


Figure 7—Tell-Tale Panel

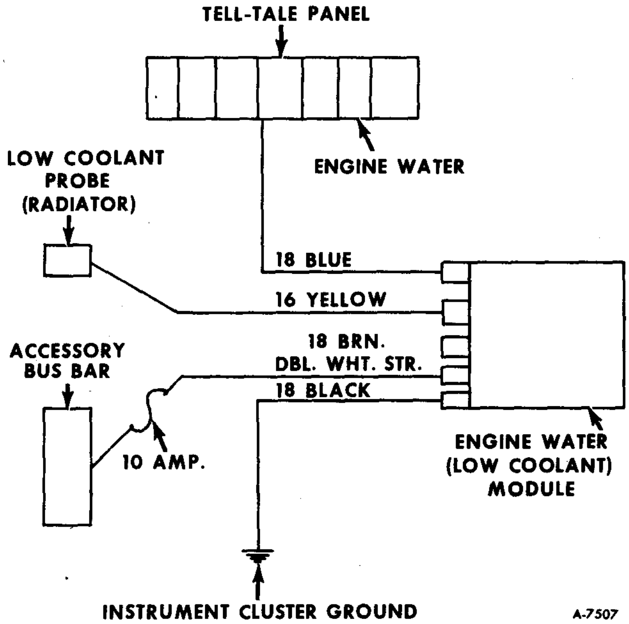


Figure 8—Engine Water ("Low Coolant") System Schematic

1. Remove instrument panel rear cover.

2. Remove tape from module. Remove module from dash panel.

3. Disconnect electrical connector from module.

4. Install replacement module in reverse sequence of removal.

RADIATOR PROBE REPLACEMENT

1. Disconnect lead wire from probe sensor.

2. Unscrew probe sensor from radiator.

3. Install replacement probe sensor in reverse sequence of removal. Torque probe sensor to 25-30 in. lbs.

ENGINE WATER "SYSTEM" CHECK

Disconnect lead wire from sensor probe in radiator. Turn ignition key to "ON" position. Check for illumination of "Engine Water" bulb in tell-tale panel. If bulb does not light, then problem is in low coolant module or tell-tale printed circuit board. See tell-tale printed circuit check procedure of "Coolant Level Indicator Diagnosis" chart, Sec. 12, Maintenance Manual X-7525.

WIRING

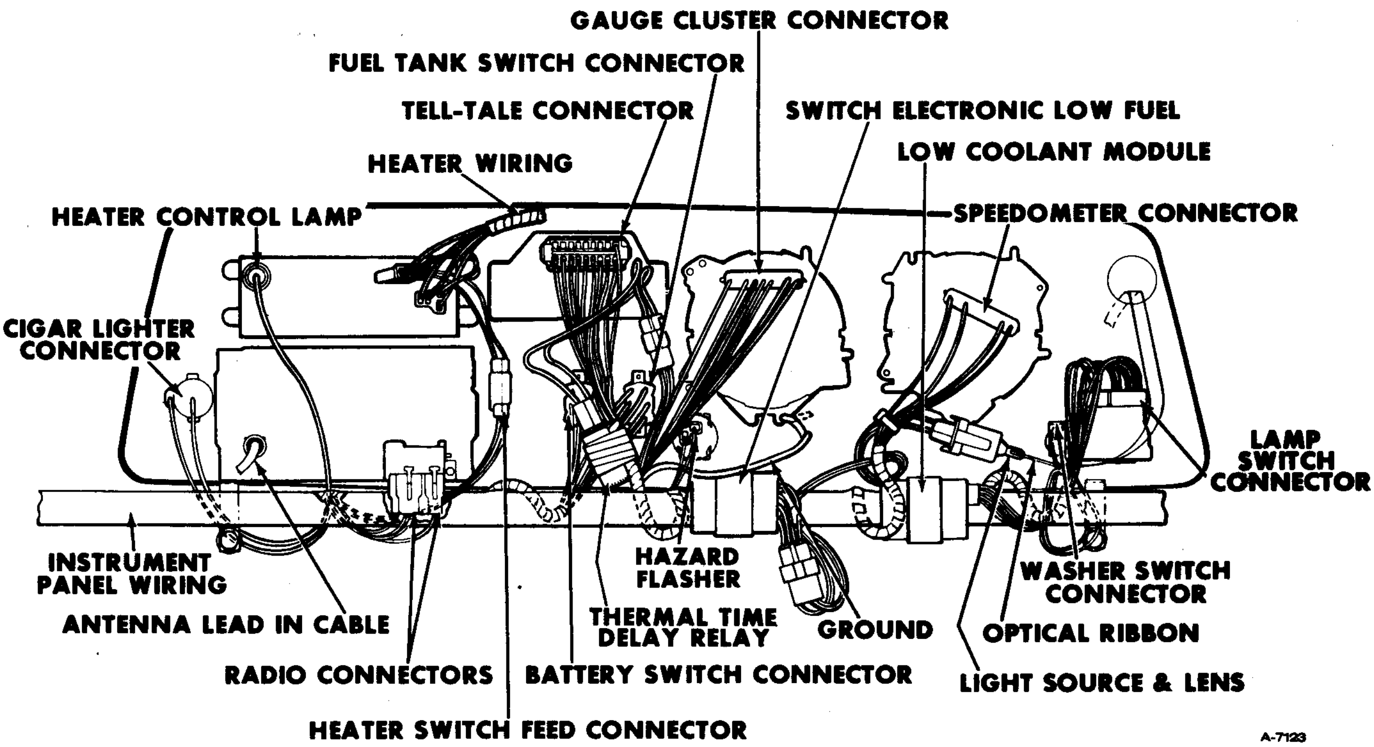


Figure 9—Instrument Panel Wiring, Typical

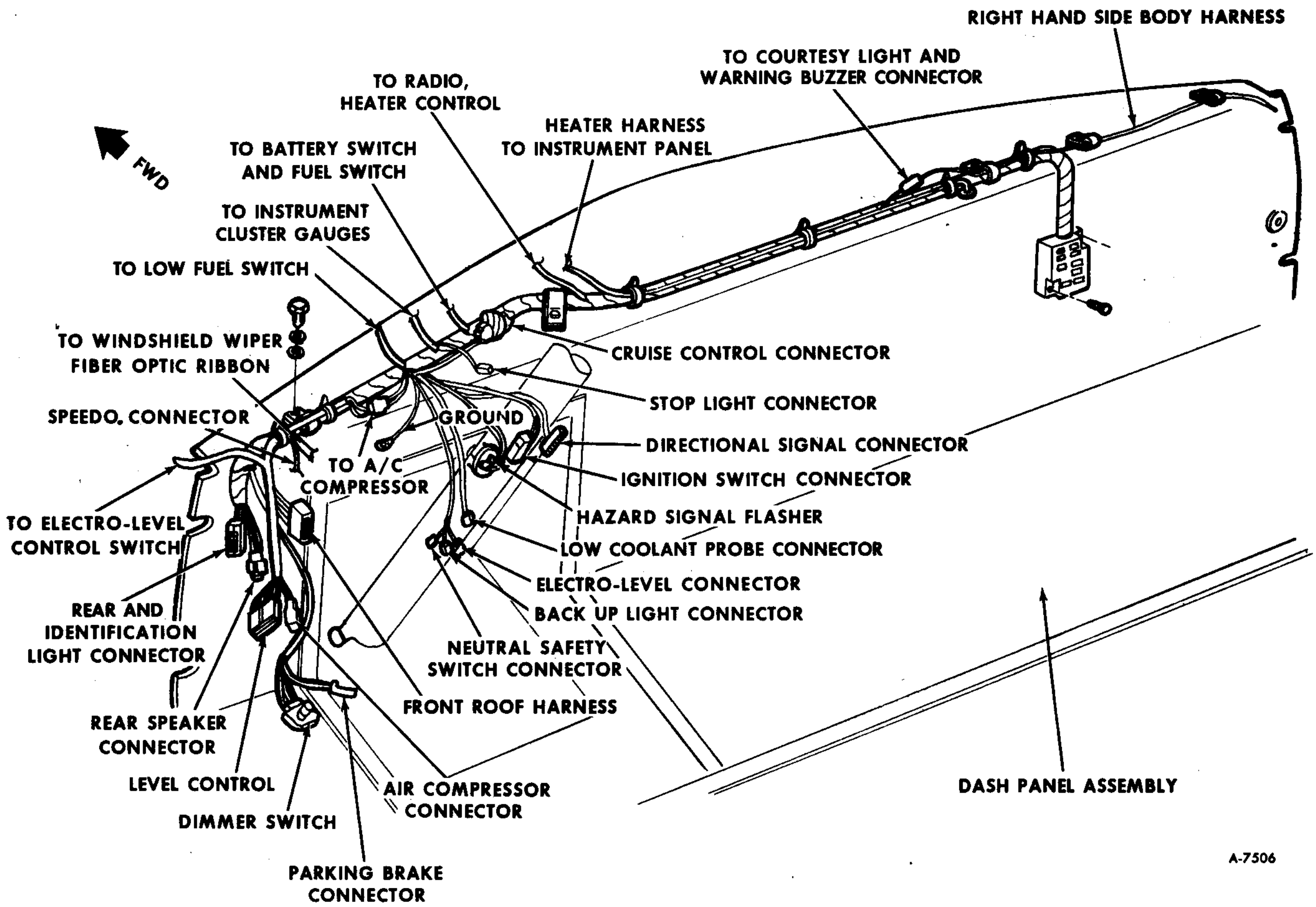


Figure 10—Instrument Panel and Electro-Level Control Harness

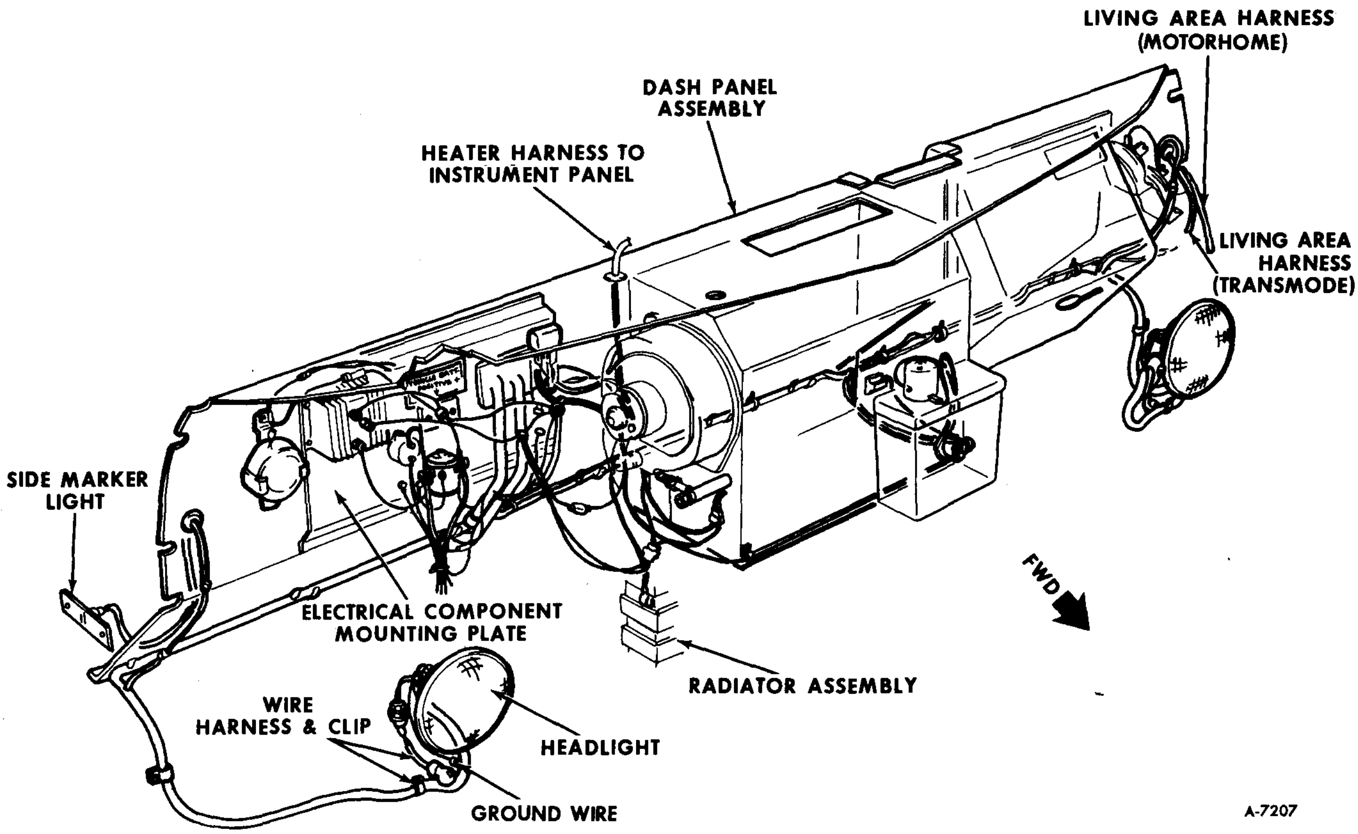


Figure 11—Dash Panel Wiring

INSTRUMENT PANEL WIRING

Wiring to the instrument panel has been revised in models covered by this supplement. Refer to figure 9 for typical panel wiring and proper connector locations. Refer also to figure 10 for dash panel wiring, and figure 11 for instrument panel wiring harness, which includes Electro-Level control switch connector location.

Note that the turn signal flasher, formerly mounted with combined turn signal/hazard

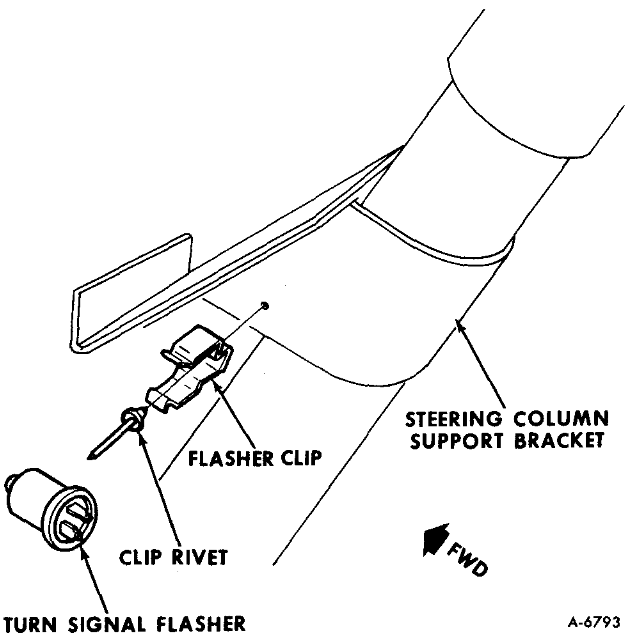


Figure 12—Turn Signal Flasher Mounting

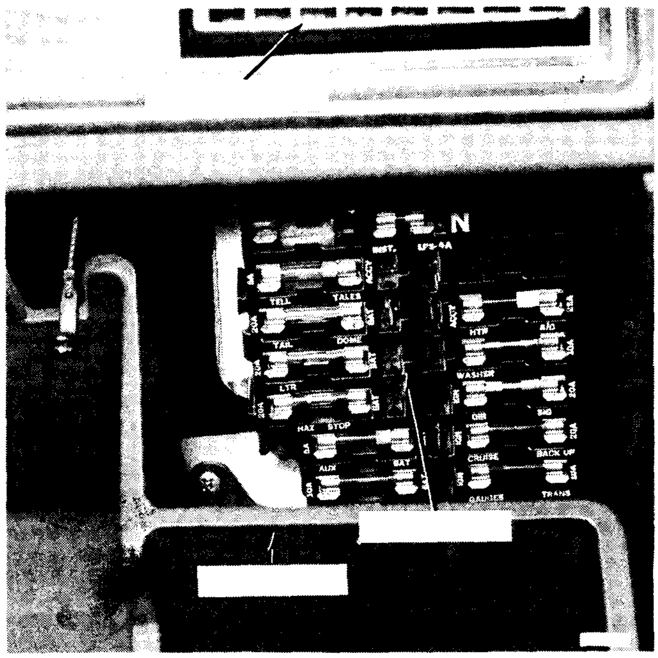


Figure 13—Fuse Panel Location

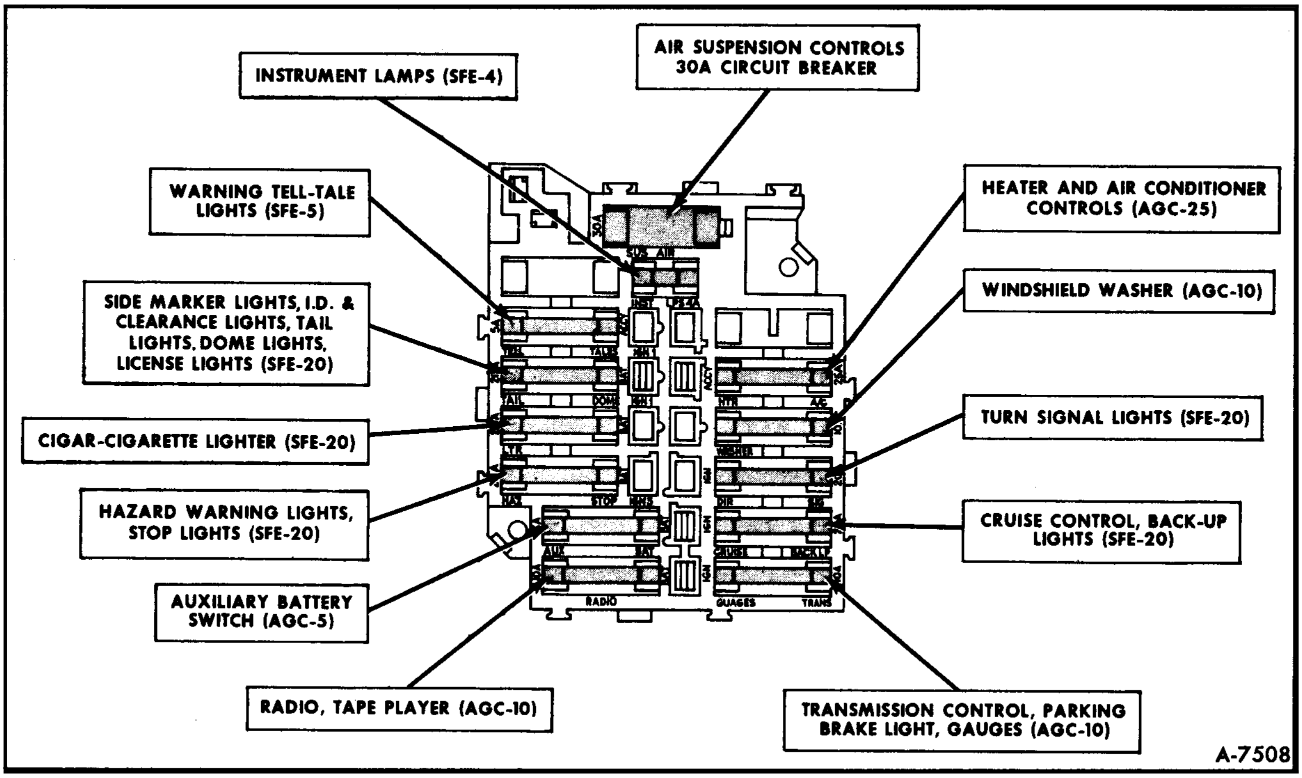


Figure 14—Fuse Panel

warning flasher, is now clipped to the steering column bracket below the instrument panel (at left side). See figure 12 for turn signal flasher mounting. The hazard warning flasher remains clipped to the instrument panel below the gauge cluster.

A time delay relay used in the automative air conditioning has been added to the heater wiring harness. For location of relay, refer to "Electrical Component Operation" of AIR CONDITIONING AND HEATING SECTION (Sec. 1B) of this supplement.

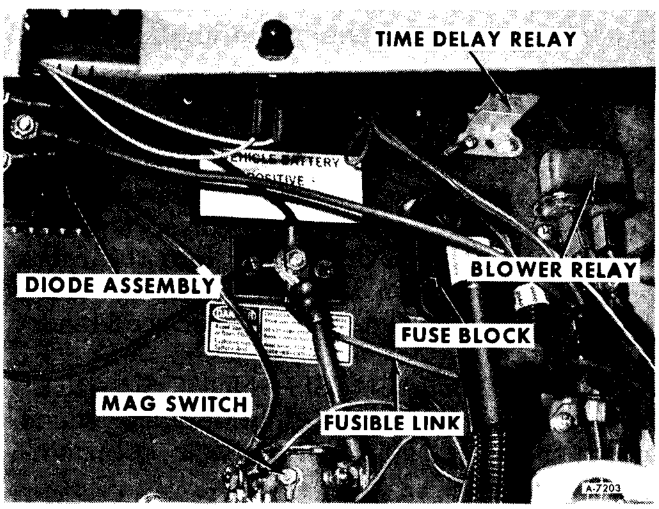


Figure 15—Motorhome Electrical Component Mounting Plate

FUSE PANEL

The fuse panel location has changed—it is still mounted on the bulkhead panel behind the glove box assembly but has moved over slightly and is now mounted in an upright position (see figure 13 for location).

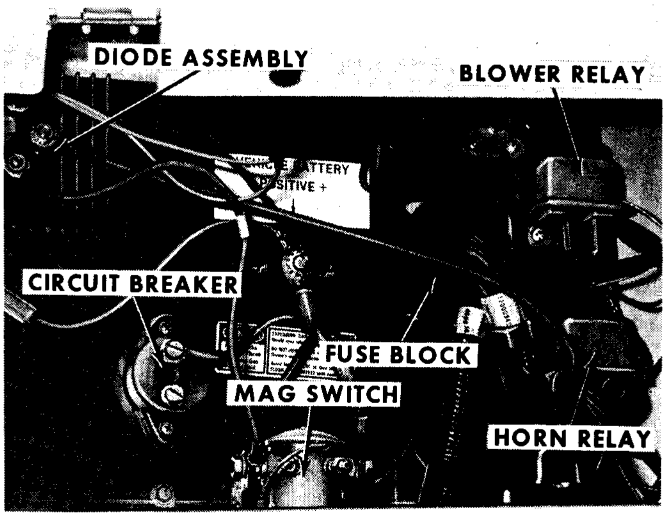


Figure 16—TransMode Electrical Component Mounting Plate

To gain access to the fuse block, open the glove box door, then release the secondary cable latch in the back of the glove compartment. Glove box will now come forward, exposing fuse block. Fuses and circuit breakers located on this panel are shown in figure 14.

ELECTRONIC COMPONENT MOUNTING PLATES

The positon of components mounted to electrical component mounting plates in Motorhome and TransMode vehicles has changed—refer to figures 15 and 16 for views of new mounting plates in these vehicles.

RADIO AND TAPE PLAYER—1977 AND 1978

Radio options for 1977 Motorhome and TransMode vehicles include an AM radio, AM-FM radio, AM-FM Stereo radio, and an AM-FM Stereo radio with 8-track tape.

Radio options for 1978 Motorhome and TransMode vehicles include an AM-FM Stereo radio and an AM-FM Stereo radio with 8-Track Tape. All description, operation and diagnosis information included in CHASSIS ELECTRICAL (SEC. 12), of Maintenance Manual X-7525 is applicable to models covered by this supplement with the exception of the following:

STEREO TAPE PLAYER CONVECTOR

Vehicles equipped with optional stereo 8-track tape player have an integral radio convector. Convector test and replacement procedures specified in Maintenance Manual X-7525 are no longer applicable.

SIX-SPEAKER RADIO SYSTEM

1978 Motorhomes with stereo radios are equipped with a six-speaker stereo system (not available in TransMode). For the most pleasing stereo effect, ths six speakers are cross-fired, with the left front, right middle, and left rear speakers reproducing the left channel sound and the opposite speakers reproducing the right channel sound. Balance adjustment procedure is the same as for the four speaker system. (Refer to "Balance Adjustment" in SEC. 12 of Maintenance Manual X-7525).

RADIO SPEAKER REPLACEMENT

REMOVAL

1. Remove four screws securing dome lamp and speaker panel to headliner (front speakers) or speaker grille to rear panel (rear speakers). If removing center speaker on Motorhome, remove four screws securing speaker to ceiling panel.
2. Disconnect speaker wires.
3. Remove nuts securing speaker to grille and remove speaker.

INSTALLATION

NOTE: Make certain that reinstalled speakers are not grounded to chassis or vehicle ground circuit. Speaker wiring is returned directly to radio and bridge audio output circuit.

1. Install nuts securing speaker to grille.
2. Connect speaker wires.
3. Install screws securing speaker assembly to headliner (or rear panel or ceiling).

DIAGNOSIS OF RADIO

Basic radio and radio/tape player diagnostic procedures are covered in SEC. 12, Maintenance Manual X-7525. Included here is a supplemental diagnosis procedure for radio noise problems, applicable to all models covered by this supplement as well as models covered by Maintenance Manual X-7525.

DIAGNOSIS OF RADIO NOISE

In correcting radio interference, there are two immediate problems to solve: the first problem is locating the source of the noise, and the second problem is discovering the actual path of interference. The engine, generator, switches and blower can be the originating sources of radio noise, and the noise is either radiated directly into the radio or enters the system through a path provided by the antenna lead-in or the power feed lead.

PRELIMINARY DIAGNOSIS—NOISE SOURCE

A description of the interference sound coming from the radio will assist in determining its origin.

The major sources of radio noise originate at either the engine or generator. Engine noise may be described as an ignition, frying or

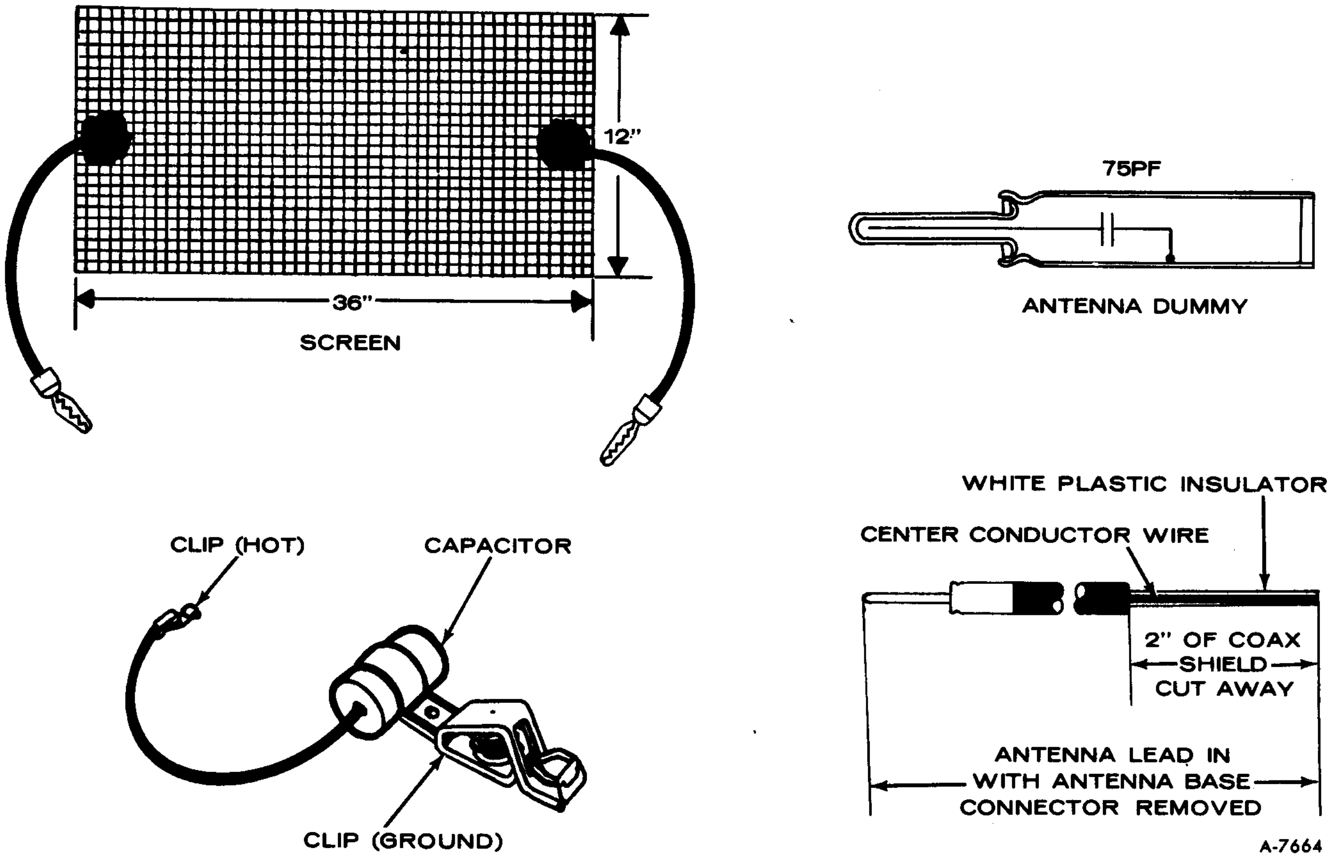


Figure 17—Radio Suppression Tools

popping sound in the radio. The generator sound is a whine or siren-like noise in the background that increases or decreases with the engine rpm.

