GROUP 5

BRAKES

NOTICE: All Brake attaching fasteners are an important attaching part in that they could affect the performance of vital parts 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 the parts.

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or compressed air. Many 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. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

UNIT REPAIR CONTENTS

SECTION 5

GENERAL BRAKES

CONTENTS

GENERAL DESCRIPTION

This section describes brake system general items for all standard brake systems. A description of the Anti-lock brake system and its components can be found in Section 5E.

DIAGONAL SPLIT MASTER CYLINDER

This master cylinder is designed for use in diagonal split hydraulic systems. It incorporates the functions of the standard dual master cylinder plus a fluid level sensor and proportioning valves. In a diagonal split system, the left rear brake and the right front brake are on the same hydraulic circuit in the master cylinder. The left front brake and the right rear brake are also on the same circuit in the master cylinder. In addition, this master cylinder has a quick take-up feature.

QUICK TAKE-UP FEATURE

The quick take-up feature is used on both conventional and diagonal split master cylinders. It provides a large volume of fluid at low pressure with initial brake application. The low pressure fluid provides the displacement requirements of the system created by the seal retracting pistons into the calipers and retraction of rear drum brake shoes.

COMPACT MASTER CYLINDER

This master cylinder is a composite design for use in a diagonally split hydraulic system. It incorporates the functions of the standard dual master cylinder plus it has a fluid level sensor switch and integral proportioners.

OPERATION OF DISC BRAKE

Upon application of the brakes, pressure is exerted equally against the bottom of the piston and also against the bottom of the cylinder bore. The pressure applied to the piston is transmitted to the inner shoe and lining, forcing the lining against the inner rotor surface. The pressure applied to the bottom of the cylinder bore forces the caliper to slide or move on the mounting bolts inward toward the center of the car. Since the caliper is one piece, this movement causes the outer section of the caliper to apply pressure against the back of the outer shoe and lining assembly, forcing the lining against the outer rotor surface. As pressure increases, the shoe and lining assemblies are pressed against the rotor surfaces with increased force, bringing the car to a stop. When the brake pedal is released, line pressure is released and the seal and seal groove cause the piston to be slightly retracted, resulting in less drag on the rotor by both shoe and lining assemblies. Lining wear is automatically compensated for by the sliding action of the caliper.

OPERATION OF DUO-SERVO DRUM BRAKES

The conventional anchor plate and direct torque drum brakes are called duo-servo design. In the duo-servo drum brake, the force that the wheel cylinder applies to the primary shoe is multiplied by the primary lining friction to provide a very high force applied to the secondary shoe. Torque from the brake shoes is transferred to the anchor pin and through the backing plate, to the axle flange. Direct torque as the name implies, transfers braking torque from the brake shoes to the anchor pin and then directly to the rear axle housing. Adjustment is automatic when the brakes are applied while the car is backing up. For service procedures, see Sections 5C1, 5C2 or 5C3.

LEADING-TRAILING DRUM BRAKES

In the leading-trailing drum brake, the return springs hold both shoes against the wheel cylinder at the top and against the fixed anchor at the bottom. When the brakes are applied the wheel cylinder moves both shoes out to contact the drum. The forward shoe wraps itself into the drum and self-energizes during forward application. With application in reverse, the rear shoe wraps itself into the drum providing self energization.

Leading-trailing brakes adjust themselves during any service application with no vehicle motion required. Also with leading/trailing brakes, it is normal for the forward shoe to wear faster than the rear shoe. Once the shoes have been put into service they should never be switched as this may render the self adjustment feature inoperative and result in increased pedal travel.

PROPORTIONER VALVES

These valves limit outlet pressure to the rear brakes after a predetermined master cylinder pressure has been reached. This is used when less rear apply

force is needed to obtain optimum braking and is usually found on disc/drum brake configurations.

PRESSURE DIFFERENTIAL WARNING SWITCH

The pressure differential warning switch is installed between the hydraulic circuits of some dual circuit brake systems. It constantly compares hydraulic pressure in both circuits and turns on the "BRAKE" warning light in the event of a hydraulic failure in either circuit. The switch is designed so that it will latch in the "warning" position once a failure has occurred. The system must be repaired and pedal force applied to develop up to 3100 kPa (450 psi) of line pressure to reset the switch. For electrical details on the "BRAKE" warning system, see page 8A-41-0.