The minor sources of noise in the radio system are discharged from either an electrical switch or the blower motor. An electrical switch generates a pop noise that can be heard in the radio system when the switch is directly or indirectly activated by the driver. A blower noise is a sound in the radio which changes speed in accordance with the blower motor operational speed.

Because of the relative complication of the two major radio noise sources (engine and generator) longer diagnostic procedures are required for detecting and solving the radio interference they create. Minor in comparison, the switch pop and blower motor noises have simple solutions after their detection. Therefore, the following suppression procedures for both the major and minor sources of radio noise appear in a decreasing order of complexity.

PRELIMINARY DIAGNOSIS—NOISE ENTRY

If all the radio components are well grounded and the source of the radio noise is not the fault of the radio chassis, determine how the interference is entering the radio.

Radio noise can penetrate the system four ways: through the antenna, through the power feed lead, through direct radiation into the radio or through the speaker leads. The great percentage of radio noises enter the system by being radiated into either the antenna or power feed lead.

An easy way to determine if the interference is getting in on the antenna lead-in or the power feed lead is to temporarily install an antenna dummy into the antenna socket at the rear of the radio chassis. The antenna dummy may be fabricated from an old antenna lead in and a 75 PF capacitor as illustrated in figure 17. The antenna dummy will prevent noise from entering the radio through the antenna socket.

To use this tool, disconnect the radio antenna from the rear of the radio chassis and plug in the antenna dummy. Turn on the engine and radio to see if the noise has been eliminated and if it has, the noise was radiated into the radio through the antenna lead-in. However, if the noise remains then the interference is coming in on the power feed lead.

Depending on where the radio noise originated and by what path the interference is getting into the radio system (either through the antenna lead-in or power feed lead) , the interference entry problems require different solutions for the inlet conditions. They will be discussed individually under the following noise suppression procedures.

PRELIMINARY CHECKS

1. All ground straps must be clean and tight.
2. Ignition system must use resistance type spark plugs and TVRS spark plug cables.
3. The radio and antenna lead-in must be properly grounded, cleaned and tightened.
4. Antenna must be trimmed (peaked) correctly on the AM scale.

ENGINE NOISE SUPPRESSION

Interfering engine noises in the radio system may sound like an ignition, frying or popping sound and will commonly be radiated into the radio through the power feed lead or the antenna lead-in. Decide the path of entry by performing the antenna dummy test as described in "Preliminary Diagnosis—Noise Entry" under "DIAGNOSIS OF RADIO NOISE".

POWER FEED NOISE ENTRY

Engine noises on the power feed line are usually the result of large voltage spikes which cannot be handled by the input filter in the radio. One way to correct this problem is to find out its cause and eliminate it. This procedure is by far the most difficult remedy to implement. Another alternative in eliminating the interference is to add external filters for reducing the voltage spikes to a sufficient level so that the radio filter can suppress the balance.

As the first, but less desirable course of action, try moving any wiring harness from close proximity to the ignition system to reduce the possibility of the ignition system voltage spikes entering the harness.

The alternative approach uses capacitors for filtering the voltage spike interferences from the power feed lead by installing them ahead of the lead. This will reduce the intensity of the spike low enough to assure its final suppression by the radio input filter. As shown in figure 17, temporarily connect a .3 MFD or .5 MFD ignition-type capacitor to the various cavities in the fuse block, a .5 MFD to a 2 MFD capacitor to the battery terminal of the generator and/or a suitable filter package into the power feed lead. If any of these temporary remedies appear to aid in the engine noise suppression, proceed to a more permanent fix.

ANTENNA NOISE ENTRY

Engine noise coming in on the antenna system is a radiated signal which may be suppressed or shielded from the antenna. However, to accomplish a fix for this problem, it will be necessary to locate the source of the difficulty. Generally the noise will radiate from either the instrument panel or the engine compartment.

Two tools will assist in locating the problem. One tool is a piece of 36" x 12" screen with two clip leads at either end (or 36" x 36" screen for use over engine hatch) as shown in figure 17. The screen will be used as a shield to stop the noise radiation to the antenna. The second tool is an antenna test probe which is fabricated from a long antenna lead-in of approximately five to six feet. Make the test probe as shown in figure 17.

To locate the source of the radio noise, turn on the engine and radio with its antenna plugged in. Now lay the piece of screen across the instrument panel and attach its clip leads, located on either end of the screen, to bare metal on the vehicle. If the radio noise disappears or its intensity is reduced, the interference is being radiated up through the instrument panel and the screen is providing the shield necessary to remove the noise from the antenna.

Further pinpointing of the interference is established by using antenna test probe, illustrated in figure 17, to find the source of the noise. Unplug the antenna from the rear of the radio chassis and connect the test probe into the antenna socket. Turn the engine and radio on. Start probing the upper and lower instrument panel area for the entire length of the instrument panel wiring harness with the cut-away end of the test probe. Be careful not to grab the cut-away end while making the checks since it will cause faulty results. A noisy wiring harness is a likely suspect for radio interference and if it is determined to be the cause, add a .5 MFD capacitor from the faulty wire in the harness to ground.

If the screen on top of the instrument panel reduces the noise, but probing the instrument panel wiring harness fails to produce a sufficient interference source, then the noise is probably radiated from the engine campartment up through the instrument panel to the radio. Using the antenna test probe, check the dash panel behind the instrument panel, the heater duct area and accelerator pedal linkage for extraordinary noise sources. If a source is discovered, suppress it. When diagnosing the dash panel or instrument panel for an interference source, keep in mind that these panels will exhibit "normal interference sources" which may require a comparison diagnosis with another identical vehicle.

GENERATOR NOISE SUPPRESSION

Generator whine may be described as an annoying high pitched whistle or a siren-like noise; both fluctuate with the rise and fall of the engine rpm, affecting the radio quality in a variety of ways. The produced interference can be heard on either the AM or tape modes at low volume, which may increase in intensity as the volume control is increased. Similar to other radio noises, generator whine can get into the radio system being carried through the power feed wire, through the antenna lead-in or radiated directly into the radio.

Prior to diagnosis and with the radio operating in the vehicle, make certain the antenna and radio are properly grounded, and a good connection between the antenna lead-in and radio is maintained. Corrosion or other causes of poor connection make the radio system more susceptible to all noise interference.

Before attempting to eliminate the generator noise, determine if the noise is affecting the radio on the AM band, the tape function or both.

DIAGNOSIS

1. Tune the radio to an AM station at mid-band or above.

NOTE: For the combination radio/tape players, insert a tape deck upside down to turn on the set without music.

2. Start the engine and listen for the generator whine which increases and decreases with the fluctuation of engine rpm.

3. If no generator noise is detected, it may be necessary to increase the radio volume and load the generator by turning on the headlights and a few accessories.

4. If the generator whine is encountered, remove the antenna lead-in from the radio, and add the antenna dummy to the radio as outlined in "Preliminary Diagnosis—Noise Entry" under "DIAGNOSIS OF RADIO NOISE". If the noise persists, a power feed entry is the problem and may be remedied by adding a .5 to a 2 MFD capacitor to the generator output terminal or a .5 MFD capacitor to the radio feed cavity at the fuse block.

5. However, if the generator noise is eliminated by installing the antenna dummy, the radio interference is radiated into the antenna lead-in. Detect the source of the antenna radiation as outlined in "Antenna Noise Entry" under "ENGINE NOISE SUPPRESSION".

6. To correct the antenna noise problem, make certain the antenna system is well grounded by measuring the continuity between it and the vehicle ground; try running the faulty wire through a shielded cable; or try to add a .5MFD capacitor to any offensive circuit under the instrument panel.

SWITCH NOISE SUPPRESSION

A switch pop is described as either a crackling, pop or snapping sound heard in the radio when the driver directly or indirectly activates a controlling switch. To stop a switch pop from entering into the radio system, it is necessary to know which vehicle system is causing the noise. For example, when applying the brake system, the brake light switch contacts will meet, sending a sudden surge of current through the switch and wiring harness to the brake lights. The wiring harness may act as a radiating antenna causing the radio to intercept the radiated power surge, and a pop is then heard in the radio speakers.

Generally whenever the switch contacts open and close, an arc is produced. The arc will affect the radio performance in two ways, either by producing a single voltage spike which will enter the radio through the power feed or antenna lead, or by radiating a broad band of frequencies which will enter the receiver via direct radiation or the antenna lead.

A good course of action for suppressing a switch pop is to put a capacitor on the controlling switch. Usually a .5 MFD capacitor can be tried on two position: across the switch contacts if they are accessible, or from the hot side of the switch to ground. Sometimes a capacitor in both positions will cure the problem.

BLOWER MOTOR NOISE SUPPRESSION

Blower motor noise shows up as a static sound in the radio which will follow in intensity according to the blower motor speed. The

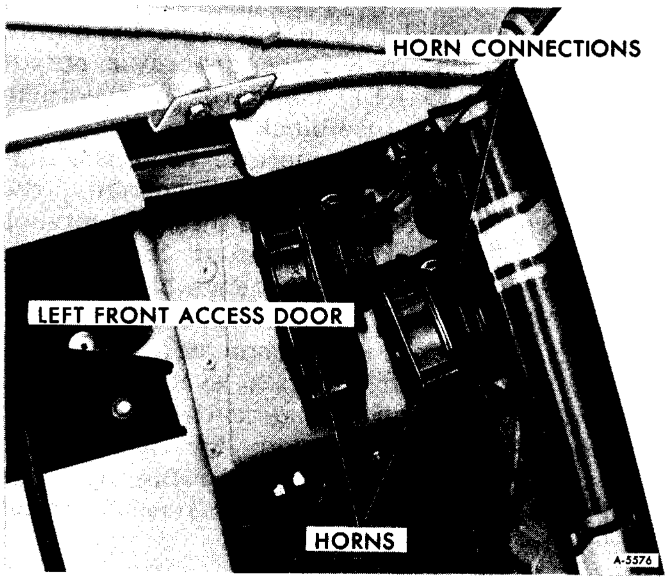


Figure 18—Horn Installation

noise is caused by arcing in the motor brushes. Suppress the motor noise by adding a .25 MFD feed-through capacitor on the blower motor power feed wire. Be sure the capacitor has a good ground or the noise will persist. If the interference is not eliminated, put another .5MFD capacitor in parallel with the feed-through capacitor.

HORN

Horn mounting has been revised in models covered by this supplement. These two air-tone "S" type vibrating electric horns are mounted typically as shown in figure 18 (viewed behind front access door-driver side).

The electric air-tone "S" type horn is carefully adjusted and inspected during manufacture and is designed to operate indefinitely without attention. The horn assembly should not be adjusted or repaired. "Horn Diagnosis" procedures described in Maintenance Manual X-7525 are not affected by new installation.

LIGHT BULB SPECIFICATIONS— 1977 AND 1978

INSTRUMENT PANEL

Usage	Quantity	Bulb No.
Brake System Tell-Tale	1	161
Generator Tell-Tale	1	161
Park Brake Tell-Tale	1	74
Cruise Control Tell-Tale	1	74
Door Ajar Tell-Tale	1	74
Low Fuel Tell-Tale	1	74
Engine Water Tell-Tale	1	74
Electro-Level Tell-Tale	2	74
High Beam Indicator	1	161
Turn Signal Indicator	2	168
Instrument Cluster Lights	2	194
Speedo Cluster Lights	2	194
Dome Lights	2	211
Radio Dial (AM/FM Stereo Tape)	1	566
Radio Dial (Except AM/FM Stereo Tape)	1	1893
Heater Control	1	1895
Voltmeter	1	53

EXTERIOR

Usage	Quantity	Bulb No.
Clearance and I.D.	10	67
License	1	67
Side Markers-Front	2	194
Side Markers-Rear	2	194
Back-Up Lights	2	1156
Parking and Turn Signals	2	1157
Stop and Tail	2	1157
Headlights	2	6014

VEHICLE FUSES AND CIRCUIT BREAKERS

The following fuses are located in the fuse block behind the glove box in the dash. Do not use fuses of higher amperage rating than those specified below—or property damage may result.

Usage	Name On Fuse Block	Fuse Type
Instrument Lamps	INST LPS	SFE-4
Warning Tell-Tale Lights	TELL TALES	SFE-5
Side Marker Lights I.D. & Clearance Lights Tail Lights Dome Lights License Lights	TAIL DOME	SFE-20
Cigar-Cigarette Lighter	LTR	SFE-20
Hazard Warning Lights, Step Lights	HAZ STOP	SFE-20
Auxiliary Battery Switch	AUX BAT	AGC-5
Radio, Tape Player	RADIO	AGC-10
Heater and Air Conditioner	HTR A/C	AGC-25
Windshield Washers	WASHER	AGC-10
Turn Signal Lights	DIR SIG	SFE-20
Cruise Control, Back-Up Lights	CRUISE BACK-UP	SFE-20
Transmission Control, Parking Brake Light, Gauges	GAUGES TRANS	AGC-10

VEHICLE FUSES AND CIRCUIT BREAKERS (CON'T)

The following circuits employ circuit breakers or have fuses located as indicated:

Headlight Circuit Breaker	Built Into Light Switch
Main Harness Fusible Link	Between Junction Block and Horn Relay
Heater Blower Fusible Link	Built Into Line at Right Access Door Near Heater Blower Relay
Hazard Signal Flasher GM No. 673499	In Clip behind Instrument Panel at Fuel Selector Switch
Turn Signal Flasher GM No. 491392	On Left Side of Steering Column
Vehicle Trouble Light AGC-10	In Line, Behind Access Door, Near Light
Air Suspension Compressor 30A Circuit Breaker	In Fuse Block
Water Pump	In Line, Near Water Pump

SECTION 13

RADIATOR AND COOLANT RECOVERY SYSTEM

The following "Caution" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology: See "Caution" on page one of this section.

CAUTION: 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 OF 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. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

NOTE: Refer to "Specifications" at the end of this section for all torque values not given in the text.

CONTENTS

NOTE: Refer to ENGINE COOLING (SECTION 6K) of Maintenance Manual X-7525 for information relative to coolant circulation, temperature indicators, thermostats, and fan belts. For coolant recommendations and capacities, refer to to GENERAL INFORMATION AND LUBRICATION (SECTION 0) in Maintenance Manual X-7525.

DESCRIPTION

All vehicles are equipped with a cross-flow radiator and a recovery-type cooling system. The level in the coolant recovery reservoir should be maintained at the "COLD" line when coolant is cold.

At normal operating temperatures, level can reach "HOT" line on reservoir. However, should the coolant level fall below the cold level line, additional coolant (other than for draining and refill) should be added through the coolant recovery reservoir.

MAINTENANCE

At regular intervals, cooling system components should be inspected to determine if service is required. Regular systematic checks will reveal faulty condition of various units and indicate necessity of servicing or replacement of such components before failure occurs.

Suggested checks are:

1. Frequently check coolant level. If low, add recommended coolant as required.

2. Check hose connections and tighten clamps if seeping is evident. Cracked, stripped, or corroded clamps should be replaced.

3. Inspect radiator hoses for spongy or checked appearance. Deteriorated hoses should be replaced before bursting occurs which would result in coolant loss and could cause extensive engine damage due to overheating.

4. Check radiator core for leaks and for accumulation of dirt which obstructs air passages and reduces effective heat transfer.

To assist in maintaining effecient heat dissipation, an occasional external flushing withwater will remove majority of dirt accumulation and foreign matter form between core fins.

Water under moderate pressure should be directed from behind core to force debris out in opposite direction of its entrance. Water should be directed in line with fins, not sideways, to reduce possibility of bending fins.

5. Inspect radiator mounting pads for deterioration and replace as required.

6. Inspect for proper clearance between fan blades and shroud. Check fan attaching bolts for tightness and observe alignment of fan blades in relation to each other. Replace fan if any blade is bent. Distance between blades and shroud should be equal around entire perimeter of the ring. If adjustment is required, shroud attaching bolts may be loosened and the shroud shifted as necessary to provide proper clearance.

7. Check radiator filler cap seals for evidence of cracking or separation. Replace as required.

8. When coolant loss is evident or engine overheating occurs, the damaged or clogged radiator should be serviced by a radiator specialist or replaced with a new one. Efficient repair of radiators requires the use of special tools and equipment as well as provisions for making proper tests. If radiator core requires painting, spray with special radiator paint; do not use paint mixed with oil, as oil mixed paint will form an insulation and prevent efficient dissipation of heat.

RADIATOR MOUNTING

The 403 cubic inch engine was first used in vehicles identified with the following Vehicle Identification Numbers:

Motorhome	TZE167V101285
23' TransMode	TZE337V101287
26' TransMode	TZE367V101312

Beginning with these vehicles the radiator core venturi ring and venturi ring seal are no longer used. Refer to figures 1 and 2 for radiator and fan shroud mounting with 403 engine.

RADIATOR REPLACEMENT

REMOVAL

1. Disconnect battery ground cable.
2. Open drain cock at lower corner of radiator assembly (figure 1), and drain radiator.
3. While radiator is draining, remove vehicle front grille.
4. Disconnect brake fluid lines and oil fill tube from radiator (clamped to driver side).
5. Remove bolts mounting air conditioning condenser to radiator support (two bolts each side). If necessary, remove condenser side baffles and lower front baffle. Then pull condenser forward.
6. Disconnect coolant recovery hose from radiator.
7. Disconnect upper radiator hose.
8. Remove two shroud-to-support upper bolts. Refer to figure 2..
9. Raise vehicle.
10. Disconnect lower radiator hose.
11. Disconnect transmission oil cooler lines and engine oil cooler lines at radiator.
12. Disconnect power steering hose clamps from radiator.
13. Remove lower bolts securing shroud to radiator support (figure 2), and carefully place shroud over engine fan to provide clearance for radiator removal.
14. Disconnect lead wire to low coolant probe sensor ("engine water" sensor).
15. Remove radiator support mounting bracket (see figure 1) on driver side. Remove three radiator support bolts on each side.
16. Lower radiator and support from vehicle.

If replacing radiator, remove support channel from radiator. Place new radiator core in radiator support channel, and secure support channels to radiator.

Lift radiator assembly up into vehicle. It is suggested that this be attempted only with two persons, as the assembly is quite heavy.

INSTALLATION

CAUTION: *See "Caution" on page one of this section.*

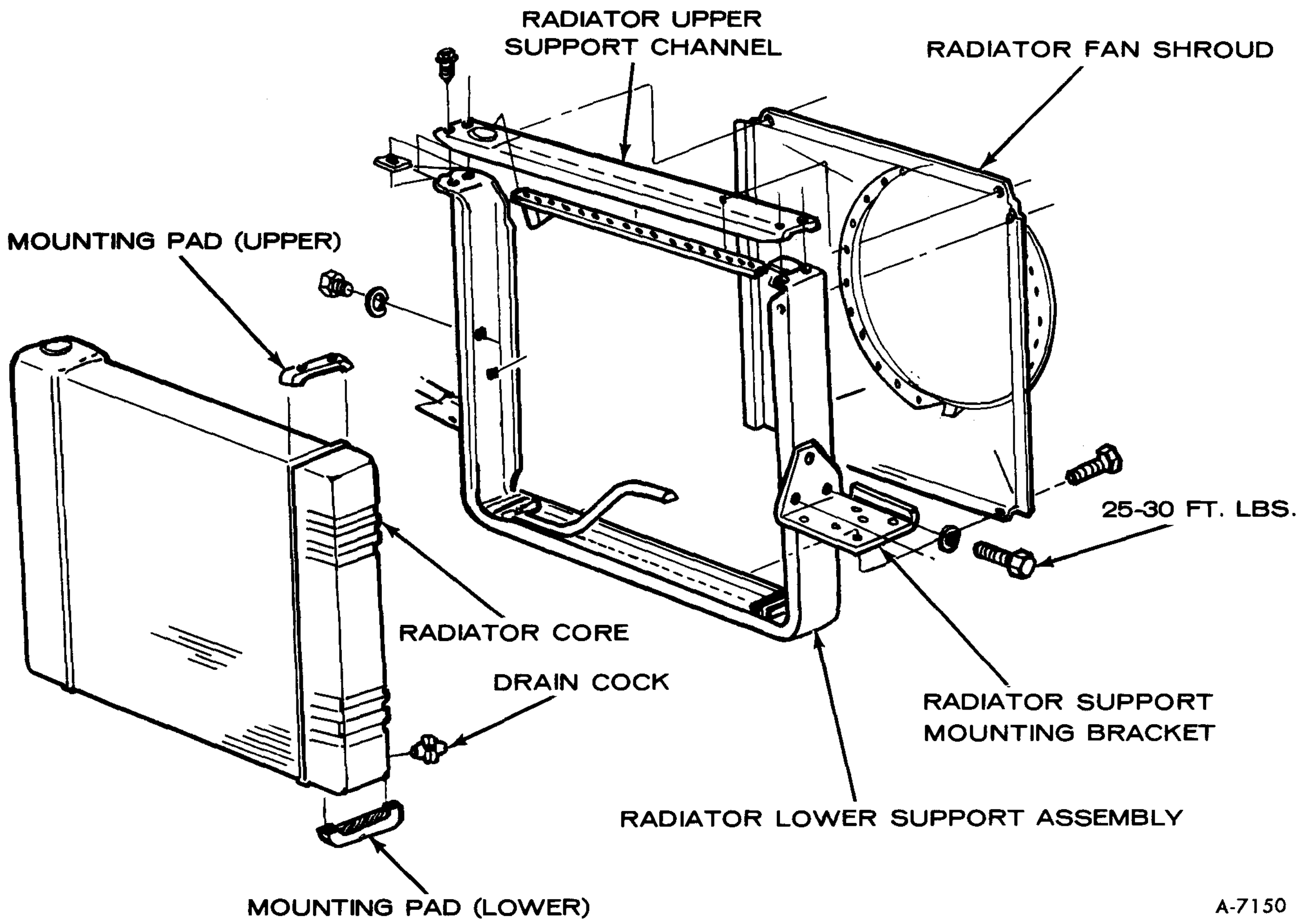


Figure 1—Radiator Mounting

1. Install radiator and support channel in vehicle. Torque attaching bolts to specification.

2. Insert low coolant probe sensor and torque to 25-30 in. lbs. Connect probe lead wire.

3. Install two fan shroud to radiator support lower bolts.

4. Connect power steering hose clamps to radiator.

5. Install upper support channel assembly bolts.

6. Connect lower radiator hose.

7. Connect engine oil cooler and transmission cooler lines at radiator.

8. Install two shroud-to-support upper bolts.

9. Lower vehicle.

10. Connect radiator upper hose.

11. Connect coolant recovery hose at radiator.

12. Install condenser. Replace any baffles which were removed.

13. Connect brake lines and oil fill tube (one clamp-driver side of radiator.)

14. Install vehicle front grille.

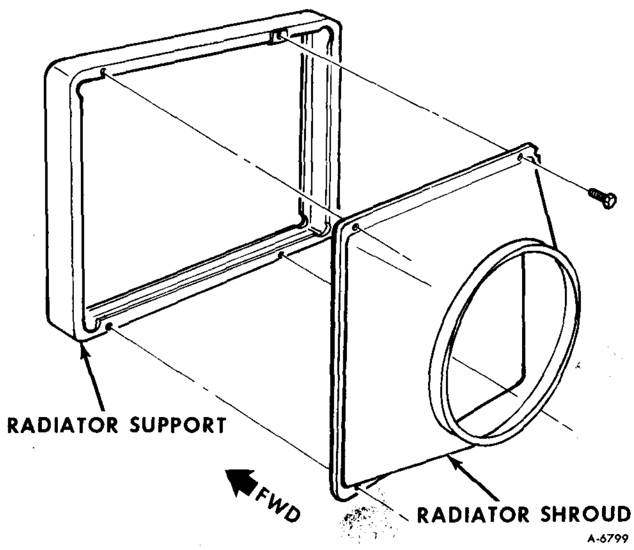


Figure 2—Radiator Shroud

15. Refill radiator following procedure described in Section 6K, Maintenance Manual X-7525.
16. Start engine and check for leaks.

NOTE: For service and diagnosis of "Coolant Level" indicator system, refer to CHASSIS ELECTRICAL (Section 12), Maintenance Mnaual X-7525.

PRESSURE CAP AND VALVE

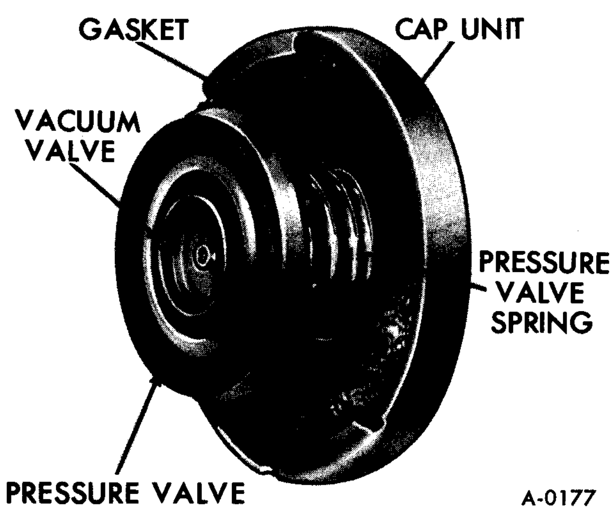


Figure 3—Pressure Cap

A pressure relief valve assembly, integral with the radiator filler cap, incorporates a pressure valve and a vacuum valve. (See figure 3). When pressure in system reaches valve setting (See "Specification" at end of this section), pressure valve opens and liquid is allowed to escape. As liquid in the system cools it contracts; this allows pressure valve to close and also creates a partial vacuum in system. Atmospheric pressure acting through the overflow tube unseats the vacuum valve and allows coolant to enter radiator.

The radiator filler cap is constructed with a spring-loaded rubber seal which is pressed firmly against surface of filler neck seat when cap is installed. Rubber seal must be in good condition and top of radiator filler neck must be clean and smooth in order to form an air-tight seal. Seal of filler cap and operation of pressure relief valve can be checked using a conventional cooling system testing kit.

CAUTION: *When the engine is at normal operating temperature or above, the internal pressure built up in the cooling system will blow out scalding fluid and vapors if the radiator cap is suddenly removed. To prevent loss of coolant and to avoid the danger of being burned, the coolant level should be checked, or coolant added, only to the coolant recovery reservoir. If the radiator cap must be removed when the engine is hot, place a cloth over the cap and rotate the cap slowly counterclockwise to first stop and allow pressure to escape completely. Then turn cap again slowly counterclockwise to remove.*

COOLANT RECOVERY SYSTEM

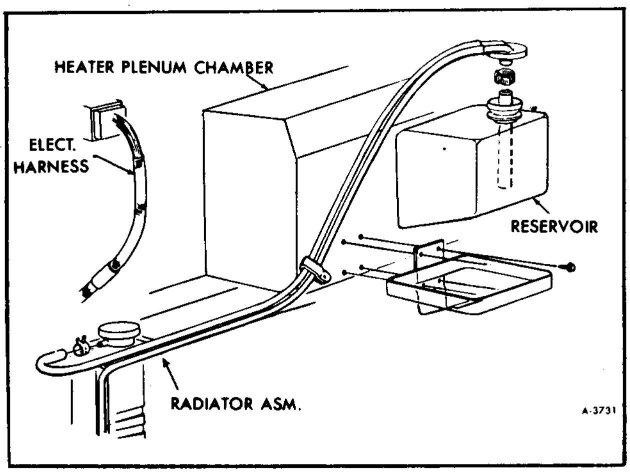


Figure 4—Coolant Recovery System

The coolant recovery system consists of a reservoir, pressure cap and interconnecting hose. The reservoir is mounted above the radiator and is accessible from the front access doors and connected to the radiator filler neck with a hose. The coolant level must be maintained at the "COLD" mark on the side of the reservoir when coolant is cold. A gasket incorporated into the filler cap forms a seal at the radiator filler neck. A leak at this gasket will result in loss of coolant during normal operation. The pressure cap must be installed so that the marking on top of the cap aligns with the overflow tube on the filler neck.

Refer to figure 4 for removal and installation of coolant recovery system components.

ENGINE COOLANT

COOLANT RECOMMENDATIONS

For coolant drain and refill procedure, refer to SECTION 6K of Maintenance Manual X-7525. Cooling system maintenance intervals will be found in SECTION 0 of this supplement.

COOLANT TESTING

Always test solution before adding water or anti-freeze. Engine should be warmed up to operating temperature. Fill and empty tester several times to warm tester before using. Keep tester clean inside and out.

Some testers will indicate correct freezing point only when test is made at a specific temperature. Other testers are provided with thermometers and tables and indicate freezing points corresponding to readings made at various temperatures. Disregarding temperatures of solution may cause an error as large as $30^{\circ}F$ ($1.1^{\circ}C$). Read and be guided by instructions furnished by the tester manufacturer.

In the event coolant freezes solid in extreme cold weather, place vehicle in warm building or improvise some means of thawing coolant before starting engine. Under no circumstance should engine be operated when coolant is frozen solid. After thawing, refill system with a higher concentration of anti-freeze solution and start engine. Inspect entire system for leakage and then test coolant with hydrometer to determine if adequate anti-freeze protection is provided.

COOLANT PRECAUTIONS

1. Overheating is not always caused by a defective cooling system; incorrect ignition timing, dragging brakes, or under-inflated tires can cause overheating.
2. Keep water pump and fan drive belts at proper tension. Refer to ENGINE COOLING SYSTEM (Section 6K) of this manual.
3. Do not remove radiator filler cap when engine is hot. Wait until system cools off.
4. Do not pour cold water into cooling system when the engine is hot. Wait until system cools off.
5. If cooling system requires frequent refilling, check for leaks.
6. Keep all connections tight, and make sure gasket on radiator filler cap is in good condition.
7. When filling system with anti-freeze solution, always follow recommendations of anti-freeze manufacturer.
8. Use only ethylene glycol base coolant meeting GM Specification 1899M.
9. Drain and flush cooling system every other year, preferably at start or end of winter operation.

•

COOLING SYSTEM PRESSURE RELIEF VALVE (PRESSURE CAP)

Models	Valve Opening Stamped	PSI
Motorhome and TransMode	RC32	9

TORQUE SPECIFICATIONS

FASTENER	TORQUE
Radiator Support Mounting Bracket Bolts to Radiator Support	25-30 Ft. Lbs.

SECTION 24

MISCELLANEOUS GMC LIVING AREA FACILITIES

The information in this section pertains to components and/or systems found in the GMC Motorhome (Models ZEO6581 or ZEO6584) ONLY.

CONTENTS

SECTION 24B

LIVING AREA ELECTRICAL

The information described in Maintenance Manual X-7525 under the heading LIVING AREA ELECTRICAL (SEC. 24B) is applicable to models covered by this supplement with the exception of the following:

CONTENTS

MODEL ZE06581

CONVERTER REPLACEMENT

The 120-volt/12-volt power converter is located in the living area electrical compartment.

1. Disconnect battery ground cable from living area battery. Unplug converter at 120-volt outlet.

2. Disconnect converter lead at fuse panel (figure 1).

3. Remove converter 4 mounting bolts (figure 1). Pull converter forward (or tip sideways if possible) to allow access to wall panel retaining screws.

4. Remove wall panel retaining screws (behind power converter) and pull wall forward.

5. Disconnect ground screw and converter ground wire from frame (belt rail) behind wall panel (figure 1). Lift out converter.

6. Converter installation is reverse of removal procedure. Be sure to attach converter ground wire securely before converter is placed in position. Torque mounting bolts to specification (figure 1).

NOTE: Figure 2 is a schematic of the 1978 120-volt electrical system.

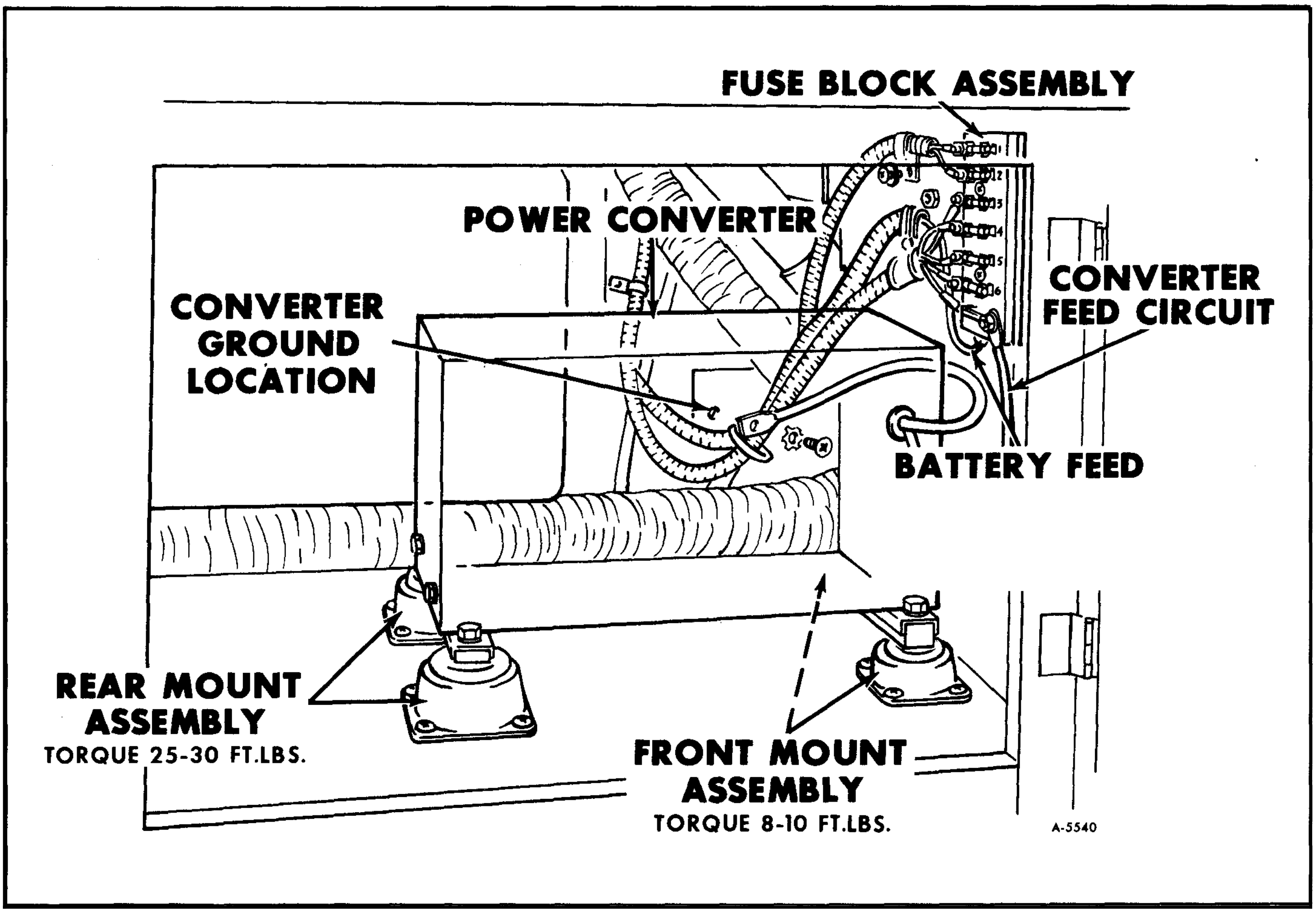
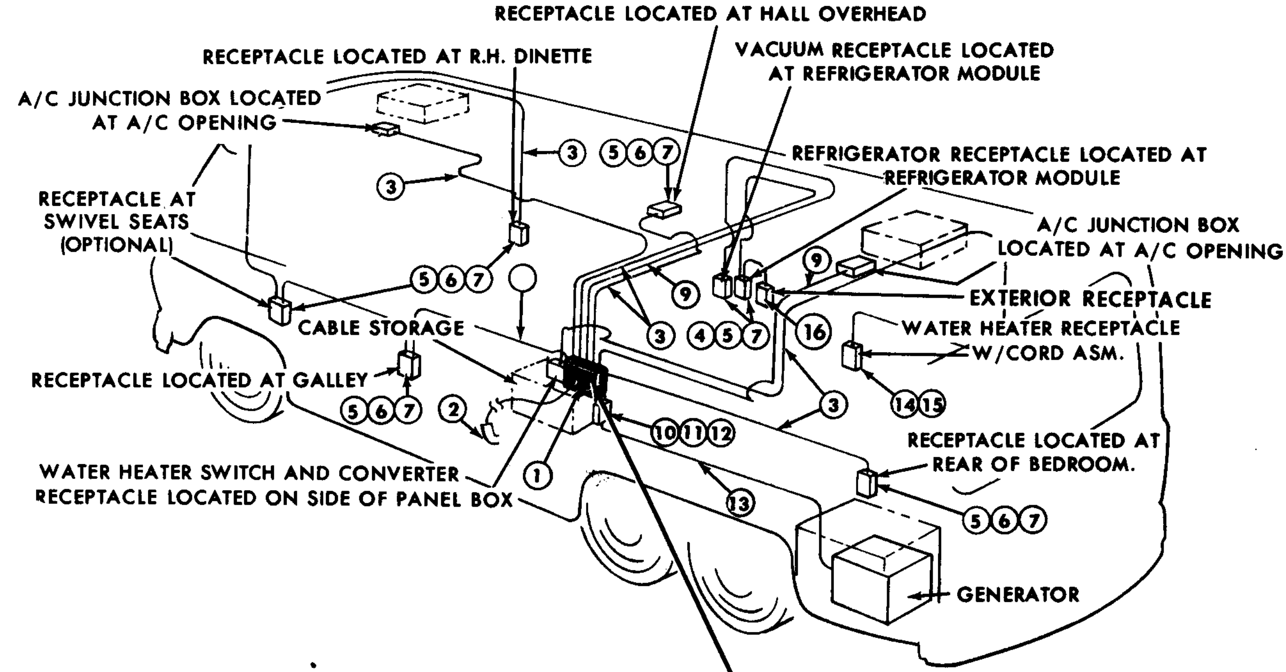


Figure 1—Converter Installation (ZE06581)

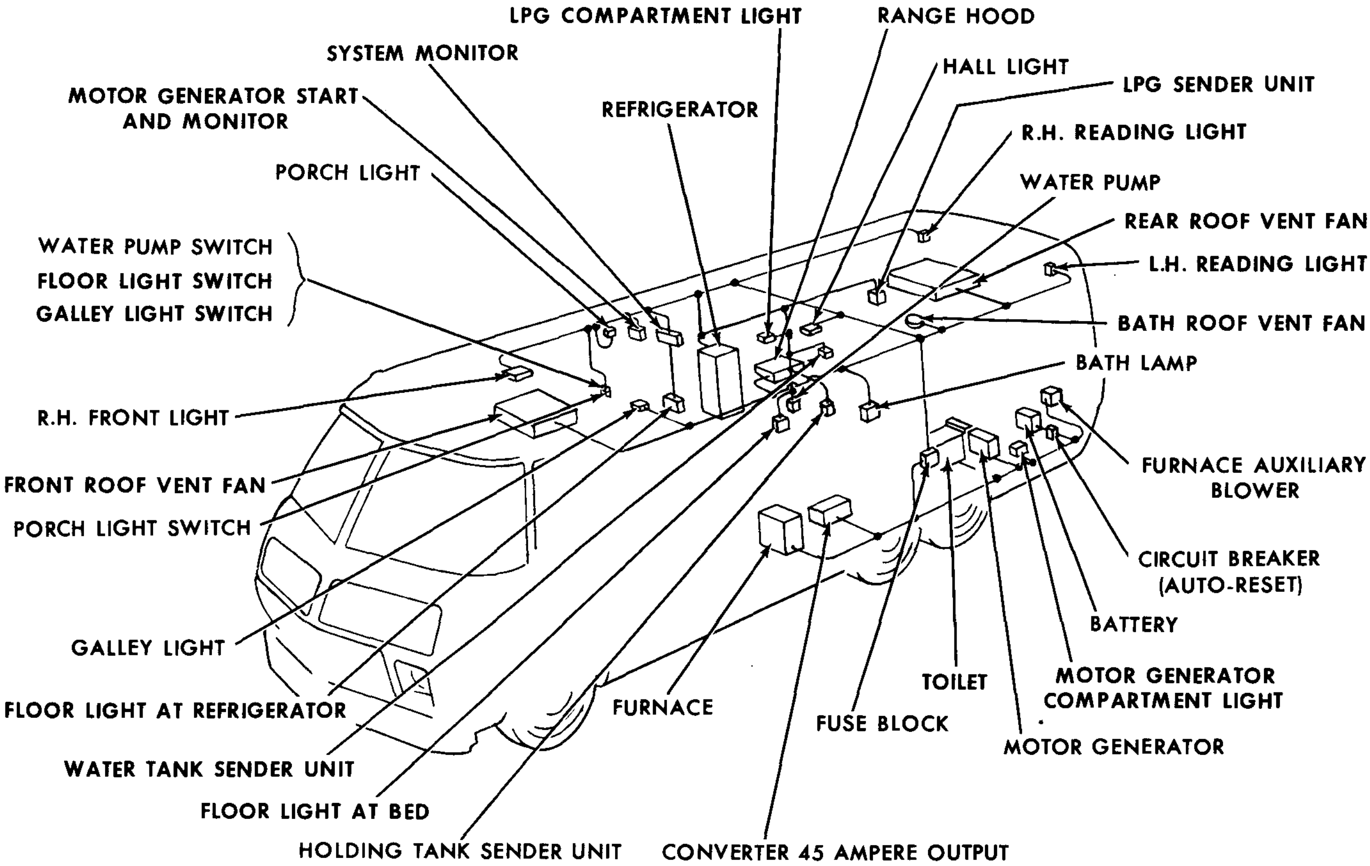


ITEM NO.	PART NAME
1	MAIN PANEL BOX
2	#8-4 WIRE CORD TYPE '50' W/PLUG
3	WIRE 12/2 W/GROUND WIRE
4	SINGLE RECEPTACLE
5	OUTLET BOX
6	DUPLEX RECEPTACLE
7	OUTLET PLATE
8	SWITCH & RECEPTACLE
9	14/2 W/GROUND WIRE
10	3 POLE 4 WIRE RECPTACLE
11	OUTLET BOX
12	OUTLET PLATE
13	#6-2 WIRE CORD IN METAL CONDUIT
14	'J' BOX
15	BLANK COVER PLATE
16	EXTERIOR RECETACLE

CIRCUIT BREAKER PANEL				
CIRCUIT #1	CIRCUIT #2	CIRCUIT #3	CIRCUIT #4	CIRCUIT #5
FRONT AIR COND. RECEPT.	WATER HEATER RECEPT.	HALL OVER RECEPT.	MICROWAVE RECEPT.	REAR AIR COND. RECEPT.
	CONVERTER RECEPT.	BEDROOM RECEPT.		
		GALLEY RECEPT.		
		SWIVEL CHAIR RECEPT.(OPT.)		
		R.H. DINETTE RECEPT.		
		REFRIGERATOR RECEPT.		
		EXTERIOR RECEPT.		
		VACUUM RECEPT.		

A-7648

Figure 2—1978 Living Area 120-Volt AC Electrical Schematic (ZE06581)



15A —#1 L.H. READING LIGHT 1.50A., REAR ROOF VENT FAN 3.50A., BATH ROOF VENT FAN 3.50A., GALLEY LIGHT 2.88A., TOTAL 11.38 AMP.

15A —#2 FRONT ROOF VENT FAN 3.50A., RANGE HOOD FAN AND LIGHTS 6.70A., HALL LIGHT 2.88A., TOTAL 13.08 AMP.

15A —#3 FURNACE 6.80A., FURNACE AUXILIARY BLOWER 3.00A., MOTOR GENERATOR COMPARTMENT LIGHT 1.44A., TOTAL 11.24 AMP.

15A —#4 REFRIGERATOR 5.00A., LPG COMPARTMENT LIGHT 1.44A., R.H. FRONT LIGHT 2.88A., TOTAL 9.32 AMP

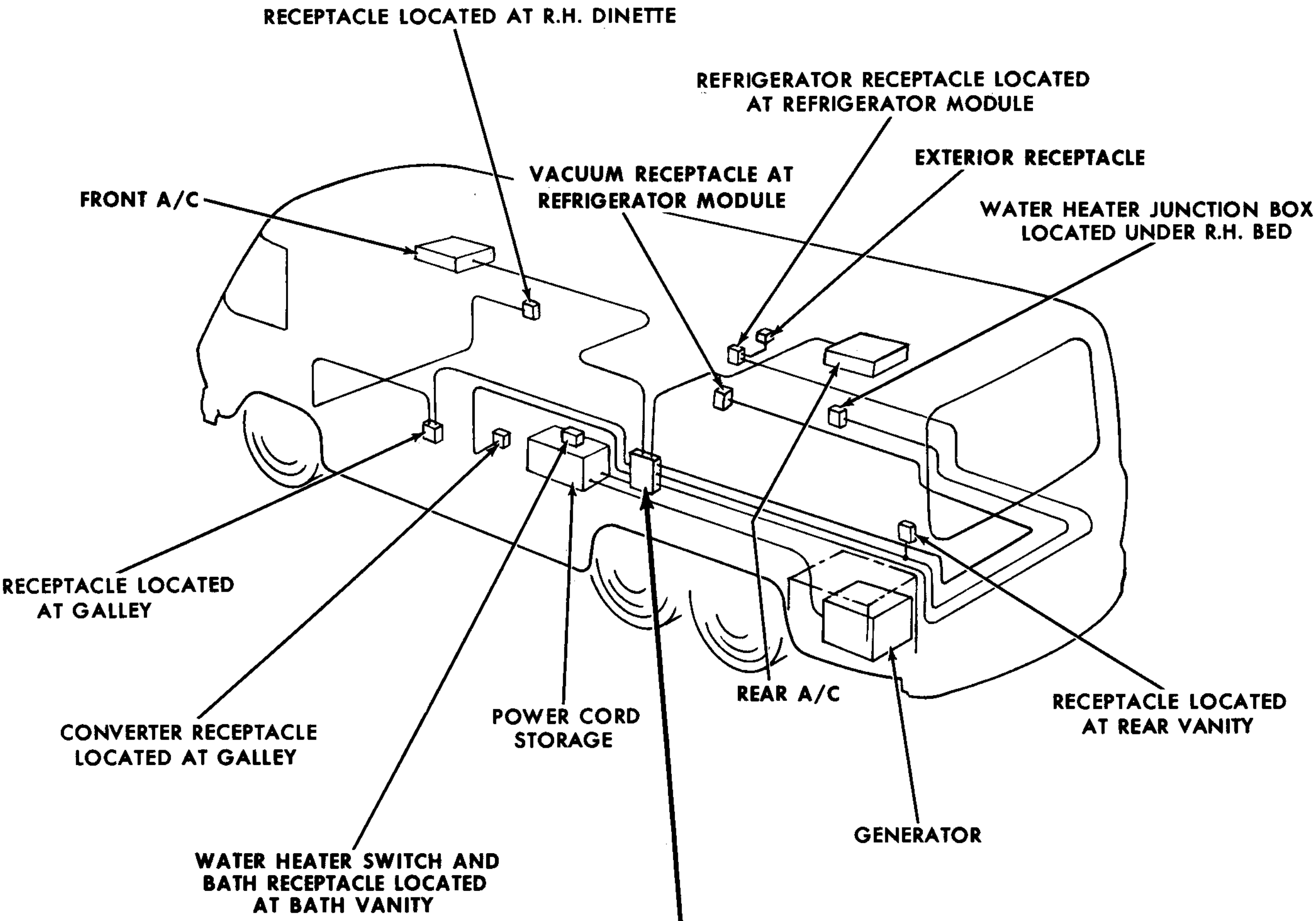
15A —#5 PORCH LIGHT 1.44A., FLOOR LIGHTS 1.18A., WATER PUMP 5.50A., TOTAL 8.12 AMP.

15A —#6 RECIRC. TOILET 7.00A., TOTAL 7.00 AMP.

15A —#7 R.H. READING LIGHT 1.50A., GALLEY LIGHT SWITCH 2.88A., BATH LIGHT 4.32., SYSTEMS MONITOR 2.50A., TOTAL 11.20 AMP.

A-7649

Figure 3—Living Area 12-Volt DC Electrical Schematic (ZE06584)



CIRCUIT BREAKER PANEL				
CIRCUIT #1	CIRCUIT #2	CIRCUIT #3 GRD. FAULT PROTECTED	CIRCUIT #4	CIRCUIT #5
FRONT AIR COND. RECEPT.	WATER HEATER RECEPT.	BEDROOM RECEPT.	VACUUM RECEPT.	REAR AIR COND.
	CONVERTER RECEPT.	GALLEY RECEPT.		
		R.H. DINETTE RECEPT.		
		REFRIGERATOR RECEPT.		
		BATH RECEPT.		
		EXTERIOR RECEPT.		

A-7650

Figure 4—Living Area 120-Volt AC Electrical Schematic (ZE06584)

MODEL ZEO6584

DESCRIPTION

The 12-volt living area circuits are protected by automotive-type fuses, and the 120-volt circuits are protected by circuit breakers like those found in modern homes. Schematics of the 12-volt and 120-volt systems are shown in figures 3 and 4. The 12-volt living area fuse block is located in the bathroom vanity beneath the sink, as shown in figure 5. In the event of an overloaded circuit, the cause should be corrected and a new fuse of the same capacity must be installed.

The main circuit breaker panel (figure 6) is located just above the left rear twin bed. To gain access to panel, push lightly on access door. The panel contains circuit breakers that are designed to snap to the neutral position in the event of an overloaded 120-volt circuit. Once the cause of an overload is corrected, the circuit breaker must be moved first to the "OFF" position and then to the "ON" position.

The 120-volt/12-volt power converter is located behind the oven, above the furnace (figure 7). When the vehicle is plugged into 120-volt external power source, the converter powers all 12-volt components and recharges the living area battery.

For explanation of 12-volt fuse block number code, refer to figure 3. The circuit breakers for the 120-volt system and the circuits they protect are shown in figure 4.

GROUND FAULT INTERRUPTER CIRCUIT BREAKER

In Model ZEO6584, the circuit breaker panel includes a ground-fault interrupter circuit breaker designed to protect user from the hazards of line to ground electric shock (figure 6).

The ground-fault interrupting circuit breaker is designed to protect individuals using appliances plugged into the bedroom, galley, dinette, refrigerator, bath, and optional exterior receptacle.

If an appliance continuously trips the circuit breaker, the appliance is defective and should be repaired or replaced. Circuit breaker may also trip if circuit is overloaded. Problem should be corrected before circuit breaker is reset.

TESTING THE CIRCUIT BREAKER

For maximum protection against electrical shock hazard, the circuit breaker should be tested at least once a month and the test date recorded.

Test Procedure

1. Push "test" button. The circuit breaker should move to the center position, which indicates that power to the protected circuit is discontinued.
2. To restore power, push the circuit breaker to "OFF" position before resetting circuit breaker to "ON" position.

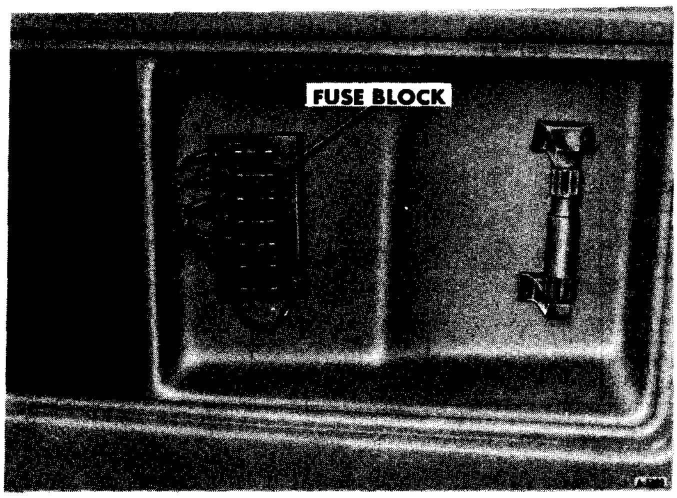


Figure 5—Fuse Panel (ZE06584)

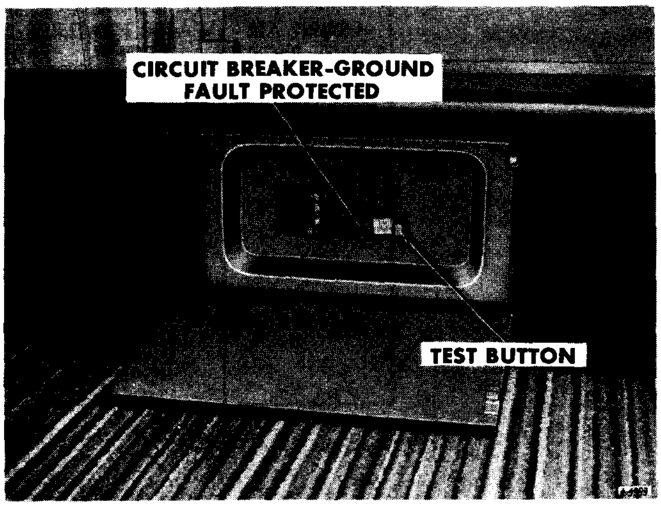


Figure 6—Circuit Breaker Panel (ZE06584)

CAUTION: *If circuit breaker does not trip when the test button is pushed, a loss of ground fault protection is indicated and a potentially lethal situation exists. The circuit breaker should be replaced.*

CONVERTER REPLACEMENT

Model ZE06584 converter is located behind the oven, above the furnace (figure 7). If power converter does not appear to be functioning properly, be certain that ground wire is connected securely to frame and that positive lead is securely fastened at circuit breaker above converter.

NOTE: Converter humming does not indicate failure.

1. Shut off LP gas at tank.
2. Disconnect battery ground cable from living area battery.
3. Unplug converter at 120-volt outlet near furnace.
4. Disconnect gas lines at range. Remove range/oven. (Refer to "Range/Oven Unit Replacement", Maintenance Manual X-7525, Sec. 24H for detailed procedure.)

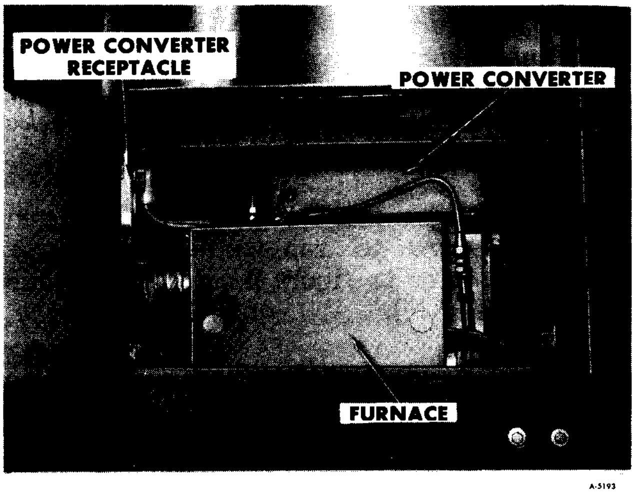


Figure 7—Converter Location (ZE06584)

5. Remove mounting bolt "A" at upper end of rear mounting bracket (figure 8). Disconnect converter ground wire from frame. Disconnect converter feed at circuit breaker.

NOTE: This circuit breaker is an automatic reset type, rated at 60 amps.