OPERATION OF COMBINATION VALVE

The metering or hold off section of the combination valve limits pressure to the front disc brakes until a pre-determined front input pressure is reached, approximating the pressure to overcome the rear shoe and lining retractor springs. There is no restriction at inlet pressures below 20 kPa (3 psi) to allow for pressure equalization during non apply periods.

The proportioning section of the combination valve proportions outlet pressure to the rear brakes after a pre-determined rear input pressure has been reached.

The valve has a "By-Pass" feature which gives full system pressure to the rear brakes in the event of a front system failure, also full front pressure is retained in the event of rear failure.

FLUID LEVEL SENSOR SWITCH

Some master cylinders are equipped with a fluid level sensor. This sensor will activate the red "BRAKE" light if a low fluid condition is detected. Once the fluid level is corrected the "BRAKE" light will go out. For electrical details on the "BRAKE" warning system, see page 8A-41-0.

PRESSURE SWITCH

The Powermaster and Anti-lock brake systems both use a pressure switch. One of the functions of this switch is to activate the red "BRAKE" light if a low system pressure is detected. See Section 5D4 for Powermaster System Details or Section 5E for Anti-lock System details.

DIAGNOSIS AND INSPECTION

BRAKE SYSTEM TESTING

Brakes should be tested on a dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if roadway is wet, greasy or covered with loose dirt so that all tires do not grip the road equally. Testing will also be adversely affected if roadway is crowned so as to throw weight of car toward wheels on one side or if roadway is so rough that wheels tend to bounce.

Test brakes at different car speeds with both light and heavy pedal pressure; however, avoid locking the brakes and sliding the tires. Locked brakes and sliding tires do not indicate brake efficiency, since heavily braked, but turning wheels will stop car in less distance than locked brakes. More tire-to-road friction is present with a heavily braked turning tire than with a sliding tire.

The brake system is designed and balanced to avoid locking the wheels except at very high deceleration levels. It is designed this way because the shortest stopping distance and best control is achieved without brake lock-up.

Because of high deceleration capability, a firmer pedal may be felt at higher deceleration levels.

External Conditions That Affect Brake Performance

1. **Tires.** Tires having unequal contact and grip on road will cause unequal braking. Tires must be equally inflated, and the tread pattern of right and left tires must be approximately equal.
2. **Car Loading.** When a car has unequal loading, the most heavily loaded wheels require more braking power than others. A heavily loaded car requires more braking effort.
3. **Wheel Alignment.** Misalignment of the wheels, particularly in regard to excessive camber and caster will cause the brakes to pull to one side.

WARNING LIGHT OPERATION

Vacuum Booster Power Assist

A-B-C-H-E-G-J-N CARLINES

The standard brake system uses a single red "BRAKE" warning light located in the instrument panel cluster. When the ignition switch is in the START position, the "BRAKE" warning light should glow and go off when the ignition switch returns to the Run position.

The following conditions will activate the "BRAKE" light:

1. Parking brake applied. The light should be on whenever the parking brake is applied and the ignition switch is on.
2. Low fluid level (except B-G carlines). A low fluid level in the master cylinder will turn the "BRAKE" light on.
3. Pressure Differential Switch detects a failure (B-G carlines). The "BRAKE" light will remain on until the problem is corrected. See "Pressure Differential Warning Switch" in this section.

Powermaster System

G Carline

The Powermaster system uses a single red "BRAKE" warning light located in the instrument panel cluster. When the ignition switch is in the start position, the "BRAKE" warning light should glow and go off when the ignition switch is returned to the Run position. On initial system start up, it may be normal

for the "BRAKE" light to stay on for up to 20 seconds while the pump pressurizes the accumulator.

The following conditions will actuate the "BRAKE" light:

1. Parking brake applied. The light should be on whenever the parking brake is applied and the ignition switch is on.
2. Accumulator pressure drops below 3000-2450 kPa (435 - 355 psi). The light should remain on until the pump pressurizes the accumulator.
3. Pressure differential switch detects a failure. The "BRAKE" light will remain on until the problem is corrected. See "Pressure Differential Warning Switch" in this section.