6. Remove two bracket bolts "B" and "C" (figure 8) securing side bracket to furnace mounting bracket. Next, remove front and rear bracket bolts "D" and "E" (figure 8), closest to vehicle interior. Lift off rear mounting bracket.

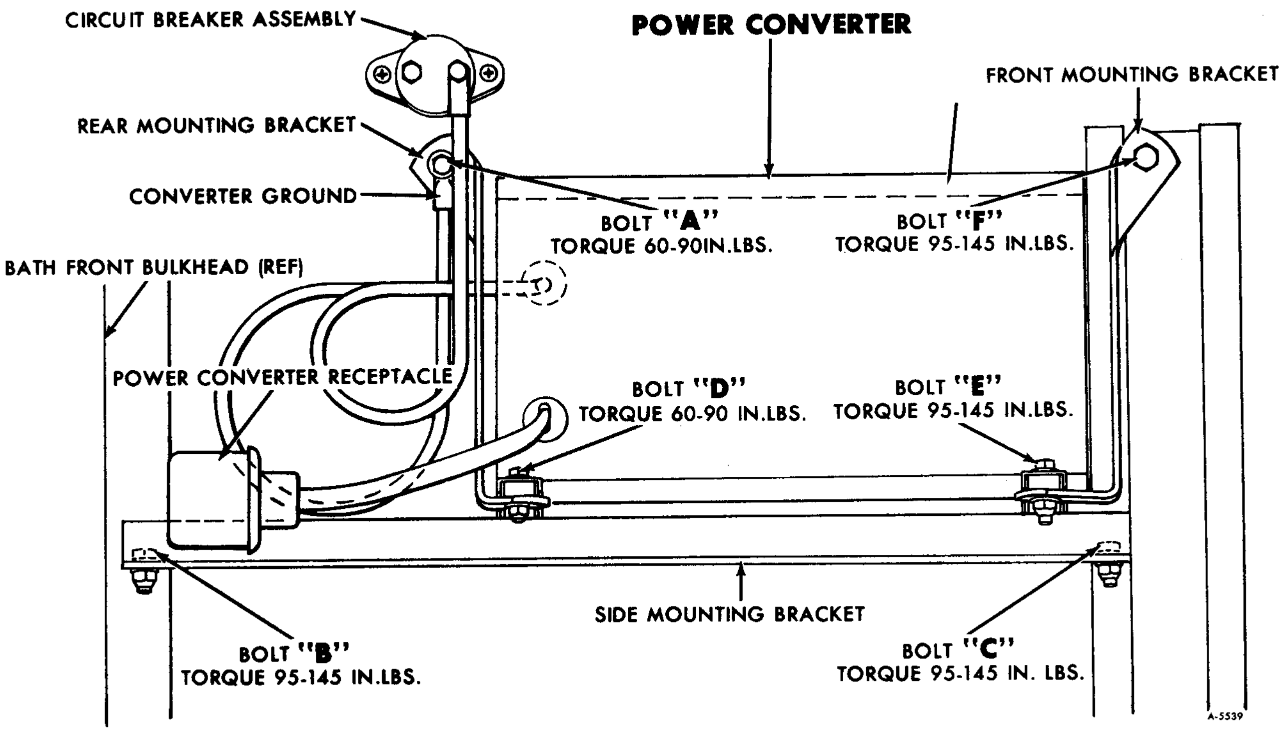


Figure 8—Converter Installation (ZE06584)

7. Loosen remaining front bracket bolt "F", and rotate front mounting bracket forward, allowing converter to be pulled out. Converter will be removed with side mounting bracket attached.

8. Remove side mounting bracket from converter. Secure to replacement converter assembly. Refer to figure 8 for torque values (bolts "B" and "C").

9. Converter installation is reverse of removal procedure. Tighten all attaching parts to torque indicated in figure 8.

EXTERIOR RECEPTACLE

The optional exterior receptacle in model ZEO6584 is located on the right side of the vehicle, behind the refrigerator grille. The exterior receptacle is wired into circuit #3 in the circuit breaker panel, which is ground fault protected. This is designed to protect anyone using appliances that are plugged into this receptacle from the hazards of line to ground electric shock.

If an appliance continuously trips the circuit breaker, the appliance is defective and should be repaired or replaced.

SPECIFICATIONS

LIVING AREA 12-VOLT SYSTEMS FUSES (ZEO6581)

The following are located in the fuse block in the living area electrical compartment, near the hall closet. Do not use fuses of higher amperage rating than those specified below, or damage may result.

Usage	No. on Fuse Block	Fuse Type
L.H. Front Light Front Roof Vent Fan Galley Light Rear Roof Vent Fan	No. 1	AGC-15
Range Hood Vent Fan and Lights Bath Vent Fan Rear L.H. Reading Light	No. 2	AGC-15
Porch Light Aisle Lights Galley Light Water Pump Systems Monitor	No. 3	AGC-15
Refrigerator Hall Light LPG Compartment Light	No. 4	AGC-15
R.H. Front Light Bath Light Rear R.H. Reading Light	No. 5	AGC-15
Toilet (Recirc.)	No. 6	AGC-15
Furnace Furnace Auxiliary Blower Oven Light Motor Generator Compartment Light	No. 7	AGC-15

LIVING AREA 12-VOLT SYSTEMS FUSES (ZEO6584)

The following are located in the fuse block in the bathroom vanity beneath the sink.

Do not use fuses of higher amperage rating than those specified below, or damage may result.

Usage	No. on Fuse Block	Fuse Type
L.H. Reading Light Rear Roof Vent Fan Bath Roof Vent Fan Galley Light	No. 1	AGC-15
Front Roof Vent Fan Range Hood Fan and Lights Hall Light	No. 2	AGC-15
Furnace Furnace Auxiliary Blower Motor Generator Compartment Light	No. 3	AGC-15
Refrigerator LPG Compartment Light Front Light	No. 4	AGC-15
Porch Light Floor Lights Water Pump	No. 5	AGC-15
Recirc. Toilet	No. 6	AGC-15
R.H. Reading Light Galley Light Switch Bath Light Systems Monitor	No. 7	AGC-15

LIGHT BULB SPECIFICATIONS (LIVING AREA)

Usage	Quantity	Bulb. No.
R.H. Front Light	2	1141
L.H. Front Light	2	1141
Kitchen Light	2	1141
Hall Light	2	1141
Porch Light	1	1141
Compartment Lights	2	1141
Range Hood Lights	2	1156
Rear Compartment Reading Lights	2	1383
Bathroom Lights	6	1141
Aisle Lights	2	67
Visor Vanity Mirror	2	74
Microwave Oven		
Oven Cavity (120-volt)	2	25 Watt
Timer Dial (120-volt)	1	7 Watt

12-VOLT LIVING AREA COMPONENTS CURRENT RATING

R.H. Front Light	2.88 Amp.
L.H. Front Light	2.88 Amp.
Hall Light	2.88 Amp.
Rear R.H. Reading Light	1.50 Amp.
Rear L.H. Reading Light	1.50 Amp.
Kitchen Light	2.88 Amp.
Aisle Lights (Per Light)	.59 Amp.
Porch Light	1.44 Amp.
Bathroom Lights (ZEO6581)	8.64 Amp.
Bathroom Lights (ZEO6584)	4.32 Amp.
Range Hood Vent Fan and Light	6.70 Amp.
Furnace Blower	6.8 Amp.
Water Pump	5.5 Amp.
Refrigerator (ZEO6581)	6.0 Amp.
Refrigerator (ZEO6584)	5.0 Amp.
Recirculating Toilet	7.0 Amp.
Monitor Panel	2.5 Amp.
Front Vent Fan	3.50 Amp.
Rear Vent Fan	3.50 Amp.
Bath Vent Fan	3.50 Amp.
Oven Lamp (L.P. Gas Oven)	1.44 Amp.
Furnace Auxiliary Blower	3.00 Amp.
Motor Generator Compartment Lamp	1.44 Amp.
LPG Compartment Lamp	1.44 Amp.

120-VOLT SYSTEM CURRENT RATING

Water Heater		8.7 Amp.
Power Converter		6.8 Amp.
Refrigerator (ZEO6581)		0.7 Amp.
Refrigerator (ZEO6584)		0.6 Amp.
Roof Mount Air Conditioner	(Front)	15.0 Amp.
	(Rear)	12.0 Amp.
Vacuum Cleaner		7.0 Amp.
Microwave Oven		14.8 Amp.

SECTION 24C
MOTOR GENERATOR

The information described in Maintenance Manual X-7525 under the heading MOTOR GENERATOR (SEC. 24C) is applicable to models covered by this supplement with the exception of the following:

Contents of this section are listed below:

MOTOR GENERATOR CAUTION

CAUTION: *Do not interfere with or bypass electrical circuit breaker or attempt in other ways to defeat its purpose. Don't fill fuel tank while engine is running and don't smoke when filling fuel tank. Wipe up any oil and gasoline spills immediately and make sure oily rags aren't left on the power plant or in its compartment. Replace any compartment insulation that may become fuel or oil soaked. Do not use flammable materials directly above or around the power plant compartment. Make sure the ventilation system provides a constant flow of air to expel any fuel vapor from motor generator compartment while vehicle is in transit. Also, be sure any openings made in the motor generator compartment for conduit, wiring, etc. are sealed to prevent toxic gases from entering vehicle interior. Do not remove oil-fill cap while engine is running.*

IGNITION AND BATTERY CHARGING SYSTEM

ONAN MOTOR GENERATOR (6KW AND 4KW)

BREAKER POINT ADJUSTMENT AND TIMING PROCEDURE

To maintain maximum efficiency from the Onan unit, check the breaker points every 100 hours and change the breaker points every 200 hours of operation. The breaker point box may be of two types, refer to figure 1 or figure 2. To change the breaker points and set the ignition timing, use the procedure appropriate to particular unit.

TYPE 1 BREAKER POINTS

1. Remove the two screws and the cover on the breaker box.
2. Remove the two spark plugs so the engine can easily be rotated by hand. Check condition of spark plugs at this time.
3. Remove mounting screw (A) and pull the points out of the box just far enough so screw (B) can be removed and leads disconnected.
4. Remove screw (C) and replace condenser with a new one. Tighten screw (C).
5. Replace points with a new set. Tighten screw (B) but do not completely tighten mounting screw (A).
6. Remove push-on terminal from ignition coil negative terminal. Connect test lamp, one lead to battery positive (+) terminal at starter, the other lead to push-on terminal (–)

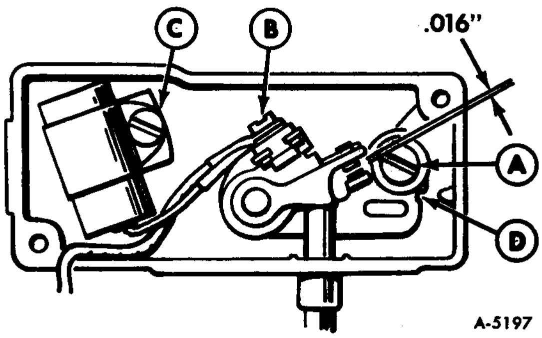


Figure 1—Breaker Point Adjustment—Type 1

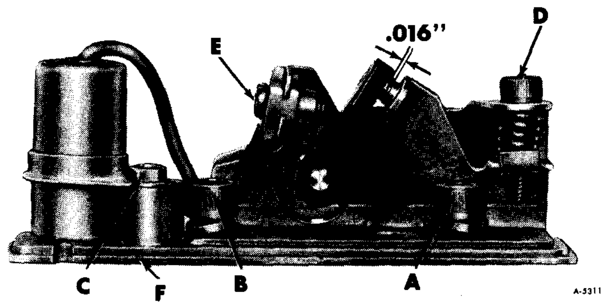


Figure 2—Breaker Point Adjustment—Type 2

removed from ignition coil terminal. (To use Ohmmeter or self-powered test lamp, remove push-on terminal from ignition coil negative terminal. Connect one of meter leads to removed terminal, the other to suitable engine ground. Do not connect Ohmmeter to battery positive lead at starter or damage to instrument could result.)

7. Rotate engine clockwise (facing flywheel) by hand until 20^{o} BTDC mark on flywheel aligns with center of timing access hole. (Note, early units marked at 25^{o} BTDC should be set at 25^{o} BTDC.) Then, using a screwdriver inserted in notch (D) on the left side of the points (reverse view of figure 1), adjust points until test lamp just goes out (or Ohmmeter reads Infinity). Tighten screw (A).

8. To check, turn crankshaft against rotation (counterclockwise) until points just close. At this time test lamp should light (or Ohmmeter should read "Zero"). Now slowly rotate the engine clockwise. Lamp should go out (or Ohmmeter read Infinity) just as the points break, which is the time at which ignition occurs. (6KW — 20^{o} BTDC or 25^{o} BTDC, whichever is marked on flywheel.) Breaker points are now adjusted properly and timing is set.

NOTE: Type 1 breaker box assembly may be converted to Type 2 breaker box assembly to provide easier access to ignition contacts.

TYPE 2 BREAKER POINTS

1. Remove single screw and the breaker point cover box.

2. Remove the two spark plugs so the engine can easily be rotated by hand. Check condition of spark plugs at this time.

3. Using a screwdriver, remove mounting screw (C). Use an Allen wrench to remove mounting screws (A) and (B). Loosen screw (E) to remove leads. Remove points and condenser from base (F).

4. Replace points and condenser with a new set. Tighten screws (A), (B) and (C). Connect leads and tighten screw (E).

5. Remove push-on terminal from ignition coil negative terminal. Connect test lamp, one lead to battery positive (+) terminal at starter, the other lead to push-on terminal (–) removed from ignition coil terminal. (To use Ohmmeter or self-powered test lamp, remove push-on terminal from ignition coil negative terminal. Connect one of meter leads to removed terminal, the other to suitable engine ground. Do not connect Ohmmeter to battery positive (+) lead at starter or damage to instrument could result.

6. Rotate engine clockwise (facing flywheel) by hand until 20^{o} BTDC mark on flywheel aligns with center of timing access hole. (Note, early units marked at 25^{o} BTDC should be set at 25^{o} BTDC.) Then, using an Allen wrench inserted in screw (D), adjust points until test lamp just goes out (or Ohmmeter reads Infinity).

7. To check, turn crankshaft against rotation (counterclockwise) until points just close. At this time test lamp should light (or Ohmmeter should read "Zero" resistance). Now slowly rotate engine clockwise. The lamp should go out (or Ohmmeter read Infinity) just as the points break, which is the time at which ignition occurs. (6KW—20^{o} BTDC or 25^{o} BTDC, whichever is marked on flywheel.) Breaker points are now adjusted properly and timing is set.

SECTION 24D
REFRIGERATOR

The information described in Maintenance Manual X-7525 under the heading REFRIGERATOR (SEC. 24D) is applicable to models covered by this supplement with the exception of the following:

GENERAL INFORMATION

The Norcold six cubic foot refrigerator will be used in model ZEO6584. The refrigerator will operate on either 12-volts D.C. or 120-volts A.C. This dual voltage refrigerator automatically switches from A.C. to D.C. or D.C. to A.C.

The six cubic foot refrigerator cooling system is basically the same as the seven and one-half cubic foot refrigerator with the exception of the power required to operate the swing motor compressor. Refer to "Compressor Voltage Check" and "Compressor Amperage" for specific values required.

REFRIGERATOR SERVICING

COMPRESSOR VOLTAGE CHECK

The voltage is checked at the compressor terminals with an A.C. voltmeter (Figure 1).

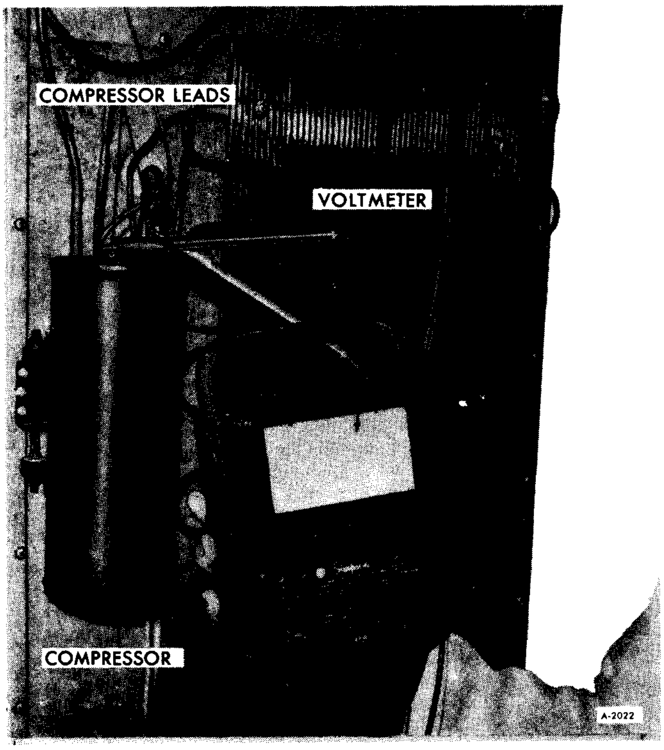


Figure 1—Checking Compressor Voltage

NOTE: A standard (RMS) A.C. voltmeter will read a high A.C. compressor voltage on D.C. operation. The reason being the inverter does not produce a true sine wave on D.C. operation. The 120-volt A.C., 60 cycles/second, will produce a true sine wave which an A.C. voltmeter is designed to read.

If the voltage at the compressor is not adequate the voltage source should be checked.

<u>A.C. Operation</u>

Using a standard (RMS) A.C. voltmeter the voltmeter reading should be:

6 cubic foot model = 19 to 21 volts
7-1/2 cubic foot model = 22 to 24 volts

<u>D.C. Operation</u>

Using a standard (RMS) A.C. voltmeter the voltmeter reading should be:

6 cubic foot model - 27.2 to 29.2 volts
7-1/2 cubic foot model - 31.5 to 33.5 volts

COMPRESSOR AMPERAGE

One method of determining whether or not the proper amount of freon is in the cooling

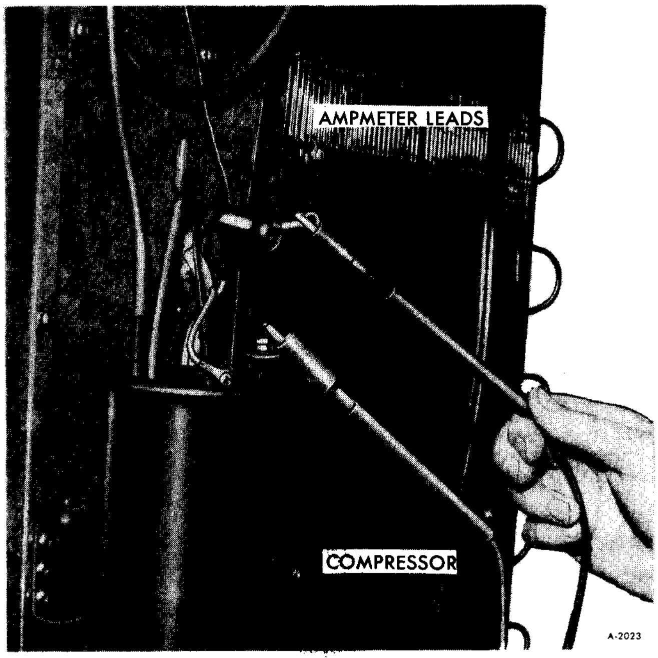


Figure 2—Checking Compressor Amperage

system is to measure the number of amps drawn by the compressor when connected to a 120-volt source.

This is done by removing one of the compressor leads and connecting a 0-5 A.C. ammeter in series with the compressor (figure 2). A reading of 2 amps should be read for the six cubic foot model and approximately 2.6 amps for the seven and one-half cubic foot model.

If the amperage reading is high, this is an indication the system is undercharged. If a low reading is obtained the system is overcharged. If it is determined that the system is under or overcharged, the entire cooling system must be replaced.

NORCOLD REFRIGERATOR SPECIFICATIONS

Model	6 Cubic Foot	7.5 Cubic Foot
Compressor Power	40 Watts	60 Watts
Compressor Amps Required	2 Amps	2.6 Amps
Compressor Volts Required (A.C. Operation)	19 to 21 Volts A.C.	22 to 24 Volts A.C.
Compressor Volts Required (D.C. Operation)	27.2 to 29.2 Volts A.C.	31.5 to 33.5 Volts A.C.
Compressor Motor Resistance	2 to 3 Ohms	2 to 3 Ohms
Compressor Motor Speed	60 Strokes/Sec.	60 Strokes/Sec.
Inverter Output	11 Volts A.C.	11 Volts A.C.
Transformer Output	20 Volts A.C.	23 Volts A.C.
Input Voltage	12 Volts A.C. or 120 Volts A.C.	12 Volts D.C. or 120 Volts A.C.
Refrigerant	R 12	R 12
Refrigerant Charge	2.56 Ounces	3.17 Ounces

SECTION 24G
FURNACE

The information described in Maintenance Manual X-7525 under the heading FURNACE is applicable to models covered by this supplement with the exception of the following:

DUO-THERM FURNACE

CONTENTS

GENERAL INFORMATION

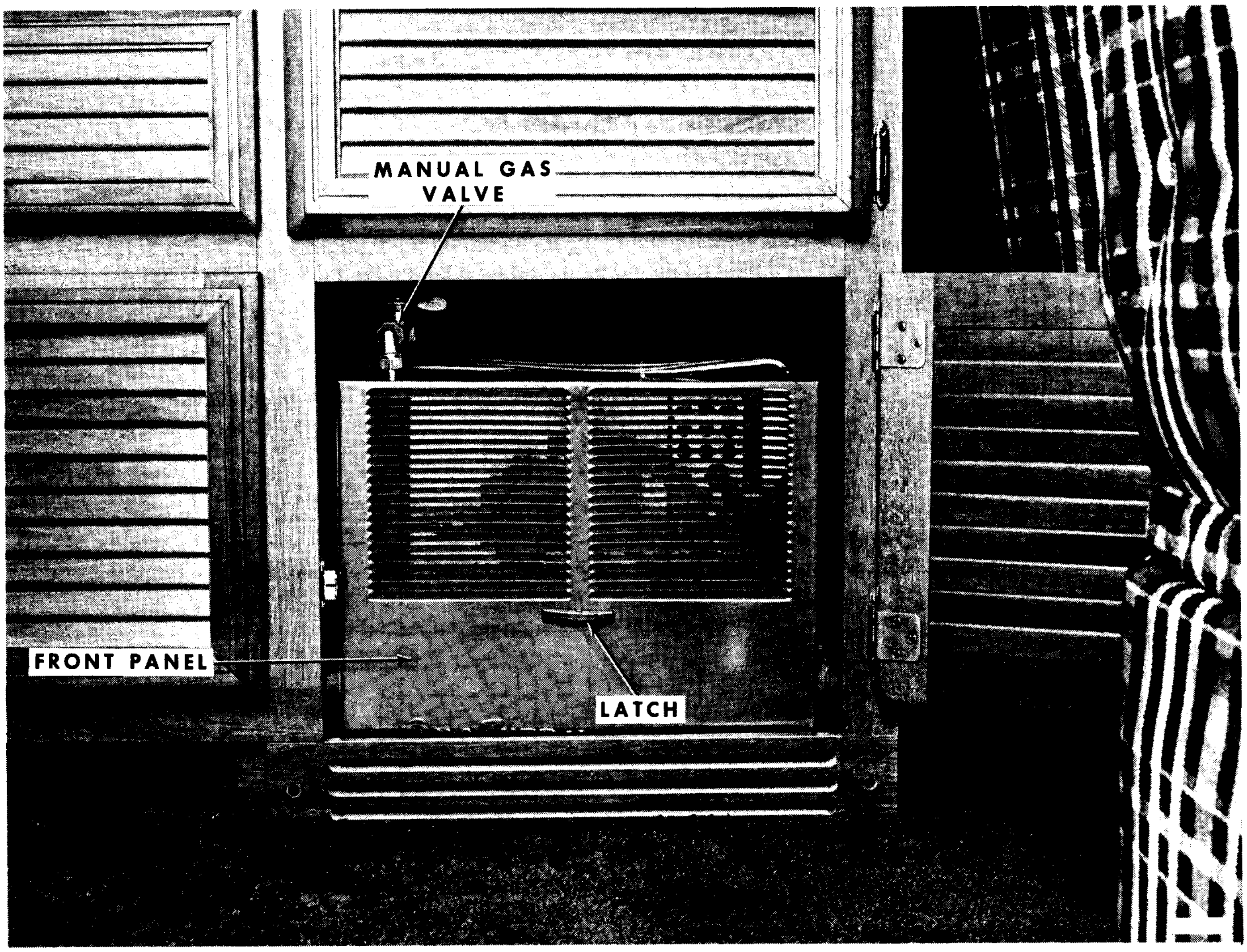


Figure 1—Duo-Therm Furnace Installed

During the 1977 model year the 30,000 B.T.U. Duo-Therm furnace (figure 1) was installed as standard equipment in the GMC Motorhome, the furnace is located in the compartment, at floor level, under the kitchen sink. The identification plate is located at the front of the combustion chamber assembly. The furnace has no pilot light, but is ignited by a direct spark ignition system.

The furnace utilizes a sealed combustion system. The combustion air is drawn in from outside the vehicle, passes through the combustion chamber and returned to the outside. Air inside the vehicle is drawn through the front panel on the furnace and passed around the heat chamber, then discharged into heat ducts located on the front and rear sides of the furnace casing.

NOTE: An auxiliary furnace blower located behind the kitchen range/oven aids in conducting heated air to the bathroom module.

The furnace operates on 12-volts D.C. and its wiring diagram is shown in figure 2.

COMPONENT DESCRIPTION

GAS CONTROL VALVE

The gas control valve (figure 3) contains a manual shut off for the LP gas supply to the furnace. Also included in the valve is a pressure regulator which limits LP gas to the furnace between 10 1/2 and 11 1/2 inches of water pressure.

NOTE: This valve is in addition to the LP gas regulator valve located at the LP gas tank.

GAS SOLENOID VALVE

The gas solenoid valve (figure 3) controls the flow of LP gas to burner assembly. Opening and closing of this valve is controlled by the sail switch and the ignition system.

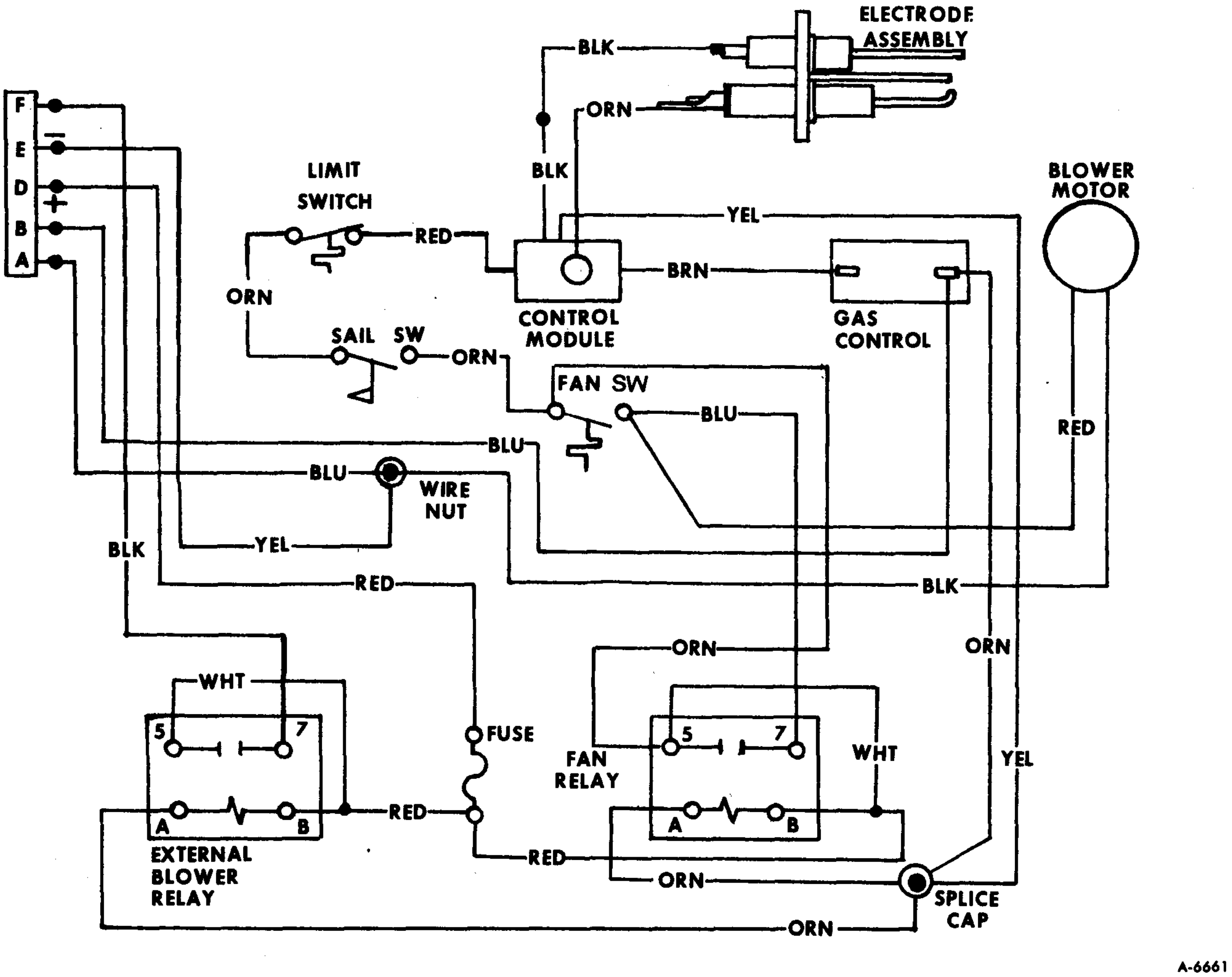


Figure 2—Duo-Therm Furnace Wiring

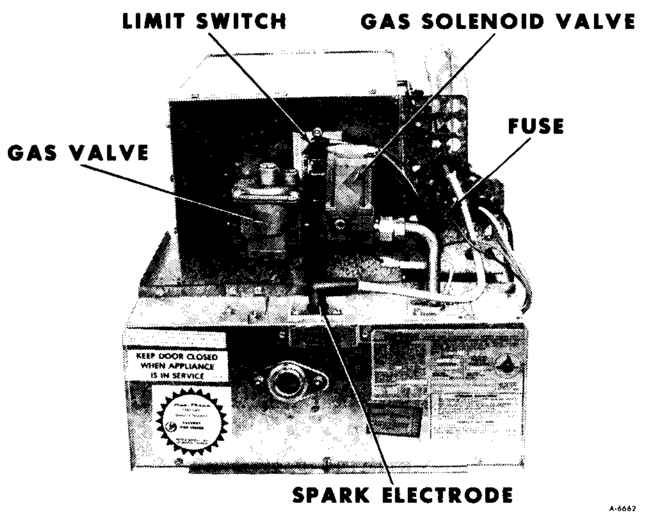


Figure 3—Furnace Components (Front View)

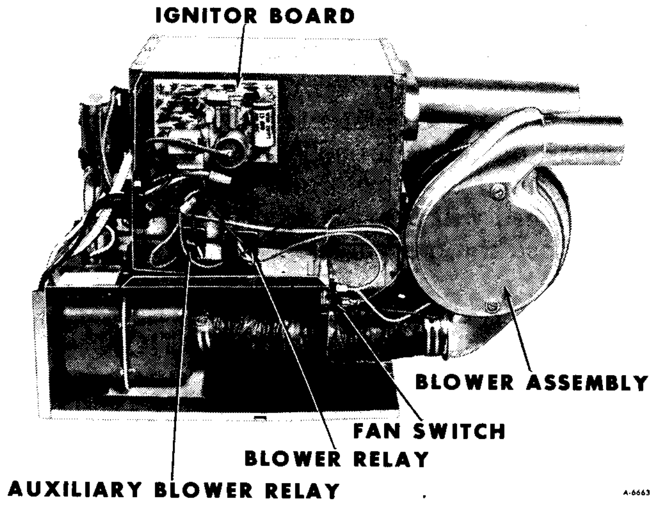


Figure 4—Furnace Components (Side View)

LIMIT SWITCH

The limit switch function is to turn off the gas supply to the burner assembly if furnace temperature exceeds the high temperature limit of 200°F (93°C). If this temperature is exceeded during furnace operation the limit switch will open causing the gas solenoid valve to close, thus shutting off LP gas to the furnace.

BLOWER ASSEMBLY

The furnace blower assembly contains one motor that is used to drive both the combustion air and circulating air blower wheels. The combustion air blower is sealed so as to allow no passage of air between it and the circulating air blower. The combustion air blower wheel draws air from outside the vehicle into the combustion chamber, and forces combustion products out the exhaust tube. The circulating air blower wheel pulls air into the front of the furnace, forces it across the heat chamber, and discharges it to the heat ducts located on both sides of the furnace casing.

RELAYS

Two relays (figure 4) are located on the right side of the furnace. The auxiliary blower relay is energized when the thermostat contacts close (calling for heat). When energized this relay feeds current to the auxiliary blower motor located behind the range/oven. When the thermostat contacts open the auxiliary blower motor will shut off.

The blower relay energizes the blower motor when thermostat calls for heat. When the thermostat contacts open the blower relay contacts open, thus the ground circuit for the relay is broken. The blower will continue until the fan switch shuts off the blower.

FAN SWITCH

The fan switch (figure 4) controls the sequence of blower operation. The fan switch is a two pole switch. When the bimetal disc in the switch is heated to operating temperature, the switch changes position. The blower will continue to run as long as the circulating air chamber is hot even though the thermostat contacts are open and the gas solenoid valve is closed. When the chamber cools, the fan switch changes back to its original position and shuts the blower off.

SAIL SWITCH

The sail switch is located on the bottom of the blower assembly. The switch operates in response to the flow of air generated by the blower. If for any reason the air from the blower is not sufficient, the switch will not operate. This may be caused by a slow motor due to low voltage, restricted return air, or lint accumulation on the blower wheel. Once the switch engages the solenoid valve opens, gas flows to burner, and ignition occurs.

IGNITION SYSTEM

The direct spark ignition system consists of a solid state printed ignitor board, an ignitor assembly and connecting high and low voltage wires. The ignitor board is not field repairable.

The thermostat contacts when closed allows current to the ignitor board, to open the gas solenoid valve and provide the ignition spark. As soon as the flame is established, the spark ceases. Should the flame not be established within a period of 15 seconds the system will close the gas solenoid valve.

Electronic flame sensing circuitry in the spark electrode detects the presence or absence of main burner flame. If the flame is extinguished during normal operation, the ignitor board will provide one re-try for ignition, then close the gas valve.

SEQUENCE OF OPERATION

When the thermostat calls for heat, the furnace blower motor is energized immediately. When the blower reaches minimum operating speed (approximately 1-2 seconds) the main burner of the furnace is designed to ignite. The furnace will continue to run until the thermostat is satisfied or is turned to a lower setting. Following approximately one minute of burner operation a slight "snap" will be heard from within the furnace. This is the furnace fan switch changing to its normal run position. After this occurs and the thermostat is satisfied or is turned to a lower setting the main burner flame will go out, but the blower will continue to run for a short period of time and then shut off. If thermostat is adjusted to a lower setting or to "OFF" before the furnace has operated for one minute, the blower and main burner will shut off at the same time.

OPERATING FURNACE

This furnace has no pilot light, but is ignited by a direct spark ignition system. No manual lighting is required.

START-UP

1. Set thermostat located in rear of Motorhome living area to "OFF" position. Remove front panel from furnace. Turn gas valve on furnace to "OFF" position. Wait 5 minutes. This will allow any LP gas fumes in combustion chamber to dissipate.

NOTE: Be sure control valve at LP gas tank is fully open.

2. Open furnace manual valve fully. The manual valve is located just above the furnace. Do not attempt to operate furnace with valve partly opened as proper operation depends on valve being fully open.
3. Turn furnace gas valve to "ON" position. Do not attempt to operate furnace with valve partly opened as proper operation depends on valve being fully opened.
4. Set thermostat to "ON" position and adjust to desired temperature setting. When furnace ignites it will continue to run until thermostat is satisfied or is turned to a lower setting.
5. Allow 15 seconds for burner to ignite. Look for flame at furnace view port. Install furnace front panel when ignition is obtained. Furnace will now operate automatically.
6. If burner does not light, set thermostat on "OFF" position, wait 15 seconds and repeat steps 4-5.
7. If ignition is not obtained after 3 tries, go to shutdown and determine cause.

SHUTDOWN

1. Turn gas valve to "OFF" position.
2. Set thermostat on "OFF" position.

FURNACE DIAGNOSIS

BURNER DOES NOT LIGHT

PROBLEM	POSSIBLE CAUSE	CORRECTION
NO VOLTAGE TO FURNACE	1. Blown fuse living area fuse block.	1. Correct short and replace fuse.
BLOWER DOES NOT OPERATE	1. Defective blower relay.	1. Replace blower relay.
BLOWER SPEED INADEQUATE TO CLOSE SAIL SWITCH	1. Insufficient voltage - furnace operating voltage is 9 to 15 volts D.C.	1. Charge batteries or connect to shore power (external power).

FURNACE DIAGNOSIS

BURNER DOES NOT LIGHT

PROBLEM	POSSIBLE CAUSE	CORRECTION
SAIL SWITCH NOT CLOSING	1. Insufficient voltage.	1. Charge batteries or connect to shore power (external power).
	2. Loose connection.	2. Repair connection.
	3. Defective switch.	3. Replace switch.
GAS SOLENOID VALVE NOT OPENING	1. Open or short in gas solenoid valve coil.	1. Replace gas solenoid valve.
	2. Voltage not present at gas solenoid valve during ignition phase.	2. Repair defective wiring to gas solenoid valve or replace ignitor board or replace sail switch.
NO SPARK AT IGNITOR	1. Short or open in high voltage lead.	1. Replace high voltage lead.
	2. Ignitor not grounded.	2. Correct ground.
	3. Incorrect spark gap.	3. Set spark gap to 1/8" ± 1/32".
	4. Cracked ceramic on ignitor.	4. Replace ignitor.
	5. Defective ignitor board.	5. Replace ignitor board.
LIMIT SWITCH OPEN	1. Limit switch is normally closed below 200°F (94°C).	1. Replace limit switch if there is no continuity across switch below 200°F (94°C).

FURNACE LIGHTS BUT SHUTS DOWN AFTER A PERIOD

PROBLEM	POSSIBLE CAUSE	CORRECTION
FURNACE LIGHTS BUT SHUTS DOWN AFTER A FEW SECONDS	1. Ground screw loose.	1. Secure the green grounding wire to grounding screw located near the blower relays. **NOTE:** On early furnaces the green wire is grounded in the furnace junction box.
	2. Burner assembly mounting screws loose.	2. Tighten burner assembly mounting screws.
FURNACE LIGHTS BUT RANDOMLY SHUTS DOWN DURING DUTY CYCLE	1. Check flame sensor electrode lead for continuity.	1. Replace lead.
	2. Flame sensing electrode not located properly.	2. Position flame sensing electrode so that tip is in flame. The current should be 5-15 microamps through the electrode lead.
	3. Air in L.P.G. line or regulator frozen.	3. Purge L.P.G. tank and add methyl alcohol.

COMBUSTION CHAMBER ASSEMBLY REPLACEMENT

WARNING: BEFORE ANY REMOVAL OR DISASSEMBLY PROCEDURES ARE PERFORMED ON THE FURNACE, BE SURE LP GAS IS COMPLETELY TURNED OFF AT THE LP GAS TANK AND REMOVE FURNACE FUSE FROM FUSE BLOCK TO AVOID PERSONAL INJURY.

WARNING: DUE TO THE POSSIBILITY OF PERSONAL INJURY ON SHARP SHEET METAL, CARE SHOULD BE TAKEN ANY TIME SERVICE IS PERFORMED ON THE FURNACE.

REMOVAL

1. Shut off LP gas at LP gas tank and remove furnace fuse from fuse block in living area electrical compartment.

2. Remove toe board in front of furnace at floor level (figure 5) by removing two retaining screws, then remove front panel from furnace.

3. Close manual gas valve (note this valve is located just above furnace).

4. Disconnect gas line lower fitting from furnace gas valve (figure 6). Loosen gas line upper fitting. Rotate gas line 90° to allow for removal of combustion chamber assembly (figure 8).

5. Remove cover from junction box (figure 6).

6. Inside the junction box remove the wire nuts retaining wiring harness to furnace wiring. Carefully, separate wires in junction box. Using pliers, apply light pressure on special grommet. Pull grommet and furnace wiring from junction box (figure 7).

7. Remove two combustion chamber assembly mounting screws (figure 8).

8. Carefully pull combustion chamber assembly out of furnace casing (figure 9). Remove from vehicle.

INSTALLATION

NOTE: To aid in installation of combustion chamber assembly, remove inlet and outlet vent caps from outside of Motorhome (figure 10).

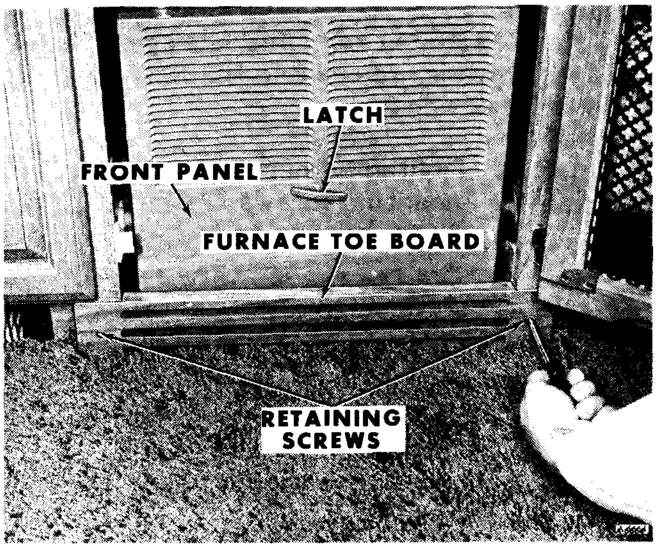


Figure 5—Removal of Furnace Toe Board

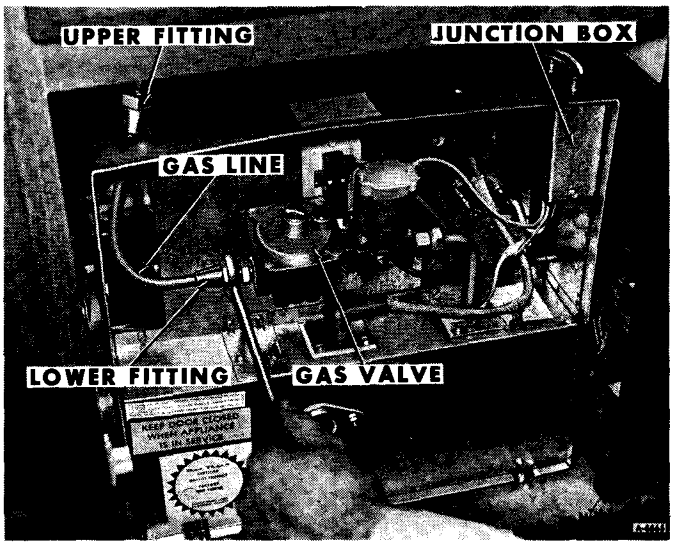


Figure 6—Disconnecting Furnace Gas Line

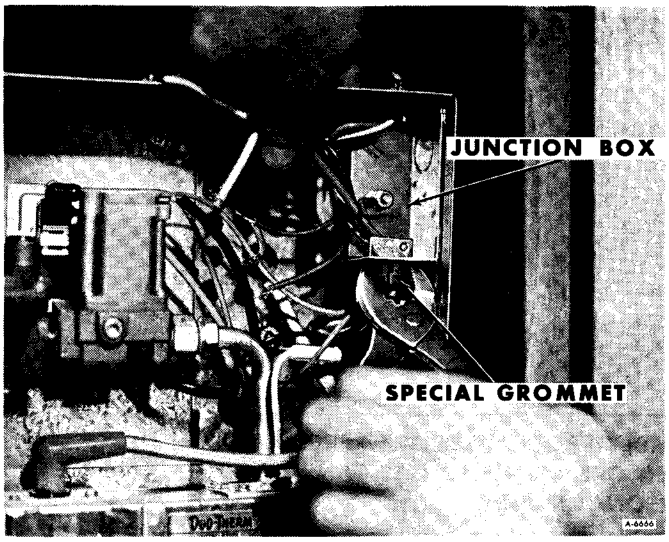


Figure 7—Removing Wiring from Junction Box

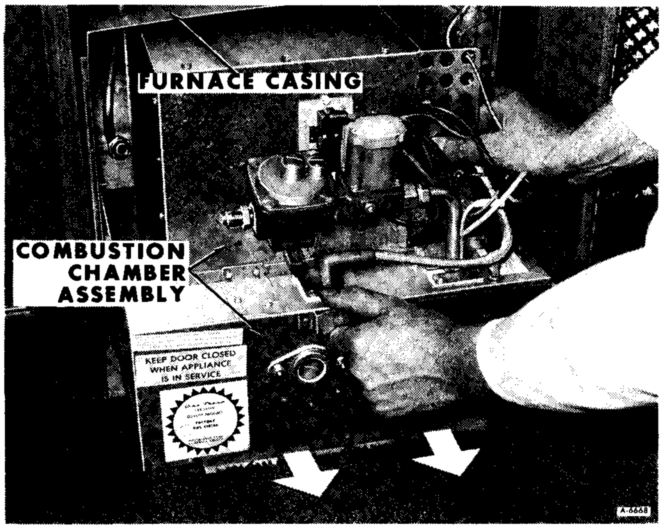


Figure 9—Removing Combustion Chamber Assembly

1. Carefully slide combustion chamber assembly into furnace casing.

2. Install two combustion chamber assembly retaining screws (figure 8).

3. Install furnace wiring and special grommet into junction box (figure 7).

4. With aid of wiring diagram (figure 2) connect wiring harness to furnace wiring using solderless connectors in the junction box. Install junction box cover.

5. Connect gas line to furnace gas valve (figure 6). Tighten upper and lower fittings on gas line.

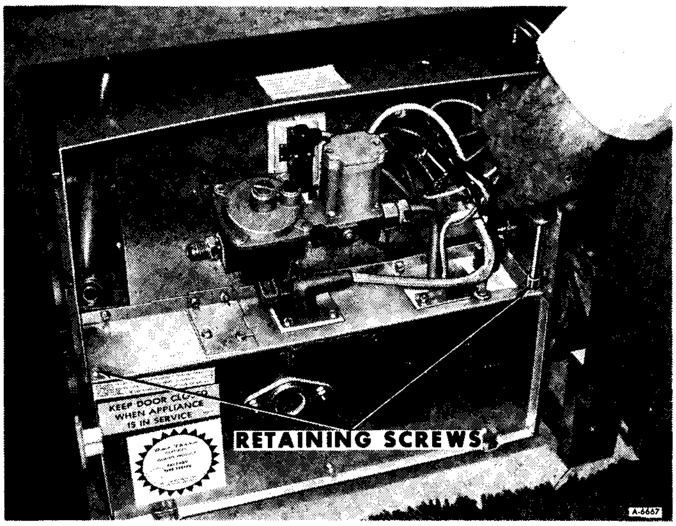


Figure 8—Removing Combustion Chamber Assembly Retaining Screws

6. Install furnace toe board with two retaining screws (figure 5).

7. Carefully install furnace vent caps from outside of vehicle (figure 10).

8. Move vehicle outside of service building to be sure of adequate ventilation while operating furnace. Check furnace for proper operation by performing furnace "Start-Up" and "Shutdown" as described earlier in this section.

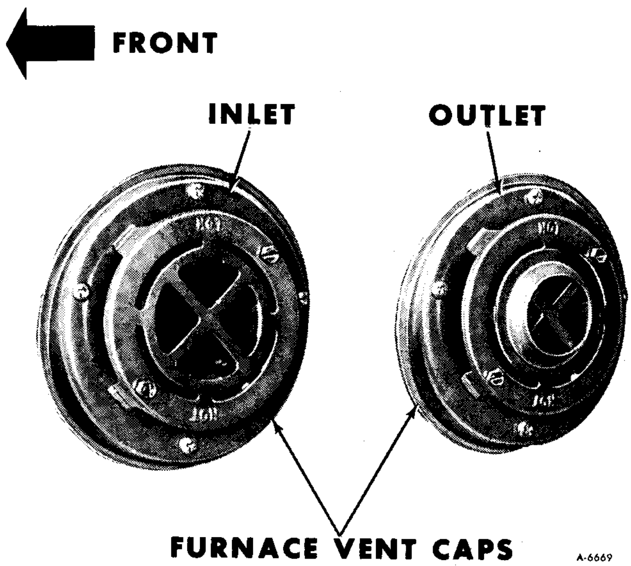


Figure 10—Furnace Vent Caps

COMPONENT REPLACEMENT

The following components (figure 3) can be inspected and replaced without removing the combustion chamber assembly from the vehicle.

1. Gas Valve.
2. Gas Solenoid Valve.
3. Limit Switch.
4. Furnace Fuse.

Removal of the combustion chamber assembly is required for replacement of other furnace components.

WARNING: BEFORE ANY REMOVAL OR DISASSEMBLY PROCEDURES ARE PERFORMED ON THE FURNACE, BE SURE LP GAS IS COMPLETELY TURNED OFF AT THE LP GAS TANK AND REMOVE FURNACE FUSE FROM FUSE-BLOCK TO AVOID PERSONAL INJURY.

WARNING: DUE TO THE POSSIBILITY OF PERSONAL INJURY ON SHARP SHEET METAL, CARE SHOULD BE TAKEN ANY TIME SERVICE IS PERFORMED ON THE FURNACE.

GAS VALVE REPLACEMENT

REMOVAL

1. Close manual gas valve (note this valve is located just above furnace).
2. Disconnect gas line from gas valve (figure 6).
3. Remove gas solenoid valve from main burner gas line (figure 11).
4. Separate gas valve from gas solenoid valve.

INSTALLATION

1. Connect gas valve to gas solenoid valve using nipple.

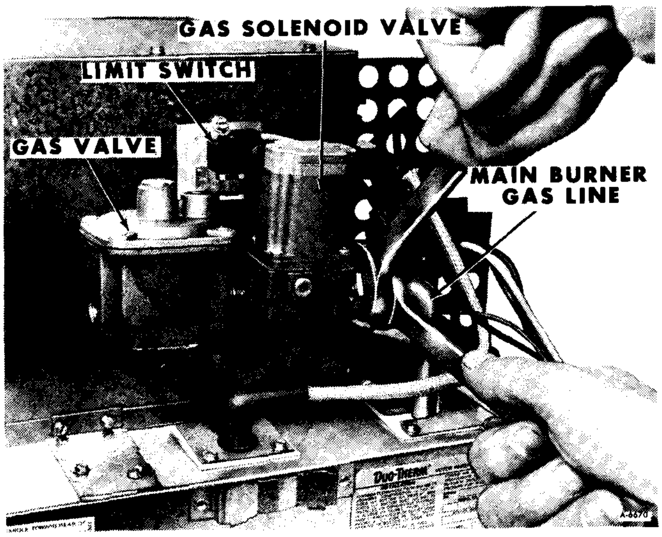


Figure 11—Removing Gas Solenoid Valve

2. Connect gas solenoid valve to main burner gas line (figure 11).
3. Connect gas line to gas valve (figure 6).

GAS SOLENOID VALVE REPLACEMENT

REMOVAL

1. Close manual gas valve (note this valve is located just above furnace).
2. Disconnect gas line from gas valve (figure 6).
3. Remove gas solenoid valve from main burner gas line (figure 11).
4. Separate gas solenoid valve from gas valve.

INSTALLATION

1. Connect gas solenoid valve to gas valve using nipple.
2. Connect gas solenoid valve to main burner gas line (figure 11).
3. Connect gas line to gas valve (figure 6).

LIMIT SWITCH REPLACEMENT

REMOVAL

1. Remove gas solenoid valve as described earlier in this section under "Gas Solenoid Valve Replacement."
2. Disconnect electrical leads from limit switch (figure 12).

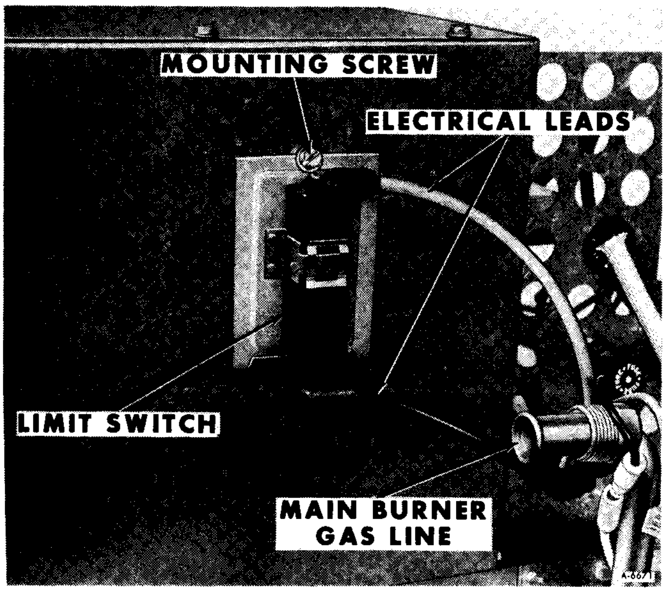


Figure 12— Limit Switch Installed

3. Remove limit switch mounting screw. Carefully remove limit switch from combustion chamber assembly.

INSTALLATION

1. Carefully install limit switch into opening on front of combustion chamber assembly. Retain switch in position with mounting screw (figure 12).
2. Connect electrical leads to limit switch.
3. Install gas solenoid valve as described under "Gas Solenoid Valve Replacement," earlier in this section.

FAN SWITCH REPLACEMENT

REMOVAL

1. Remove the combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.
2. The fan switch is located on the right side of the furnace (figure 4).
3. Disconnect electrical leads from fan switch (figure 13).
4. Remove two mounting screws and separate fan switch from warm air housing.

INSTALLATION

1. Locate fan switch on warm air housing (figure 13). Retain switch in position with two mounting screws.
2. Connect electrical leads to fan switch.
3. Install combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.

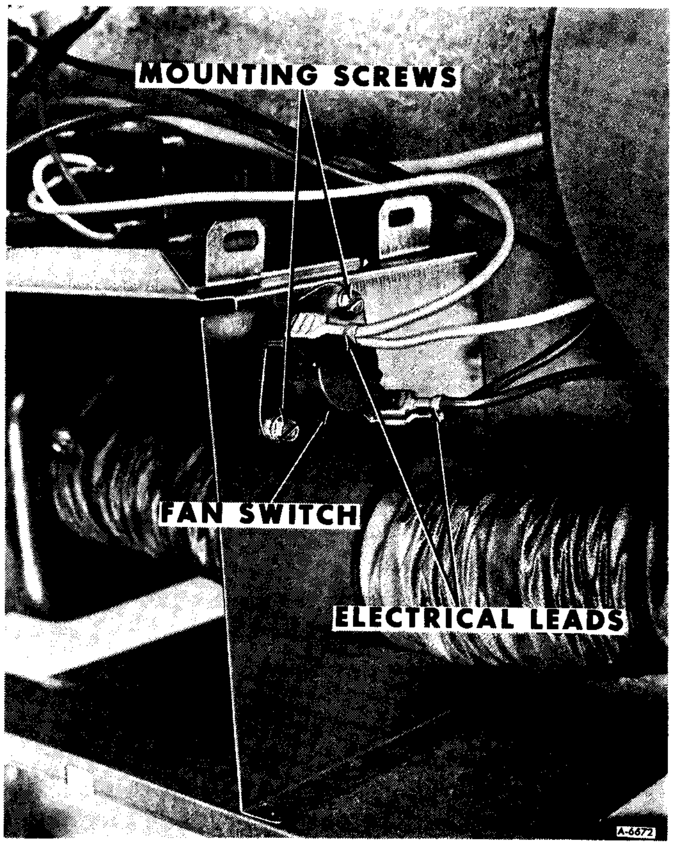


Figure 13—Fan Switch Installed

SAIL SWITCH REPLACEMENT

NOTE: The sail switch (also sometimes called combustion air switch) is located on the bottom of the blower assembly (figure 14).