Anti-lock Brake System

The Anti-lock brake system uses two indicator lamps: a red "BRAKE" warning light and an amber "ANTILOCK" light both located in the instrument panel cluster. Under normal conditions, these lights should behave as follows:

1. When ignition is turned to the "RUN" position, prior to starting the engine, the Amber "ANTILOCK" light should turn on for a short period of time and then go out.
2. As the engine is cranked, the red "BRAKE" light and the Amber "ANTILOCK" light should come on. When the key is returned to the Run position, the red "BRAKE" light and Amber "ANTILOCK" light may remain on for up to 30 seconds. After the pump pressurizes the accumulator and the EBCM (electronic brake control module) checks the brake electrical system both lights should remain off.

For further information regarding warning light operation for the Anti-lock brake system refer to Section 5E. Behavior of these two warning lights is an important part of the Anti-lock brake system diagnosis. Neither of the warning lights should turn on while driving the car. If this should occur, refer to Section 5E for diagnosis.

Brake Fluid Leaks

With engine running at idle and the shift lever in neutral, depress the brake pedal and hold a constant foot pressure on the pedal. If the pedal gradually falls away with the constant pressure, the hydraulic system may be leaking. Perform a visual check to confirm any suspected leak.

Check the master cylinder fluid levels. While a slight drop in reservoir level does result from normal lining wear, an abnormally low level in either reservoir indicates a leak in the system. The hydraulic system may be leaking either internally or externally. See Master Cylinder Check. Also, the system may appear to pass this test but still have slight leakage.

If fluid levels are normal, check the vacuum booster push rod length. If an incorrect length push rod is found, adjust or replace the push rod. Check the service brake pedal travel, brake adjustment and the parking brake adjustment.

When checking the fluid level, the master cylinder rear reservoir may be as low as one inch from the top if the front linings are worn. This is not abnormal.

Master Cylinder Check

These tests will not determine all master cylinder malfunctions. Use the brake Diagnosis Charts to help isolate the problem if it is not found by using these tests.

1. Check for a cracked master cylinder casting or brake fluid around the master cylinder. Leaks are indicated only if there is at least a drop of fluid. A damp condition is not abnormal.
2. Check for a binding pedal linkage and incorrect push rod length. If both of these are satisfactory, disassemble the master cylinder and check for swollen or elongated primary piston seal(s). If swollen seals are found, substandard or contaminated brake fluid should be suspected. If contaminated, all components should be disassembled and cleaned; all rubber components should be replaced and all pipes flushed.

Substandard or Contaminated Brake Fluid

Improper brake fluid, mineral oil or water in the fluid may cause the brake fluid to boil or the rubber components in the hydraulic system to deteriorate.

If primary piston cups are swollen, then rubber parts have deteriorated. This deterioration may also be evidenced by swollen wheel cylinder piston cups on the drum brake wheels or master cylinder cover diaphragm.

If deterioration of rubber is evident, disassemble all hydraulic parts and wash with alcohol. Dry these parts with compressed air before assembly to keep alcohol out of the system. Replace all rubber parts in the system, including hoses. Also, when working on the brake mechanisms, check for fluid on the linings. If excessive fluid is found, replace the linings.

If master cylinder piston seals are satisfactory, check for leakage or excessive heat conditions. If condition is not found, drain fluid, flush with brake fluid, refill and bleed the system.