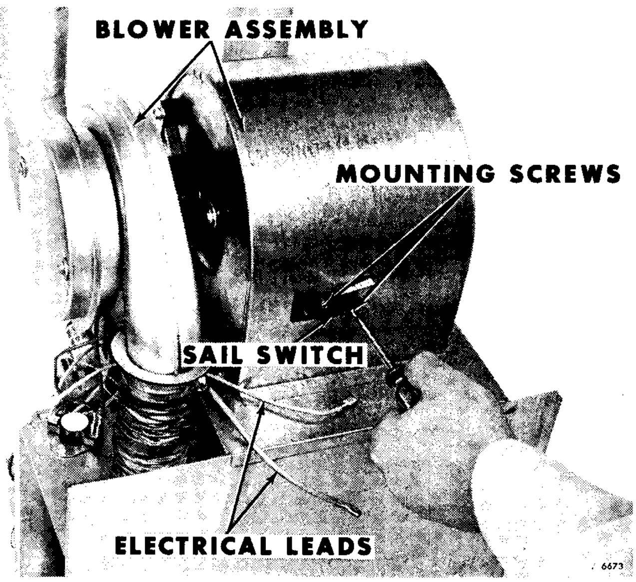


Figure 14—Removing Sail Switch

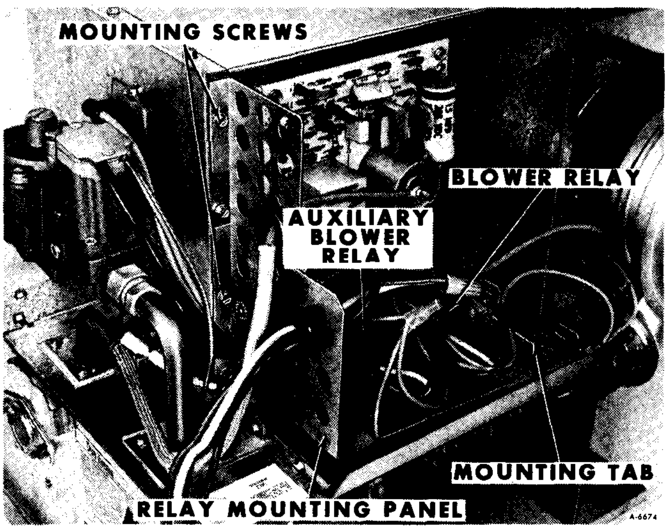


Figure 15—Furnace Relay Mounting Panel Installed

REMOVAL

1. Remove the combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.
2. Disconnect electrical leads from sail switch (figure 14).
3. Remove two mounting screws. Carefully lift sail switch away from blower assembly.

INSTALLATION

1. Carefully position sail switch on bottom of blower assembly. Install two mounting screws. Check that sail arm on the sail switch does not contact sheet metal on blower assembly.
2. Connect electrical leads to switch.
3. Install the combustion chamber assembly as described in "Combustion Chamber Assembly Replacement" earlier in this section.

FURNACE RELAY REPLACEMENT

NOTE: Two relays are located on the right side of the furnace (figure 4). The auxiliary blower relay when energized activates the auxiliary blower motor that is located behind the oven. The blower relay when energized, activates the furnace blower assembly. Replacement procedures for either relay is the same.

REMOVAL

1. Remove the combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.
2. Remove two relay panel mounting screws (figure 15).

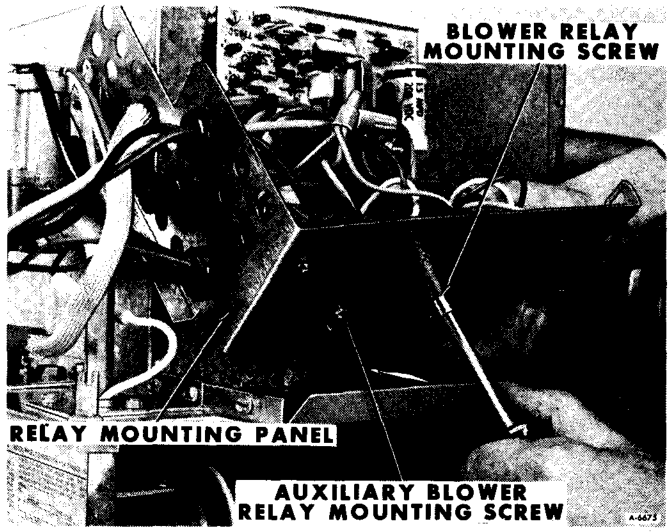


Figure 16—Removing Blower Relay

3. Carefully raise relay mounting panel, sufficiently to allow access to relay mounting screw.
4. Remove relay mounting screw (figure 16).
5. Tag relay electrical leads to aid in proper location during relay installation. Disconnect electrical leads from relay. Remove relay.

INSTALLATION

1. Connect electrical leads to relay (refer to figure 2, if necessary).
2. Install relay mounting screw (figure 16).
3. Be sure relay mounting panel engages mounting tab (figure 15). Install two panel mounting screws.

IGNITOR BOARD REPLACEMENT

REMOVAL

1. Remove the combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.
2. Remove special shoulder bolt (figure 17).
3. Remove electrical connector from ignitor board.
4. Remove high voltage lead from ignitor board.
5. Remove four mounting screws and remove ignitor board.

INSTALLATION

1. Position ignitor board on combustion chamber assembly.
2. Install four ignitor board mounting screws (figure 17).

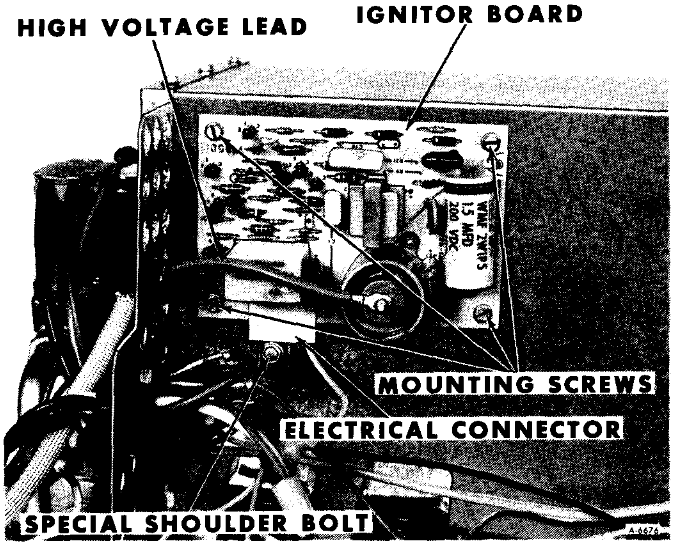


Figure 17—Location Of Ignitor Board

3. Attach electrical connector to ignitor board. Retain electrical connector in proper position by installing special shoulder bolt.
4. Connect high voltage lead to ignitor board.
5. Install the combustion chamber assembly as described in "Combustion Chamber Assembly Replacement" earlier in this section.

SPARK ELECTRODE ASSEMBLY REPLACEMENT

REMOVAL

1. Remove combustion chamber assembly as described under "Combustion Chamber Assembly Replacement" earlier in this section.

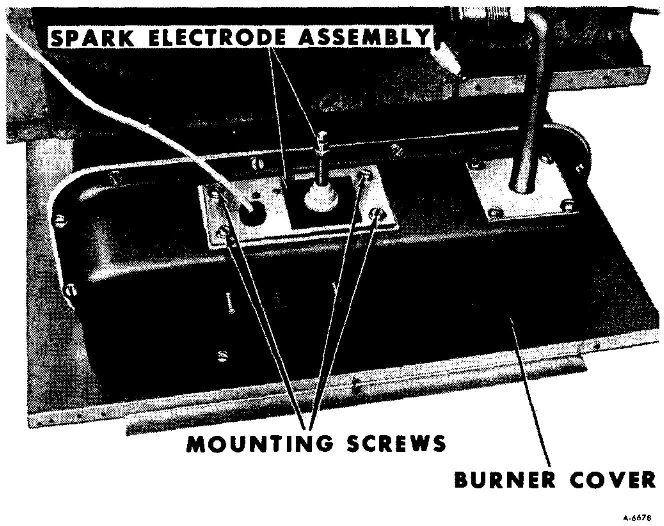


Figure 19—Spark Electrode Installed

2. Disconnect high voltage lead from spark electrode (figure 18). Remove high voltage plate and gasket.
3. Disconnect flame sensing lead near manifold bracket.
4. Remove manifold bracket and gasket.
5. Remove sight glass and gasket.
6. Remove front cover screws and then carefully remove front cover.
7. Remove four spark electrode mounting screws (figure 19).
8. Note spark electrode must clear burner orifices during removal (figure 20). Carefully move spark electrode assembly to the right. Gently tilt upward as shown, and remove from burner cover.

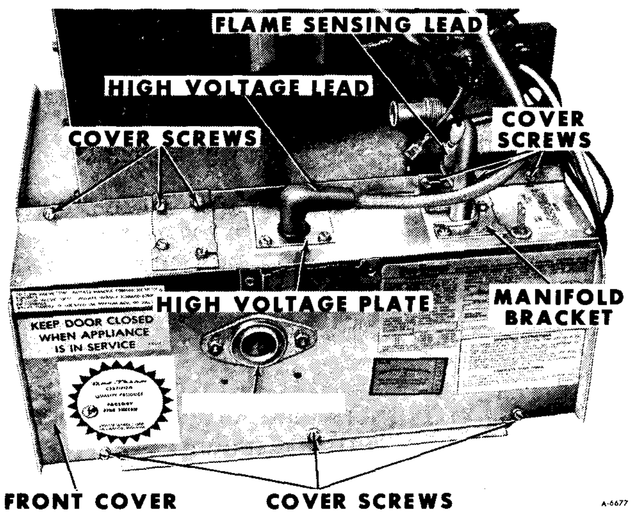


Figure 18—Location Of Furnace Front Cover

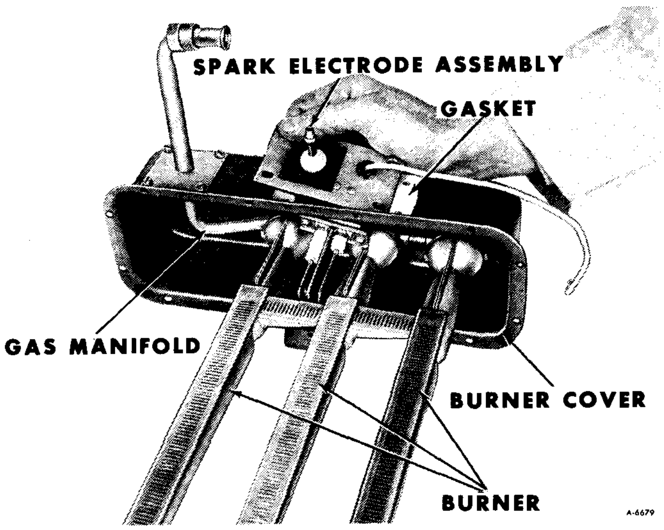


Figure 20—Removing Spark Electrode Assembly

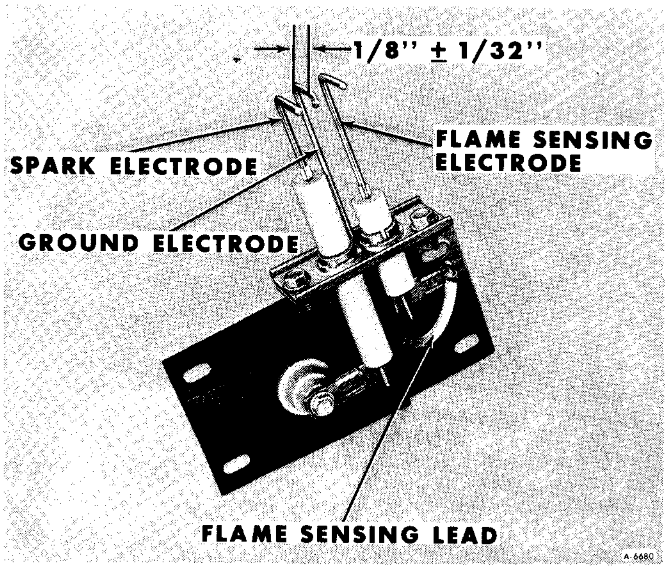


Figure 21—Spark Electrode Assembly

INSTALLATION

NOTE: Before installing spark electrode assembly, check the spark gap. The gap between the spark electrode and ground electrode should be 1/8" ± 1/32" (figure 21).

1. Noting the location of burner orifices (figure 20), carefully install spark electrode assembly and gasket. Secure spark electrode assembly with four mounting screws (figure 19).
2. Install furnace front cover (figure 18). Be sure flame sensing lead is located next to main burner gas line.
3. Install sight glass and gasket.
4. Install manifold bracket and gasket.
5. Connect flame sensing lead near manifold bracket.
6. Install high voltage plate and gasket. Connect high voltage lead to spark electrode.
7. Install the combustion chamber assembly as described in "Combustion Chamber Assembly Replacement" earlier in this section.

BURNER ASSEMBLY REPLACEMENT

NOTE: The burner assembly of the furnace is composed of three burners which are attached to the burner cover (figure 20).

REMOVAL

1. Remove spark electrode assembly as described earlier in this section under "Spark Electrode Assembly Replacement."

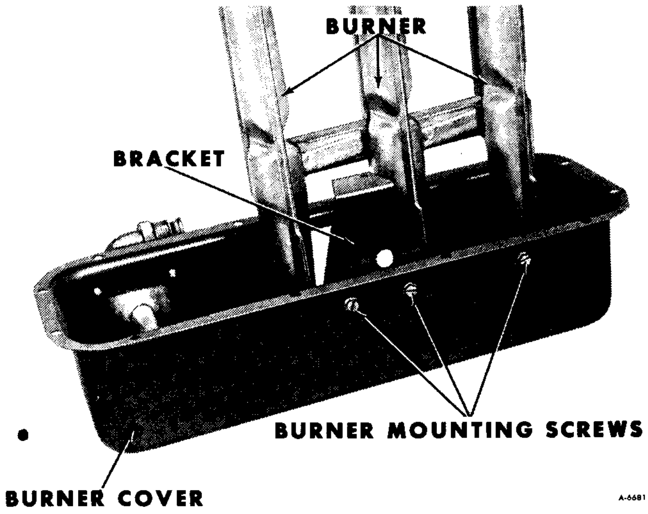


Figure 22—Burner Mounting To Burner Cover

2. Remove burner cover and gasket from combustion chamber (figure 19).

NOTE: The burners are attached to the burner cover (figure 22).

3. Remove burner mounting screws and then carefully remove burners from burner cover.

INSTALLATION

NOTE: Be sure any accumulated soot deposits are removed from inside the combustion chamber. If soot deposits are excessive check for high LP gas pressure, as necessary, when assembly of furnace is complete. There is no main air adjustment on this furnace.

NOTE: At this time the three burner orifices should be checked for obstructions. The orifices can be cleaned using a wooden tooth pick if required, or replaced if necessary.

1. Position burners and bracket in burner cover, and secure with the mounting screws.
2. Install burner assembly and burner cover, and gasket in combustion chamber (figure 19).
3. Install spark electrode assembly as described earlier in this section under "Spark Electrode Assembly Replacement."

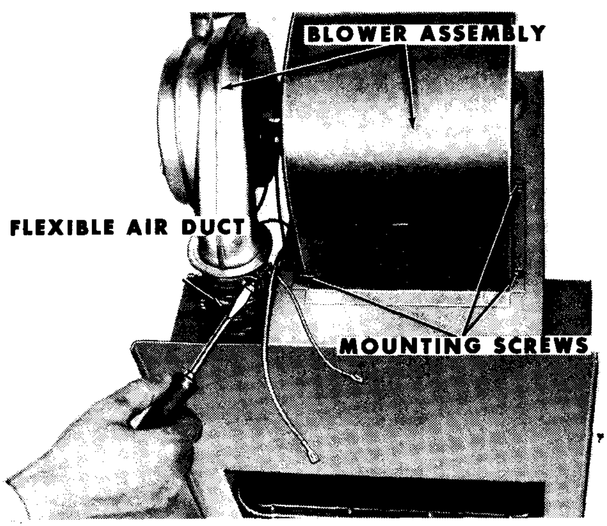


Figure 23—Disconnecting Flexible Duct From Blower

BLOWER MOTOR REPLACEMENT

REMOVAL

1. Remove sail switch as described earlier in this section under "Sail Switch Replacement.
2. Disconnect flexible air duct from blower assembly (figure 23). Disconnect blower motor electrical leads.
3. Remove three blower assembly mounting screws. Remove blower assembly from furnace.
4. Remove outer combustion air housing

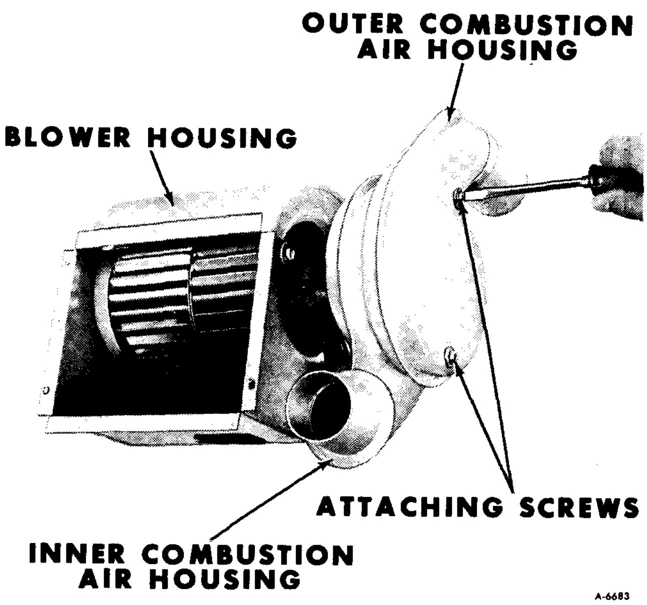


Figure 24—Removing Outer Combustion Air Housing

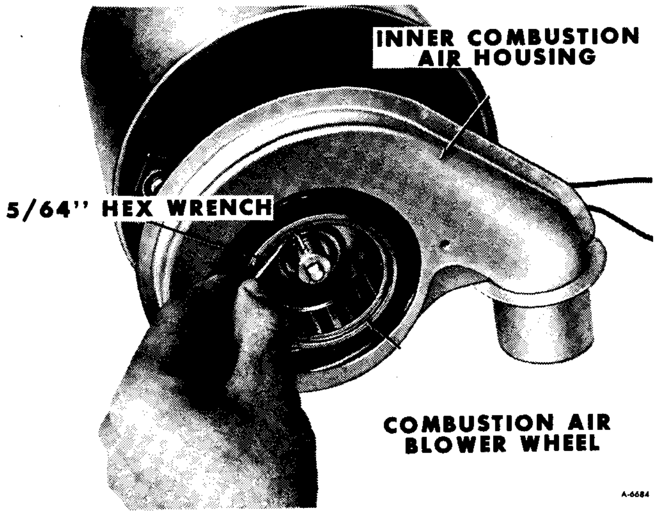


Figure 25—Removing Combustion Air Blower Wheel

attaching screws (figure 24). Remove housing and metal plate, located between inner and outer housing.

5. Using a 5/64" hex wrench, remove combustion air blower wheel (figure 25).
6. Remove two retaining nuts holding inner combustion air housing to blower motor (figure 26). Remove housing.
7. Loosen the recirculating air blower wheel retaining screw using a 1/8" hex wrench (figure 27).
8. Remove three blower motor retaining screws and washers (figure 28). Carefully remove blower motor from blower housing.

NOTE: When the blower motor has been removed from the blower housing, this will allow recirculating air blower wheel to be removed.

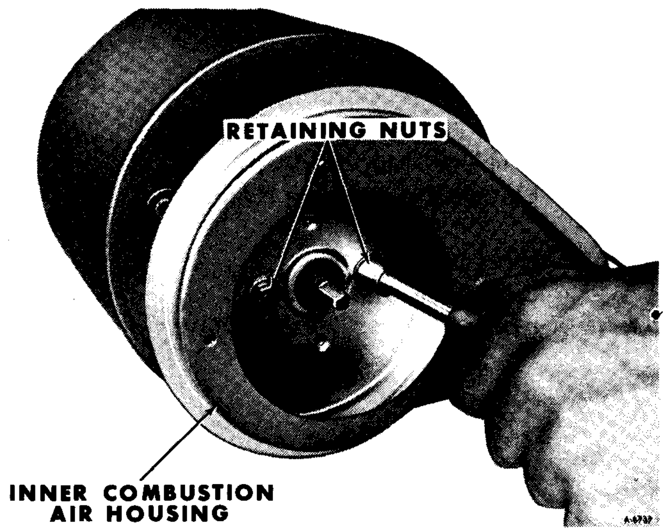


Figure 26—Removing Inner Combustion Air Housing

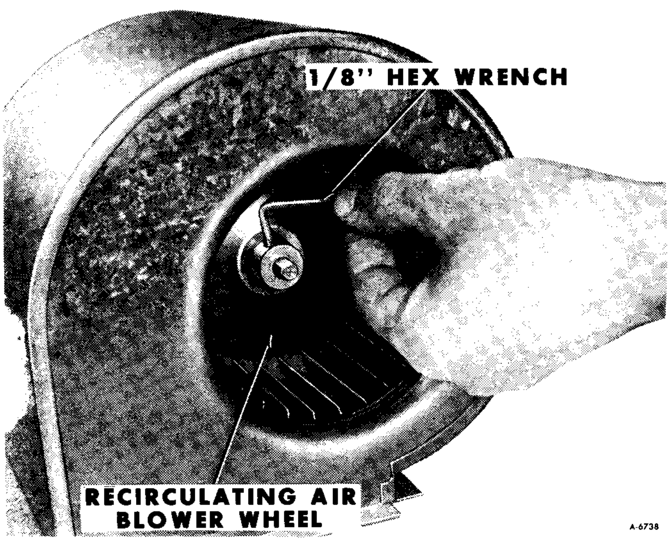


Figure 27—Loosening Recirculating Air Blower Wheel Retaining Screw

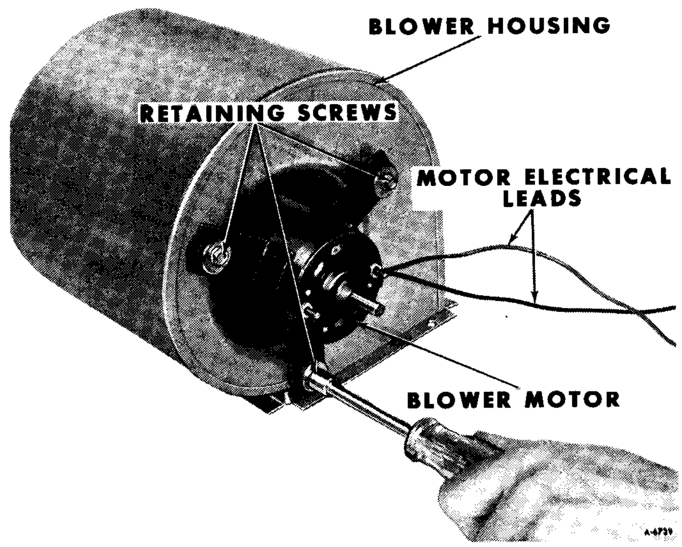


Figure 28—Removing Blower Motor Retaining Screws

INSTALLATION

1. Position the recirculating air blower wheel in blower housing.
2. Install blower motor to blower housing using three retaining screws. Before installing the retaining screws check to be sure the motor is positioned as shown in figure 28, with motor electrical leads facing blower housing mounting flange.
3. Install recirculating blower wheel retaining screw (figure 27). Before tightening retaining screw be sure blower wheel is clearing both sides of blower housing. Also, be sure retaining screw is tightened onto flat surface on the blower shaft.
4. Install the inner combustion air housing to the blower motor (figure 26). Be sure inner housing is aligned as shown in figure 24 with blower housing.
5. Install combustion air blower wheel (figure 25).
6. Position metal plate between inner and outer combustion air housings. Install outer combustion air housing (figure 24).
7. Install blower assembly to furnace with three mounting screws (figure 23). Connect blower electrical leads and flexible air duct.
8. Install sail switch as described earlier in this section under "Sail Switch Replacement."

SPECIFICATIONS

Duo-Therm Furnace	Model No.	65930-926
GM Part No.		2028332
Operating Voltage Range	Maximum	15 Volts DC
	Minimum	9 Volts DC
BTU Input		30,000
BTU Output		24,000
Furnace Fuse (Automotive Type)		15 Amp.

SECTION 24J
LIVING AREA WATER SYSTEM

The information described in Maintenance Manual X-7525 under the heading LIVING AREA WATER SYSTEM (Sec. 24J) is applicable to models covered by this supplement with the exception of the following:

GENERAL INFORMATION

The water system in model ZE06584 (illustrated in figure 1) functions basically the same as model ZE06581, with the exception of the component location and the addition of a new dry bath.

WATER SYSTEM SERVICING (ZE06584)

GALLEY SINK FAUCET

REMOVAL

1. Turn off water pump at water pump switch located beside entrance door. Open faucet to reduce line pressure.
2. Disconnect water lines from faucet.
3. Remove faucet retaining nut and special washer from underneath sink.
4. Remove faucet from sink.

REPAIR

The galley sink faucet can be repaired by procuring parts from a local plumbing supply distributor.

INSTALLATION

1. Position faucet assembly on sink.
2. Install special washer and faucet retaining nut from underneath sink.
3. Connect water lines to faucet.

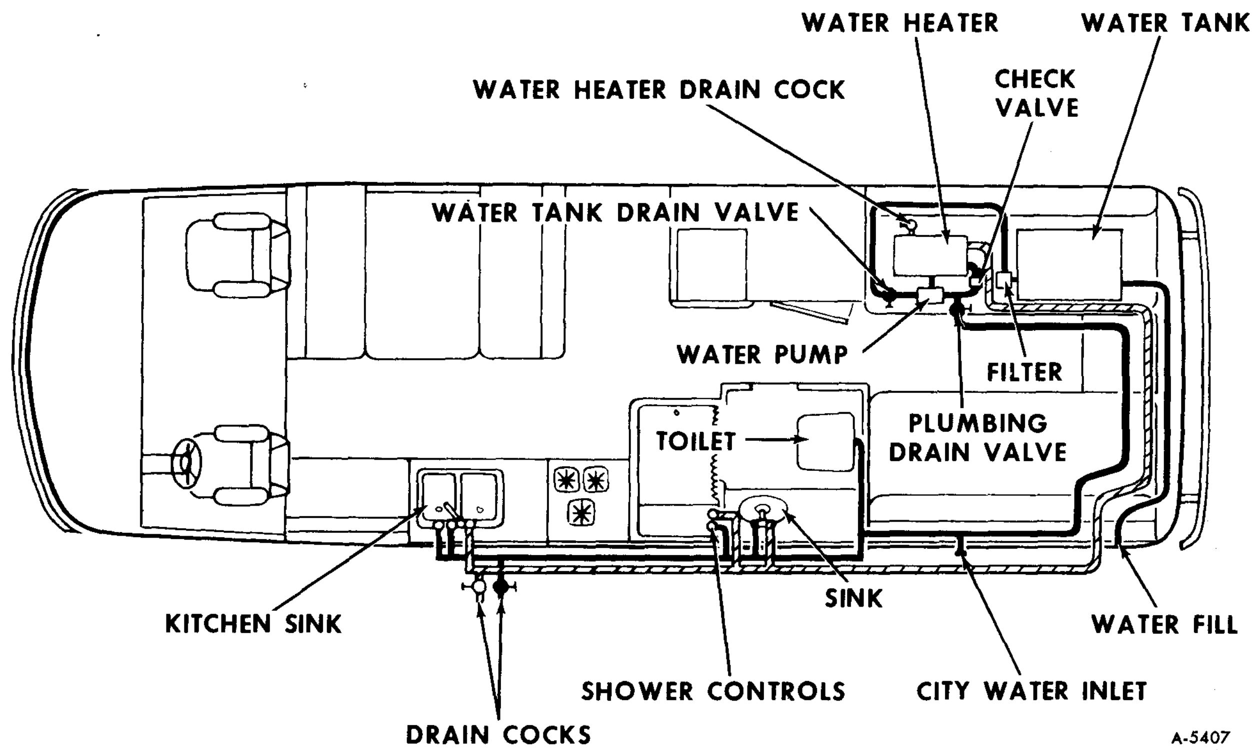


Figure 1—Living Area Water System (ZE06584)

4. Turn on water pump and operate faucet. Check for leaks.

NOTE: For a reverse water supply installation (cold water supply on the left and hot water on the right), it is only necessary to remove the faucet handle and rotate the cam 180°. Reinstall faucet handle and check for proper operation.

SHOWER FAUCET

REMOVAL

1. Turn off water pump at water pump switch located beside entrance door. Open faucet to reduce line pressure.
2. Remove screws retaining track of vanity compartment located underneath bathroom sink. Note that 12-volt living area fuse block is located in this compartment. Remove compartment only sufficiently to gain access to shower faucet.
3. Tag water lines (hot and cold) for installation. Disconnect water lines from back of faucet.
4. Remove elbows from backside of faucet.
5. Remove retaining nuts and washers that hold faucet to shower wall. Remove faucet.
6. Disconnect hose to shower head from faucet.

REPAIR

The shower faucet can be repaired by procuring parts from a local plumbing supply distributor.

INSTALLATION

1. Connect hose from shower head to faucet.
2. Position faucet on shower wall. Install washers and retaining nuts that hold faucet to shower wall.
3. Install two elbows to backside of faucet.
4. Connect water lines to elbows on back of faucet.
5. Turn on water pump and operate shower. Check for leaks.

BATHROOM SINK FAUCET

REMOVAL

1. Turn off water pump at water pump switch beside entrance door. Open faucet to reduce line pressure.
2. Remove doors from vanity compartment underneath bathroom sink.
3. Disconnect water lines from faucet.
4. Remove retaining nuts that hold faucet to sink. Remove faucet.

REPAIR

The bathroom sink faucet can be repaired by procuring parts from a local plumbing supply distributor.

INSTALLATION

1. Position faucet on sink. Install retaining nuts that hold faucet to sink.
2. Connect water lines to faucets.
3. Turn on water pump and operate faucet. Check for leaks.
4. Install doors in vanity compartment underneath sink.

WATER TANK

REMOVAL

1. Remove bolsters (back cushions), if so equipped, from right rear corner of vehicle.
2. Remove right twin bed to gain access to water compartment.
3. Turn off water pump at switch beside entrance door. Turn off water heater at switch located in bathroom.
4. Open tank drain valve and allow tank to drain (see figure 1).
5. Disconnect inlet, outlet, and vent hoses from tank.
6. Disconnect the tank hold down straps.

NOTE: Do not cut straps to remove tank.

7. Remove water tank.

INSTALLATION

1. Position tank in water compartment.
2. Connect tank hold down straps.
3. Install inlet, outlet, and vent hoses on water tank.
4. Close water tank drain valve (see figure 1).
5. Fill water tank and turn on water pump to pressurize the system. Check for leaks.
6. Install right twin bed over water compartment
7. Install bolsters (back cushions), if so equipped, in right rear corner of vehicle.

WATER PUMP

REMOVAL

1. Remove bolsters (back cushions), if so equipped, from right rear corner of vehicle.
2. Remove right twin bed to gain access to water compartment.

3. Turn off water pump at switch beside entrance door. Turn off water heater switch located in bathroom.
4. Open tank drain valve and plumbing drain valve (valves are located on either side of pump) (figure 1).
5. Disconnect 12-volt electrical supply to pump by removing pump fuse.

NOTE: Water pump fuse is located in fuse holder, just to the left of the water pump.

6. Disconnect electrical leads from water pump.
7. Disconnect inlet and outlet hose from pump.
8. Remove four water pump mounting bolts and remove pump.

INSTALLATION
1. Position pump in water tank compartment. Install four pump mounting bolts.
2. Connect inlet and outlet hoses at pump.
3. Connect electrical leads to water pump.
4. Connect electrical supply to water pump by installing pump fuse in fuse holder that is located just to the left of water pump.
5. Close the tank and plumbing drain valves.
6. Fill water tank and turn on water pump to pressurize the system. Check for leaks.
7. Install right twin bed over water compartment.
8. Install bolsters (back cushions), if so equipped, in right rear corner of vehicle.

WATER HEATER

REMOVAL
1. Remove bolsters (back cushions), if so equipped, from right rear corner of vehicle.
2. Remove right twin bed to gain access to water compartment.
3. Turn off water pump at switch beside entrance door. Turn off water heater switch located in bathroom. Be sure motor generator is turned off and external power cord is not connected to an external power source.
4. Open plumbing drain valve (figure 1) and water heater drain valve (located underneath the water heater).
5. Remove access panel on water heater Disconnect two electrical leads and ground wire from water heater. Remove electrical supply cord and conduit from water heater.
6. Remove hose from pressure temperature relief valve.
7. Disconnect inlet (cold) and outlet (hot) water hoses from water heater.

WARNING: IF WATER HEATER IS EQUIPPED WITH A PRE-HEAT ASSEMBLY BE SURE ENGINE HAS BEEN ALLOWED TO COOL ONE-HALF HOUR BEFORE ATTEMPTING TO REMOVE PRE-HEAT ASSEMBLY TO AVOID PERSONAL INJURY.

8. If water heater is equipped with pre-heat assembly, remove from water heater with pre-heat hoses remaining attached to unit.
9. Remove four water heater to floor mounting bolts and remove water heater.

INSTALLATION
1. Install water heater and secure to floor with four mounting bolts.
2. If water heater was equipped with pre-heat assembly, install unit in water heater with pre-heat hoses remaining attached.
3. Connect inlet (cold) and outlet (hot) water hoses to water heater.
4. Install hose to pressure temperature relief valve.
5. Install electrical supply cord and conduit to heater. Connect two electrical leads and ground wire to water heater.
6. Close plumbing drain valve (figure 1) and water heater drain valve (located underneath the water heater).
7. Turn on the water pump and open the hot water faucet in the bathroom, until water heater is filled (air no longer coming out of faucet). Check system for leaks.
8. Turn on water heater switch with 120-volt power supply connected to the Motorhome power cord. Check for proper water heater operation.
9. Shut off water heater and water pump switch.
10. Install right twin bed over water compartment.
11. Install bolsters (back cushions), if so equipped, in right rear corner of vehicle.

WATER HEATER CHECK VALVE

(Refer to Figure 1)

A check valve is installed in the cold water line (inlet) at the water heater to prevent hot water from entering the Motorhome's cold water system.

REMOVAL

1. Remove bolsters (back cushions), is so equipped, from right rear corner of vehicle.

2. Remove right twin bed to gain access to water compartment.

3. Turn off water pump at switch beside entrance door. Turn off water heater switch located in bathroom.

4. Open plumbing drain valve and water heater drain valve (located underneath the water heater).

5. Disconnect hoses from check valve and remove.

INSTALLATION

1. Connect hoses to check valve.

NOTE: Be sure arrow molded into body of check valve is pointing toward water heater.

2. Close plumbing drain valve and water heater drain valve (located underneath water heater).

3. Turn on water pump and open the hot water faucet in the bathroom, until water heater is filled (air no longer coming out of faucet). Check for leaks.

4. Install right twin bed over water compartment.

5. Install bolsters (back cushions), if so equipped, in right rear corner of vehicle.

DRAINING LIVING AREA WATER SYSTEM (ZEO6584)

1. Open the holding tank dump valve, after making proper connection to approved dumping station.

2. Turn off water heater at switch located in the bathroom.

3. Remove bolsters (back cushions), if so equipped, from right rear corner of vehicle.

4. Remove right twin bed to gain access to water compartment.

5. Open the water heater drain cock (located underneath the water heater). Open the tank drain valve and plumbing drain valve (valves are located on either side of water pump).

6. Open the water tank drain valve and plumbing drain valve (figure 1).

7. Open the two water line drain cocks at the kitchen sink. To gain access to water line drain cocks for the kitchen sink, remove the second drawer located to the left of the kitchen sink compartment.

8. Open the kitchen and bathroom faucets.

9. Turn the flush knob on top of the toilet 90° clockwise until water no longer enters the toilet bowl.

10. Open the shower head shut-off valve and open shower faucets, with shower head extended toward shower stall drain.

11. At the external water connection (inside external utilities compartment), remove hose connection cover. Depress momentarily the button on the check valve to allow this portion of plumbing to drain. Install hose connection cover.

12. Using low air pressure (30 psi maximum), blow back through all faucets, forcing water from any low areas. Allow system to drain.

13. Turn on water pump, momentarily, to remove any water remaining in pump housing, then shut off.

14. Close all water line drain cocks and valves, including the water heater drain cock. Close kitchen, bathroom, and shower faucets. Close holding tank dump valve and latch. Stow holding tank tubes and replace dust cap.

WATER TREATMENT UNIT

On vehicles equipped with the water treatment unit (formerly water purifier) (figure 2), the lower two cartridges are identified with two stickers ("A" and "B"). Servicing this unit is described by the following:

NOTE: Under normal family usage the cartridge assembly is designed to last for several years. Interval for replacement of either cartridge may be determined by restriction of water flow at treated faucet. The filter cartridges are designed to restrict water flow when replacement is required. Be sure the cartridge assembly (all three tanks) is removed from the vehicle when unheated, and temperatures fall below freezing. The cartridge assembly should then be stored in a heated facility.

WATER TREATMENT UNIT CARTRIDGE REPLACEMENT

(Refer to Figure 2)

NOTE: Replace the primary cartridge "A" (refer to sticker on cartridge for identification) when the flow rate diminishes. Cartridge "B" may also require replacement after an extended period of use. This replacement is to be made when the replacement of cartridge "A" fails to restore the flow rate of assembly to a satisfactory level.

1. Shut off water pump and close inlet valve to cartridge assembly.
2. Remove plastic tubing connectors at either end of old cartridge.
3. Remove old cartridge and discard.
4. Locate the new replacement cartridge in the same position as the one just removed with arrow on label pointing to the outlet end of unit.
5. Connect plastic tubing to the new cartridge making certain that the tubing coming from the inlet valve connects to the "INLET" fitting.

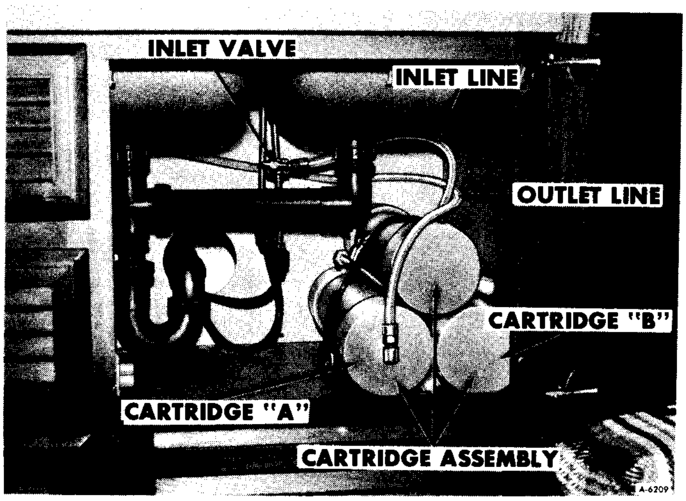


Figure 2—Water Treatment Unit Cartridge Location

6. Open the inlet valve, turn on water pump and then place water treatment faucet handle in the "UP" position water treatment faucet is located beside the galley sink faucet). Allow a full flow of water from faucet for about 15 minutes. Water treatment unit is now ready for normal usage.

SECTION 24K
TOILET

The information described in Maintenance Manual X-7525 under the heading TOILET (Sec. 24K) is applicable to models covered by this supplement with the addition of the following:

AQUA-MAGIC III

GENERAL INFORMATION

The Aqua-Magic III toilet (figure 1) is a fresh water, permanently installed flushing system. It uses a pressure flushing system. The fresh water flushing system cleans bowl with a minimum of water. No-splash bowl feature, maintains water seal even while vehicle is in motion.

TOILET TROUBLE DIAGNOSIS

Problem	Possible Cause	Correction
WATER KEEPS RUNNING INTO THE BOWL	1. Water trap in the bottom of the bowl not closing completely, which in turn keeps the ball valve partially open.	1. Remove foreign matter from water trap. Check to see that flush knob closes all the way (rotates through 90° rotation).
	2. If running water persists, and the knob works satisfactorily, faulty ball valve.	2. Replace ball valve.
TOILET LEAKS. THERE IS WATER ON THE FLOOR.	1. Leak at water supply connection.	1. If the leak is in the back of the toilet, check the water supply connection. Correct as necessary.
	2. Closet flange base seal.	2. If the leak is at the closet flange area, check the closet flange nuts for tightness. If leak continues, remove the toilet and check the closet flange height. The height should be 1/4" to 7/16" above the floor. Adjust closet flange height accordingly and replace closet flange seal.
POOR FLUSH	1. Flush knob not fully opened.	1. The knob must be held fully open during the flush. A good flush should occur within five seconds. If the problem persists, remove the water supply line and check the water supply. The flow rate should be at least eleven quarts per minute to ensure an adequate flush.

1. Cover
2. Hinge Pin Retainer
3. Hinge Pin
4. Flush Knob
5. Knob Retainer
6. Top
7. Knob Crank
8. Stein Retainer
9. O-ring
10. Screw
11. Ball Valve
12. Screw
13. Vacuum Breaker Cover
14. Float Seal
15. Float
16. Star Washer
17. Bowl
18. Spring Mounting Bracket
19. Push Link
20. Spring
21. Water Trap Crank
22. Screw
23. Washer
24. Seal
25. Water Trap
26. Base
27. Flange Seal
28. Nut
29. Bolt
30. Sealant
31. Water Trap Seal
32. Screw
33. Seal
34. Screw
35. Seat

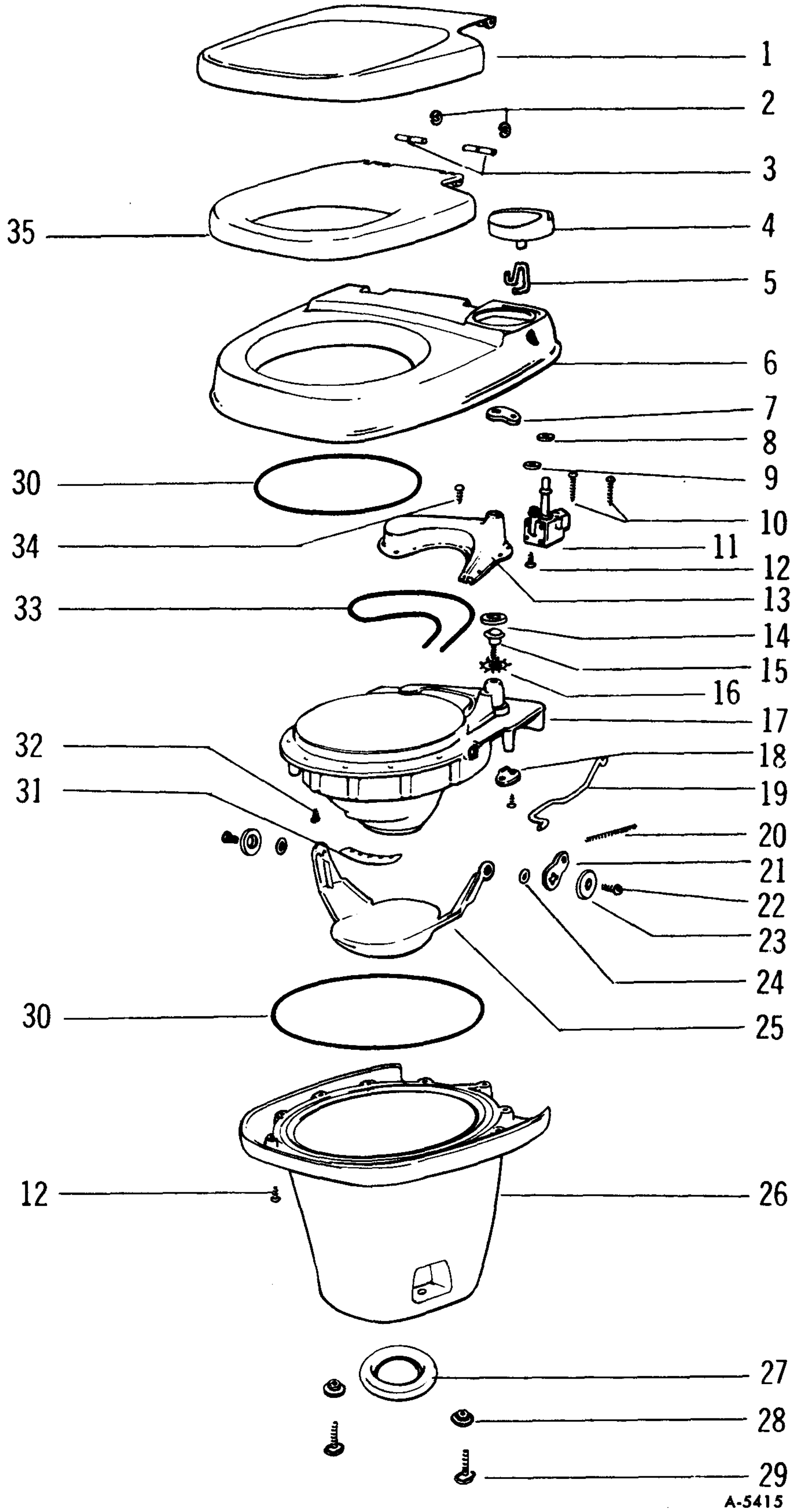


Figure 1—Aqua-Magic III Toilet

TOILET REPLACEMENT

REMOVAL

1. Turn off water pump at water pump switch located beside entrance door. Open cold water faucet in bathroom sink to reduce line pressure.
2. Disconnect toilet water fill line at right rear corner of toilet (below flush knob).
3. Flush toilet several times, if necessary, to remove water from water trap.
4. Remove two nuts located at base of toilet.
5. Lift toilet off mounting studs and remove from vehicle.
6. To avoid holding tank fumes entering vehicle place suitable air tight covering over toilet mounting flange.

INSTALLATION

1. Remove air tight covering (if used) from toilet mounting flange.
2. Install new flange seal.
3. Set toilet in place and install two mounting nuts located at base of toilet.
4. Connect toilet water fill line at right rear corner of toilet (below flush knob).
5. Turn on water pump and momentarily open cold water faucet to bleed out air in water line.
6. Flush toilet several times and check for leakage. Correct as necessary.

COMPONENT REPLACEMENT

(Refer to Figure 1)

BALL VALVE REPLACEMENT

1. Remove flush knob by pulling straight upward.
2. Remove 12 screws from underside of base. Remove base from bowl and lid assembly.
3. Remove 8 screws holding bowl to lid assembly. Carefully separate bowl from lid assembly, noting they are held together by a non-hardening type caulking material.
4. Remove 3 screws securing ball valve to bowl, and remove ball valve.
5. Install ball valve by reversing steps 1-4. Note the two long ball valve retaining screws are installed from the top, and the one short screw is installed from underneath.

VACUUM BREAKER COVER REPLACEMENT

1. Remove flush knob.
2. Remove 12 screws from underside of base. Remove base from bowl and lid assembly.
3. Remove 8 screws holding bowl to lid assembly. Carefully separate bowl from lid assembly, noting they are held together by a non-hardening type caulking material.
4. Remove 17 screws retaining vacuum breaker cover to bowl assembly.
5. Install vacuum breaker cover by reversing steps 1-4.

WATER TRAP REPLACEMENT

1. Remove flush knob.
2. Remove 12 screws from underside of base. Remove base from bowl and lid assembly.
3. Remove 8 screws holding bowl to lid assembly. Carefully separate bowl from lid assembly, noting they are held together by a non-hardening type caulking material.
4. Remove 2 screws holding water trap to bowl. Then disconnect push link from water trap. Remove water trap.
5. Install water trap by reversing steps 1-4.

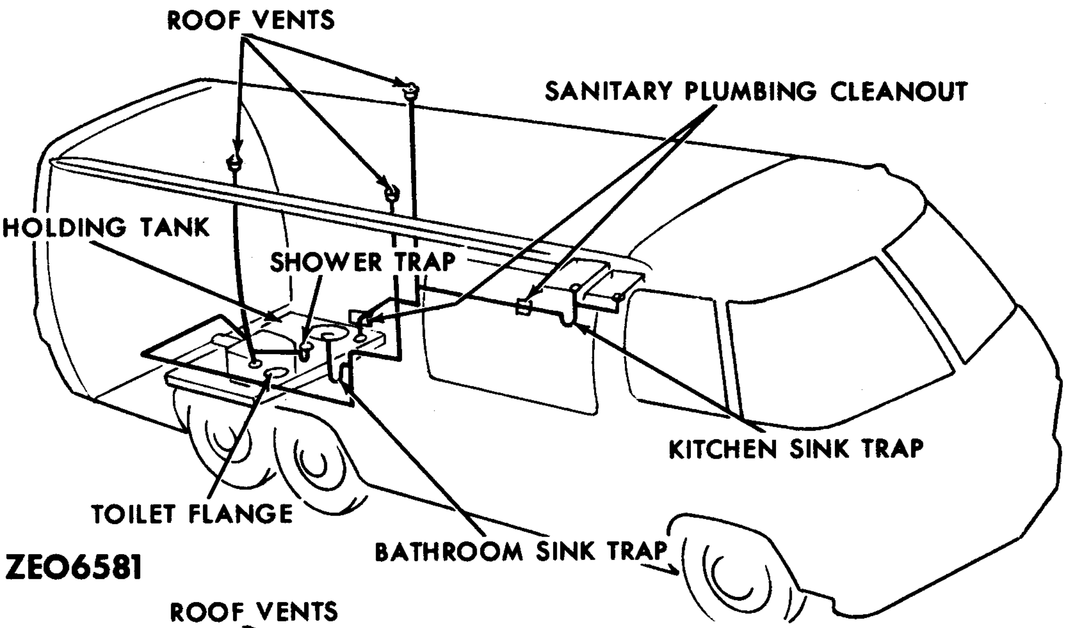
MAINTENANCE

No routine maintenance is required to clean the unit, use any high grade, non-abrasive cleaner. Do not use highly concentrated or high acid content household cleaners (no scouring powder).

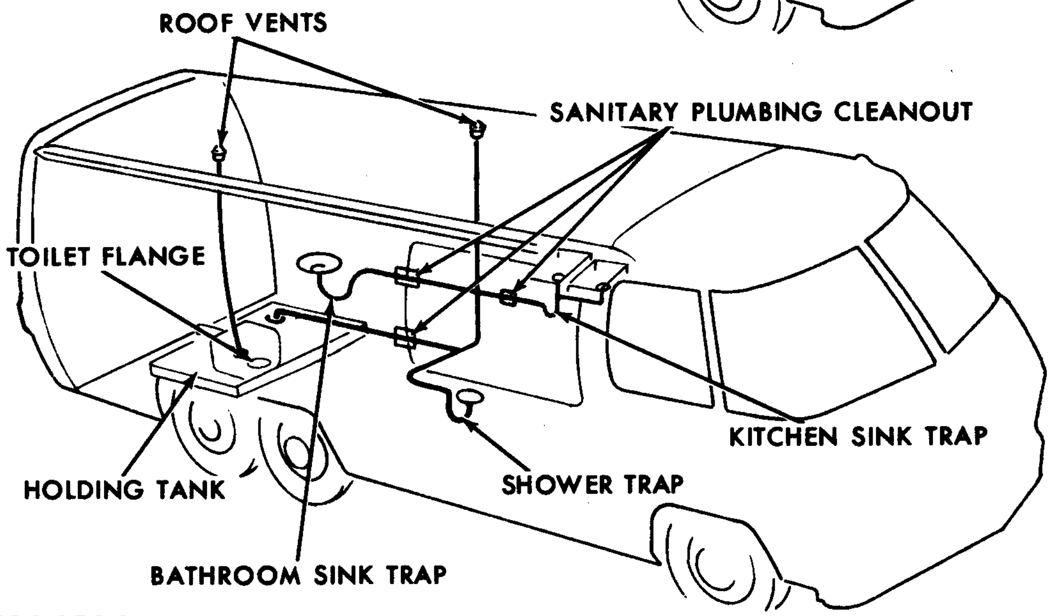
SECTION 24L

HOLDING TANK AND DRAINAGE SYSTEM

The information described in Maintenance Manual X-7525 under the heading HOLDING TANK AND DRAINAGE SYSTEM (Sec. 24L) is applicable to models covered by this supplement with the addition of the following illustration (figure 1).



ZEO6581



ZEO6584

A-7271

Figure 1—Drainage System (Models ZE0651 and ZE06584)

USE OF METRIC AND CUSTOMARY NUTS, BOLTS AND SCREWS

General Motors Engineering Standards have adopted a portion of the standard metric fastener sizes defined by SI (Systeme International). This was done to reduce the number of sizes used and yet retain the best strength characteristics in each thread size. For example, the customary 1/4—20 and 1/4—28 screws are replaced by the metric M6.3 x 1 screw which has nearly the same diameter and 25.4 threads per inch. The thread pitch is in between the customary coarse and fine thread pitches.

Metric and customary thread notation differ slightly. The difference is illustrated below:

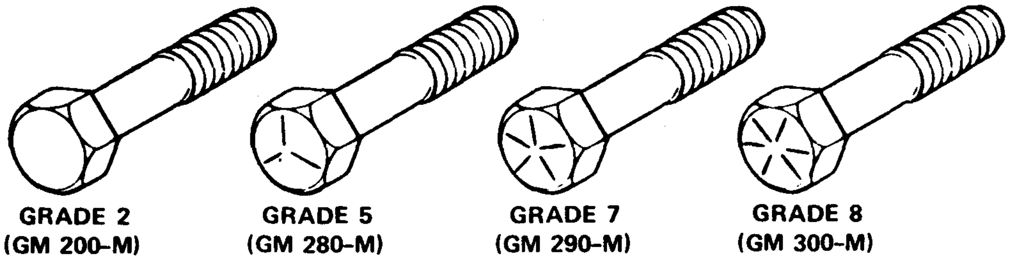
CUSTOMARY	METRIC
1/4	M6.3
Thread Major Diameter in Inches	Thread Major Diameter in Millimetres
20	1
Number of Threads per Inch	Distance Between Threads in Millimetres

Care should be taken when servicing to guard against cross threading or improper retention due to interchanged metric and inch nuts and bolts.

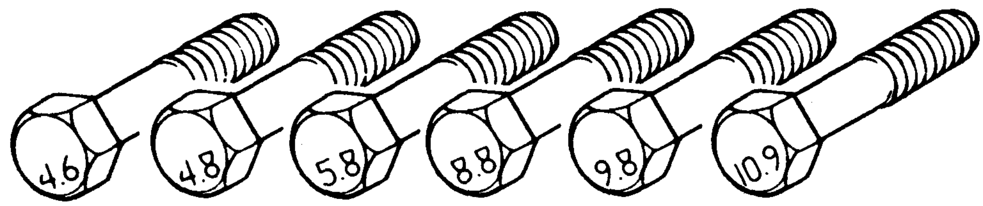
When obtaining metric or customary nuts, bolts, and screws locally for servicing care must be exercised in selecting parts that are equivalent to the original parts in dimensions, strength, and pitch of threads.

METRIC BOLT AND NUT IDENTIFICATION

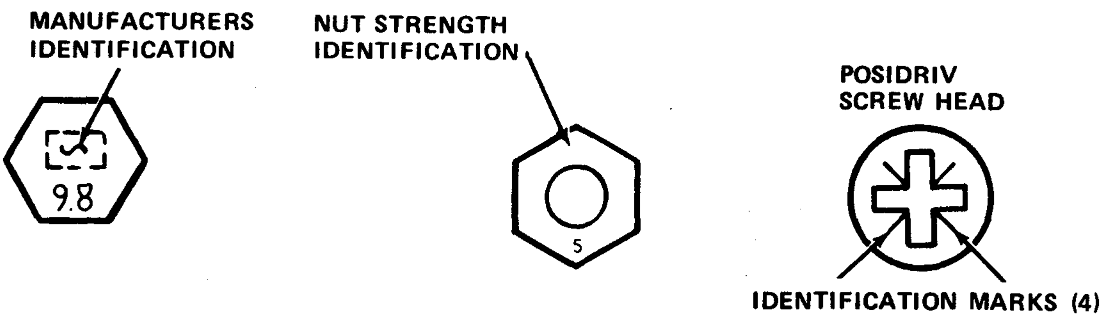
Common metric fastener strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grade 2 to 8 with line identification embossed on each bolt head. Markings correspond to two lines less than the actual grade (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.

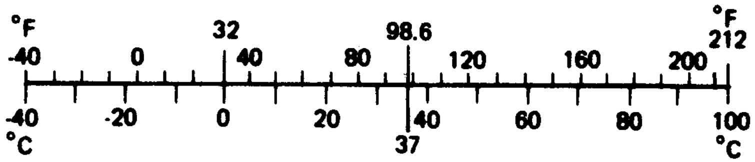


Metric Bolts - Identification class numbers correspond to bolt strength - Increasing numbers represent increasing strength.



SI METRIC-CUSTOMARY CONVERSION TABLE

Multiply	by	to get equivalent number of:
	LENGTH	
Inch	25.4	millimetres (mm)
Foot	0.304 8	metres (m)
Yard	0.914 4	metres
Mile	1.609	kilometres (km)
	AREA	
$Inch^2$	645.2	$millimetres^2$ (mm^2)
	6.45	$centimetres^2$ (cm^2)
$Foot^2$	0.092 9	$metres^2$ (m^2)
$Yard^2$	0.836 1	$metres^2$
	VOLUME	
$Inch^3$	16 387.	mm^3
	16.387	cm^3
	0.016 4	litres (l)
Quart	0.946 4	litres
Gallon	3.785 4	litres
$Yard^3$	0.764 6	$metres^3$ (m^3)
	MASS	
Pound	0.453 6	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
	FORCE	
Kilogram	9.807	newtons (N)
Ounce	0.278 0	newtons
Pound	4.448	newtons
	TEMPERATURE	
Degree Fahrenheit	(°F-32) ÷ 1.8	degree Celsius (C)



Multiply	by	to get equivalent number of:
	ACCELERATION	
$Foot/sec^2$	0.304 8	$metre/sec^2$ (m/s^2)
$Inch/sec^2$	0.025 4	$metre/sec^2$
	TORQUE	
Pound-inch	0.112 98	newton-metres (N-m)
Pound-foot	1.355 8	newton-metres
	POWER	
Horsepower	0.746	kilowatts (kW)
	PRESSURE OR STRESS	
Inches of mercury	3.377	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
	ENERGY OR WORK	
BTU	1 055.	joules (J)
Foot-pound	1.355 8	joules
Kilowatt-hour	3 600 000. or 3.6×10^6	joules (J = one W's)
	LIGHT	
Foot candle	10.764	$lumens/metre^2$ (lm/m^2)
	FUEL PERFORMANCE	
Miles/gal	0.425 1	kilometres/litre (km/l)
Gal/mile	2.352 7	litres/kilometre (l/km)
	VELOCITY	
Miles/hour	1.609 3	kilometres/hr. (km/h)

HOW TO USE CONVERSION CHARTS

Left Column is units of 10, (0, 10, 20, 30 etc.);
Top Row is in units of one (0, 1, 2, 3, etc).

EXAMPLE: Feet to Inches Conversion Chart

feet	0	1	2	3	4	5	6	7	8	9	feet
	inches	inches	inches	inches	inches	inches	inches	inches	inches	inches	
--		12	24	36	48	60	72	84	96	108	--
10	120	132	144	156	168	180	192	204	216	228	10
20	240	252	264	276	288	300	312	324	336	348	20
30	360	372	384	396	408	420	432	444	456	468	30
40	480	492	504	516	528	540	552	564	576	588	40
50	600	612	624	636	648	660	672	684	696	708	50

12 feet equals 144 inches. Read across from 10 and down from 2.
6 feet equals 72 inches. Read down from 6.

FEET TO METRES

ft	0	1	2	3	4	5	6	7	8	9	ft
	m	m	m	m	m	m	m	m	m	m	
--		0.305	0.610	0.914	1.219	1.524	1.829	2.134	2.438	2.743	--
10	3.048	3.353	3.658	3.962	4.267	4.572	4.877	5.182	5.486	5.791	10
20	6.096	6.401	6.706	7.010	7.315	7.620	7.925	8.230	8.534	8.839	20
30	9.144	9.449	9.754	10.058	10.363	10.668	10.973	11.278	11.582	11.887	30
40	12.192	12.497	12.802	13.106	13.411	13.716	14.021	14.326	14.630	14.935	40
50	15.240	15.545	15.850	16.154	16.459	16.764	17.069	17.374	17.678	17,983	50
60	18.288	18.593	18.898	19.202	19.507	19.812	20.117	20.422	20.726	21.031	60
70	21.336	21.641	21.946	22.250	22.555	22.860	23.165	23.470	23.774	24.079	70
80	24.384	24.689	24.994	25.298	25.603	25.908	26.213	26.518	26.822	27.127	80
90	27.432	27.737	28.042	28.346	28.651	28.956	29.261	29.566	29.870	30.175	90
100	30.480	30.785	31.090	31.394	31.699	32.004	32.309	32.614	32.918	33.223	100

METRES TO FEET

m	0	1	2	3	4	5	6	7	8	9	m
	ft	ft	ft	ft	ft	ft	ft	ft	ft	ft	
--		3.2808	6.5617	9.8425	13.1234	16.4042	19.6850	22.9659	26.2467	29.5276	--
10	32.8084	36.0892	39.3701	42.6509	45.9318	49.2126	52.4934	55.7743	59.0551	62.3360	10
20	65.6168	68.8976	72.1785	75.4593	78.7402	82.0210	85.3018	88.5827	91.8635	95.1444	20
30	98.4252	101.7060	104.9869	108.2677	111.5486	114.8294	118.1102	121.3911	124.6719	127.9528	30
40	131.2336	134.5144	137.7953	141.0761	144.3570	147.6378	150.9186	154.1995	157.4803	160.7612	40
50	164.0420	167.3228	170.6037	173.8845	177.1654	180.4462	183.7270	187.0079	190.2887	193.5696	50
60	196.8504	200.1312	203.4121	206.6929	209.9738	213.2546	216.5354	219.8163	223.0971	226.3780	60
70	229.6588	232.9396	236.2205	239.5013	242.7822	246.0630	249.3438	252.6247	255.9055	259.1864	70
80	262.4672	265.7480	269.0289	272.3097	275.5906	278.8714	282.1522	285.4331	288.7139	291.9948	80
90	295.2756	298.5564	301.8373	305.1181	308.3990	311.6798	314.9606	318.2415	321.5223	324.8032	90
100	328.0840	331.3648	334.6457	337.9265	341.2074	344.4882	347.7690	351.0499	354.3307	357.6116	100

MILES TO KILOMETRES

mile	0	1	2	3	4	5	6	7	8	9	mile
	km	km	km	km	km	km	km	km	km	km	
--		1.609	3.219	4.828	6.437	8.047	9.656	11.265	12.875	14.484	--
10	16.093	17.703	19.312	20.921	22.531	24.140	25.750	27.359	28.968	30.578	10
20	32.187	33.796	35.406	37.015	38.624	40.234	41.843	43.452	45.062	46.671	20
30	48.280	49.890	51.499	53.108	54.718	56.327	57.936	59.546	61.155	62.764	30
40	64.374	65.983	67.593	69.202	70.811	72.421	74.030	75.639	77.249	78.858	40
50	80.467	82.077	83.686	85.295	86.905	88.514	90.123	91.733	93.342	94.951	50
60	96.561	98.170	99.779	101.39	103.00	104.61	106.22	107.83	109.44	111.04	60
70	112.65	114.26	115.87	117.48	119.09	120.70	122.31	123.92	125.53	127.14	70
80	128.75	130.36	131.97	133.58	135.19	136.79	138.40	140.01	141.62	143.23	80
90	144.84	146.45	148.06	149.67	151.28	152.89	154.50	156.11	157.72	159.33	90
100	160.93	162.54	164.15	165.76	167.37	168.98	170.59	172.20	173.81	175.42	100

KILOMETRES TO MILES

km	0	1	2	3	4	5	6	7	8	9	km
	mil	mil	mil	mil	mil	mil	mil	mil	mil	mil	
--		0.621	1.243	1.864	2.486	3.107	3.728	4.350	4.971	5.592	--
10	6.214	6.835	7.457	8.078	8.699	9.321	9.942	10.562	11.185	11.805	10
20	12.427	13.049	13.670	14.292	14.913	15.534	16.156	16.776	17.399	18.019	20
30	18.641	19.263	19.884	20.506	21.127	21.748	22.370	22.990	23.613	24.233	30
40	24.855	25.477	26.098	26.720	27.341	27.962	28.584	29.204	29.827	30.447	40
50	31.069	31.690	32.311	32.933	33.554	34.175	34.797	35.417	36.040	36.660	50
60	37.282	37.904	38.525	39.147	39.768	40.389	41.011	41.631	42.254	42.874	60
70	43.497	44.118	44.739	45.361	45.982	46.603	47.225	47.845	48.468	49.088	70
80	49.711	50.332	50.953	51.575	52.196	52.817	53.439	54.059	54.682	55.302	80
90	55.924	56.545	57.166	57.788	58.409	59.030	59.652	60.272	60.895	61.515	90
100	62.138	62.759	63.380	64.002	64.623	65.244	65.866	66.486	67.109	67.729	100

GALLONS (U.S.) TO LITRES

U.S. gal	0	1	2	3	4	5	6	7	8	9	U.S. gal
	L	L	L	L	L	L	L	L	L	L	
--		3.7854	7.5709	11.3563	15.1417	18.9271	22.7126	26.4980	30.2834	34.0638	--
10	37.8543	41.6397	45.4251	49.2105	52.9960	56.7814	60.5668	64.3523	68.1377	71.9231	10
20	75.7085	79.4940	83.2794	87.0648	90.8502	94.6357	98.4211	102.2065	105.9920	109.7774	20
30	113.5528	117.3482	121.1337	124.9191	128.7045	132.4899	136.2754	140.0608	143.8462	147.6316	30
40	151.4171	155.2025	158.9879	162.7734	166.5588	170.3442	174.1296	177.9151	181.7005	185.4859	40
50	189.2713	193.0568	196.8422	200.6276	204.4131	208.1985	211.9839	215.7693	219.5548	223.3402	50
60	227.1256	230.9110	234.6965	238.4819	242.2673	246.0527	249.8382	253.6236	257.4090	261.1945	60
70	264.9799	268.7653	272.5507	276.3362	280.1216	283.9070	287.6924	291.4779	295.2633	299.0487	70
80	302.8342	306.6196	310.4050	314.1904	317.9759	321.7613	325.5467	329.3321	333.1176	336.9030	80
90	340.6884	344.4738	348.2593	352.0447	355.8301	359.6156	363.4010	367.1864	370.9718	374.7573	90
100	378.5427	382.3281	386.1135	389.8990	393.6844	397.4698	401.2553	405.0407	408.8261	412.6115	100

LITRES TO GALLONS (U.S.)

L	0	1	2	3	4	5	6	7	8	9	L
	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
--		0.2642	0.5283	0.7925	1.0567	1.3209	1.5850	1.8492	2.1134	2.3775	--
10	2.6417	2.9059	3.1701	3.4342	3.6984	3.9626	4.2267	4.4909	4.7551	5.0192	10
20	5.2834	5.5476	5.8118	6.0759	6.3401	6.6043	6.8684	7.1326	7.3968	7.6610	20
30	7.9251	8.1893	8.4535	8.7176	8.9818	9.2460	9.5102	9.7743	10.0385	10.3027	30
40	10.5668	10.8310	11.0952	11.3594	11.6235	11.8877	12.1519	12.4160	12.6802	12.9444	40
50	13.2086	13.4727	13.7369	14.0011	14.2652	14.5294	14.7936	15.0577	15.3219	15.5861	50
60	15.8503	16.1144	16.3786	16.6428	16.9069	17.1711	17.4353	17.6995	17.9636	18.2278	60
70	18.4920	18.7561	19.0203	19.2845	19.5487	19.8128	20.0770	20.3412	20.6053	20.8695	70
80	21.1337	21.3979	21.6620	21.9262	22.1904	22.4545	22.7187	22.9829	23.2470	23.5112	80
90	23.7754	24.0396	24.3037	24.5679	24.8321	25.0962	25.3604	25.6246	25.8888	26.1529	90
100	26.4171	26.6813	26.9454	27.2096	27.4738	27.7380	28.0021	28.2663	28.5305	28.7946	100

GALLONS (IMP.) TO LITRES

IMP gal	0	1	2	3	4	5	6	7	8	9	IMP gal
	L	L	L	L	L	L	L	L	L	L	
--		4.5460	9.0919	13.6379	18.1838	22.7298	27.2758	31.8217	36.3677	40.9136	--
10	45.4596	50.0056	54.5515	59.0975	63.6434	68.1894	72.2354	77.2813	81.8275	86.3732	10
20	90.9192	95.4652	100.0111	104.5571	109.1030	113.6490	118.1950	122.7409	127.2869	131.8328	20
30	136.3788	140.9248	145.4707	150.0167	154.5626	159.1086	163.6546	168.0005	172.7465	177.2924	30
40	181.8384	186.3844	190.9303	195.4763	200.0222	204.5682	209.1142	213.6601	218.2061	222.7520	40
50	227.2980	231.8440	236.3899	240.9359	245.4818	250.0278	254.5738	259.1197	263.6657	268.2116	50
60	272.7576	277.3036	281.8495	286.3955	290.9414	295.4874	300.0334	304.5793	309.1253	313.6712	60
70	318.2172	322.7632	327.3091	331.8551	336.4010	340.9470	345.4930	350.0389	354.5849	359.1308	70
80	363.6768	368.2223	372.7687	377.3147	381.8606	386.4066	390.9526	395.4985	400.0445	404.5904	80
90	409.1364	413.6824	418.2283	422.7743	427.3202	431.8662	436.4122	440.9581	445.9041	450.0500	90
100	454.5960	459.1420	463.6879	468.2339	472.7798	477.3258	481.8718	486.4177	490.9637	495.5096	100

LITRES TO GALLONS (IMP.)

L	0	1	2	3	4	5	6	7	8	9	L
	gal	gal	gal	gal	gal	gal	gal	gal	gal	gal	
--		0.2200	0.4400	0.6599	0.8799	1.0999	1.3199	1.5398	1.7598	1.9798	--
10	2.1998	2.4197	2.6397	2.8597	3.0797	3.2996	3.5196	3.7396	3.9596	4.1795	10
20	4.3995	4.6195	4.8395	5.0594	5.2794	5.4994	5.7194	5.9394	6.1593	6.3793	20
30	6.5593	6.8193	7.0392	7.2592	7.4792	7.6992	7.9191	8.1391	8.3591	8.5791	30
40	8.7990	9.0190	9.2390	9.4590	9.6789	9.8989	10.9189	10.3389	10.5588	10.7788	40
50	10.9988	11.2188	11.4388	11.6587	11.8787	12.0987	12.3187	12.5386	12.7586	12.9786	50
60	13.1986	13.4185	13.6385	13.8585	14.0785	14.2984	14.5184	14.7384	14.9584	15.1783	60
70	15.3983	15.6183	15.8383	16.0582	16.2782	16.4982	16.7182	16.9382	17.1581	17.3781	70
80	17.5981	17.8181	18.0380	18.2580	18.4780	18.6980	18.9179	19.1379	19.3579	19.5779	80
90	19.7978	20.0178	20.2378	20.4578	20.6777	20.8977	21.1177	21.3377	21.5576	21.7776	90
100	21.9976	22.2176	22.4376	22.6575	22.8775	23.0975	23.3175	23.5374	23.7574	23.9774	100

POUNDS TO KILOGRAMS

lb	0	1	2	3	4	5	6	7	8	9	lb
	kg	kg	kg	kg	kg	kg	kg	kg	kg	kg	
--		0.454	0.907	1.361	1.814	2.268	2.722	3.175	3.629	4.082	--
10	4.536	4.990	5.443	5.897	6.350	6.804	7.257	7.711	8.165	8.618	10
20	9.072	9.525	9.979	10.433	10.886	11.340	11.793	12.247	12.701	13.154	20
30	13.608	14.061	14.515	14.969	15.422	15.876	16.329	16.783	17.237	17.690	30
40	18.144	18.597	19.051	19.504	19.958	20.412	20.865	21.319	21.772	22.226	40
50	22.680	23.133	23.587	24.040	24.494	24.948	25.401	25.855	26.308	26.762	50
60	27.216	27.669	28.123	28.576	29.030	29.484	29.937	30.391	30.844	31.298	60
70	31.751	32.205	32.659	33.112	33.566	34.019	34.473	34.927	35.380	35.834	70
80	36.287	36.741	37.195	37.648	38.102	38.555	39.009	39.463	39.916	40.370	80
90	40.823	41.277	41.730	42.184	42.638	43.092	43.545	43.998	44.453	44.906	90
100	45.359	45.813	46.266	46.720	47.174	47.627	48.081	48.534	48.988	49.442	100

KILOGRAMS TO POUNDS

kg	0	1	2	3	4	5	6	7	8	9	kg
	lb	lb	lb	lb	lb	lb	lb	lb	lb	lb	
--		2.205	4.409	6.614	8.818	11.023	13.228	15.432	17.637	19.842	--
10	22.046	24.251	26.455	28.660	30.865	33.069	35.274	37.479	39.683	41.888	10
20	44.092	46.297	48.502	50.706	52.911	55.116	57.320	59.525	61.729	63.934	20
30	66.139	68.343	70.548	72.752	74.957	77.162	79.366	81.571	83.776	85.980	30
40	88.185	90.389	92.594	94.799	97.003	99.208	101.41	103.62	105.82	108.03	40
50	110.23	112.44	114.64	116.84	119.05	121.25	123.46	125.66	127.87	130.07	50
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12	60
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17	70
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21	80
90	198.42	200.62	202.83	205.03	207.23	209.44	211.64	213.85	216.05	218.26	90
100	220.46	222.67	224.87	227.08	229.28	231.49	233.69	235.89	238.10	240.30	100

POUNDS PER SQUARE INCHES TO KILOPASCALS

lb/in^2	0	1	2	3	4	5	6	7	8	9	lb/in^2
	kPa	kPa	kPa	kPa	kPa	kPa	kPa	kPa	kPa	kPa	
--	0.0000	6.8948	13.7895	20.6843	27.5790	34.4738	41.3685	48.2663	55.1581	62.0528	--
10	68.9476	75.8423	82.7371	89.6318	96.5266	103.4214	110.3161	117.2109	124.1056	131.0004	10
20	137.8951	144.7899	151.6847	158.5794	165.4742	172.3689	179.2637	186.1584	193.0532	199.9480	20
30	206.8427	213.7375	220.6322	227.5270	234.4217	241.3165	248.2113	255.1060	262.0008	268.8955	30
40	275.7903	282.6850	289.5798	296.4746	303.3693	310.2641	317.1588	324.0536	330.9483	337.8431	40
50	344.7379	351.6326	358.5274	365.4221	372.3169	379.2116	386.1064	393.0012	399.8959	406.7907	50
60	412.6854	420.5802	427.4749	434.3697	441.2645	448.1592	455.0540	461.9487	468.8435	475.7382	60
70	482.6330	489.5278	496.4225	503.3173	510.2120	517.1068	524.0015	530.8963	537.7911	544.6858	70
80	551.5806	558.4753	565.3701	572.2648	579.1596	586.0544	592.9491	599.8439	606.7386	613.6334	80
90	620.5281	627.4229	634.3177	641.2124	648.1072	655.0019	661.8967	668.7914	675.6862	682.5810	90
100	689.4757	696.3705	703.2653	710.1601	717.0549	723.9497	730.8445	737.7393	744.6341	751.5289	100

KILOPASCALS TO POUNDS PER SQUARE INCHES

kPa	0	1	2	3	4	5	6	7	8	9	kPa
	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	lb/in^2	
--		.1450	.2901	.4351	.5801	.7252	.8702	1.0153	1.1603	1.3053	--
10	1.4504	1.5954	1.7404	1.8855	2.0305	2.1556	2.3206	2.4656	2.6107	2.7557	10
20	2.9007	3.0458	3.1908	3.3359	3.4809	3.6259	3.7710	3.9160	4.0610	4.2061	20
30	4.3511	4.4961	4.6412	4.7862	4.9313	5.0763	5.2213	5.3664	5.5114	5.6564	30
40	5.8015	5.9465	6.0916	6.2366	6.3816	6.5267	6.6717	6.8167	6.9618	7.1068	40
50	7.2518	7.3969	7.5419	7.6870	7.8320	7.9770	8.1221	8.2671	8.4121	8.5572	50
60	8.7022	8.8473	8.9923	9.1373	9.1824	9.4274	9.5724	9.7175	9.8625	10.0076	60
70	10.1526	10.2976	10.4427	10.5877	10.7327	10.8778	11.0228	11.1678	11.3129	11.4579	70
80	11.6030	11.7480	11.8930	12.0381	12.1831	12.3281	12.4732	12.6182	12.7633	12.9083	80
90	13.0533	13.1984	13.3434	13.4884	13.6335	13.7785	13.9236	14.0686	14.2136	14.3587	90
100	14.5037	14.6487	14.7938	14.9388	15.0838	15.2289	15.3739	15.5190	15.6640	15.8090	100

POUND FEET TO NEWTON-METRES

ft-lb	0	1	2	3	4	5	6	7	8	9	ft-lb
	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	N·m	
--		1.3558	2.7116	4.0675	5.4233	6.7791	8.1349	9.4907	10.8465	12.2024	--
10	13.5582	14.9140	16.2698	17.6256	18.9815	20.3373	21.6931	23.0489	24.4047	25.7605	10
20	27.1164	28.4722	29.8280	31.1838	32.5396	33.8954	35.2513	36.6071	37.9629	39.3187	20
30	40.6745	42.0304	43.3862	44.7420	46.0978	47.4536	48.8094	50.1653	51.5211	52.8769	30
40	54.2327	55.5885	56.9444	58.3002	59.6560	61.0118	62.3676	63.7234	65.0793	66.4351	40
50	67.7909	69.1467	70.5025	71.8584	73.2142	74.5700	75.9258	77.2816	78.6374	79.9933	50
60	81.3491	82.7049	84.0607	85.4165	86.7724	88.1282	89.4840	90.3898	92.1956	93.5514	60
70	94.9073	96.2631	97.6189	98.9747	100.3305	101.6863	103.0422	104.3980	105.7538	107.1096	70
80	108.4654	109.8213	111.1771	112.5329	113.8887	115.2445	116.6003	117.9562	119.3120	120.6678	80
90	122.0236	123.3794	124.7353	126.0911	127.4469	128.8027	130.1585	131.5143	132.8702	134.2260	90
100	135.5818	136.9376	138.2934	139.6493	141.0051	142.3609	143.7167	145.0725	146.4283	147.7842	100

NEWTON-METRES TO POUND FEET

N·m	0	1	2	3	4	5	6	7	8	9	N·m
	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	ft-lb	
--		.7376	1.4751	2.2127	2.9502	3.6878	4.4254	5.1692	5.9005	6.6381	--
10	7.3756	8.1132	8.8507	9.5883	10.3258	11.0634	11.8010	12.5385	13.2761	14.0136	10
20	14.7512	15.4888	16.2264	16.9639	17.7015	18.4390	19.1766	19.9142	20.6517	21.3893	20
30	22.1269	22.8644	23.6020	24.3395	25.0771	25.8147	26.5522	27.2898	28.0274	28.7649	30
40	29.5025	30.2400	30.9776	31.7152	32.4527	33.1903	33.9279	34.6654	35.4030	36.1405	40
50	36.8781	37.6157	38.3532	39.0908	39.8283	40.5659	41.3035	42.0410	42.7786	43.5162	50
60	44.2537	44.9913	45.7288	46.4664	47.2040	47.9415	48.6791	49.4167	50.1542	50.8918	60
70	51.6293	52.3669	53.1045	53.8420	54.5796	55.3171	56.0547	56.7923	57.5298	58.2674	70
80	59.0050	59.7425	60.4801	61.2176	61.9552	62.6928	63.4303	64.1679	64.9055	65.6430	80
90	66.3806	67.1181	67.8557	68.5933	69.3308	70.0684	70.8060	71.5435	72.2811	73.0186	90
100	73.7562	74.4938	75.2313	75.9689	76.7064	77.4440	78.1816	78.9191	79.6567	80.3943	100

DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In.	Metric MM.	Fractions	Decimal In.	Metric MM.
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.1750	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

INDEX

Wiring Diagrams

Living Area

1977 /1978 12v DC (ZEO6581)

1977 / 1978 120v AC (ZEO6581)

1977 120v AC (ZEO6584)

Chassis

1977 / 1978 with Electro Level I (Models ZEO6581, ZEO6584)

1977 / 1978 Transmode with Electro Level I
(Models ZEO6083, ZEO6583)

1978 with Electro Level II (Model ZEO6581)

1978 Transmode with Electro Level II (Models ZEO6083, ZEO6583)

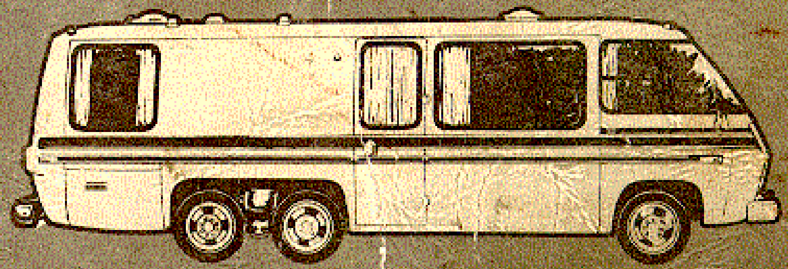
X-7725

GMC

1977 & 1978 MAINTENANCE MANUAL SUPPLEMENT

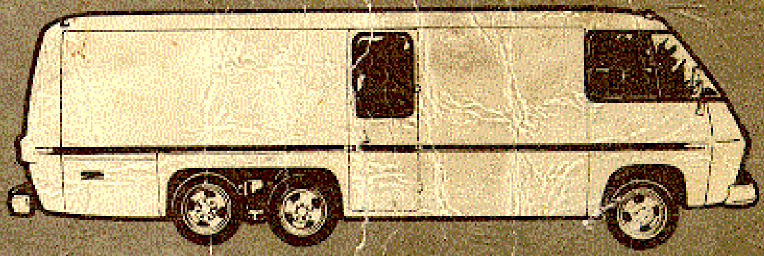
Motorhome

ZE06581
ZE06584



TransMode

ZE06083
ZE06583



GMC TRUCK & COACH

Division of General Motors Corporation

FOREWARD

Information in this Supplement when used in conjunction with the 1975 & 1976 Maintenance Manual (Form No. X-7525) provides coverage for 1977 and 1978 GMC Motorhomes andTransModes.

References are made to special tools in the various sections of this supplement. These tools or their equivalent, are necessary and are recommended to readily and efficiently accomplish certain service operations. The tools, however, are not supplied by General Motors Corporation. Information regarding the availability of these tools can be obtained from the Zone Office or from the Service Department at the factory.

All information, illustrations and specifications contained in this supplement are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

GMC

GMC TRUCK & COACH

DIVISION OF GENERAL MOTORS CORPORATION

PONTIAC, MICHIGAN 48053

IMPORTANT SAFETY NOTICE

Proper service and repair is important to the safe, reliable operation of all motor vehicles. The service procedures recommended by GMC Truck & Coach and described in this manual are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended.

It is important to note that this manual contains various Warnings and Cautions which should be carefully read in order to minimize risk of personal injury to service personnel or the possibility that improper service methods will be followed which may damage the vehicle or render it unsafe. It is also important to understand that these Warnings and Cautions are not exhaustive. GMC Truck & Coach could not possibly know, evaluate and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, GMC Truck & Coach have not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by GMC Truck & Coach must first satisfy himself thoroughly that neither his safety nor vehicle safety will be jeopardized by the service method he selects.

CAUTION

These vehicles contain some parts dimensioned in the metric system as well as in the customary system. Some fasteners are metric and are very close in dimension to familiar customary fasteners in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. (Numbers on the heads of metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings.) Mismatches or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original. For information and assistance, see your authorized dealer.