ON-CAR SERVICE

POWER BRAKE VACUUM HOSE FILTER

Remove or Disconnect

1. Hose clamps using a pair of pliers
2. Twist the filter in the hose to break the seal
3. Filter from hose

Install or Connect

1. Filter into hose on both ends
2. Position clamps to retain filter

PEDAL TRAVEL

Inspect

Tools Required:

J 28662 Brake Pedal Effort Gage

CAUSE / SYMPTOM	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow to Respond	Brakes Slow to Release	Brakes Drag	Uneven Braking Action (Side to Side)	Uneven Braking Action (Front to Rear)	Scraping Noise from Brakes Application	Brakes Squeak During	Brakes Squeak During Stop	Brakes Pulsate (Roughness)	Brakes Groan at End of Stop	Brake Tell-Tale Glows During Stop	
Leaking Brake Line or Connection	X	XX								X						XX
Leaking Wheel Cylinder or Piston Seal	X	XX		X						X						XX
Leaking Master Cylinder	X	XX														XX
Air in Brake System	XX									X						X
Contaminated or Improper Brake Fluid					X	X	X									X
Leaking Vacuum System			XX		X											X
Restricted Air Passage in Power Head			X		XX	X										
Damaged Power Head			X	X	X	X	X									
Improperly Assembled Power Head Valving			X	X	X	X	XX									
Worn Out Brake Lining - Replace			X	X				X	X	X	X	X		X		
Uneven Brake Lining Wear - Replace and Correct	X			X				X	X	X	X	XX		X		X
Glazed Brake Lining			XX		X			X	X		X	X				
Incorrect Lining Material - Replace			X	X				X	X			X		X		
Contaminated Brake Lining - Replace				XX				XX	XX	X	X	X		X		
Linings Damaged by Abusive Use - Replace			X	XX				X	X	X	X	X		X		
Excessive Brake Lining Dust			X	XX				XX	XX		X	XX		X		
Heat Spotted or Scored Brake Drums or Rotors				X				X	X		X	X	XX	X		
Out-of-Round or Vibrating Brake Drums												X	XX			
Out-of-Parallel Brake Rotors													XX			
Excessive Rotor Run-Out													X			
Faulty Automatic Adjusters	X						X	X	X							X
Incorrect Wheel Cylinder Sizes			X	X				X	X							
Weak or Incorrect Brake Shoe Retention Springs				X		X	XX	X	X	XX	X	XX				
Brake Assembly Attachments - Missing or Loose	X						X	X	X	X		X	X	X		
Insufficient Brake Shoe Guide Lubricant						X	X	X	X	XX	XX					
Restricted Brake Fluid Passage or Sticking Wheel Cylinder Piston		X	X		X	X	X	X	X							
Faulty Metering Valve	X		X	X	X	X	X		X							X
Brake Pedal Linkage Interference or Binding			X		X	XX	XX									
Improperly Adjusted Parking Brake							X									
Drums Tapered or Threaded										XX						
Incorrect Front End Alignment								XX								
Incorrect Tire Pressure								X	X							
Incorrect Wheel Bearing Adjustment	X									X			X			
Loose Front Suspension Attachments								X		XX			X	X		
Out-of-Balance Wheel Assemblies													XX			
Operator Riding Brake Pedal	X	X	X				X		X					X		
Improperly Adjusted Master Cylinder Push Rod	X					X	XX									
Sticking Wheel Cylinder or Caliper Pistons			X			X	X	X	X							
Faulty Proportioning Valve			X		X	X	X									

XX - Indicates more probable cause(s) X - Indicates causes

Figure 1 Brake System Diagnosis

BRAKE DIAGNOSIS CHART — 4 WHEEL DISC SYSTEMS

CAUSE / SYMPTOM	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow to Respond	Brakes Slow to Release	Brakes Drag	Uneven Braking Action (Side to Side)	Uneven Braking Action (Front to Rear)	Scraping Noise from Brakes	Brakes Squeak During Application	Brakes Squeak During Stop	Brakes Chatter (Roughness)	Brakes Groan at End of Stop	Brakes Tell-Tale Glows
Leaking Brake Line or Connection	X	XX	X						X						XX
Leaking Piston Seal	X	XX	X	X				X	X						X
Leaking Master Cylinder	X	XX	X						X						X
Air in Brake System	XX		X						X						XX
Contaminated or Improper Brake Fluid	X				X	X	X	X	X						X
Leaking Vacuum System			XX		X										X
Restricted Air Passage in Power Head		X	X		XX	X									
Damaged Power Head		X	X	X	X	XX									
Worn Out Brake Lining			X	X				X	X	X	X	X		X	
Uneven Brake Lining Wear-Replace	X			X				X	X	X	X	XX		X	X
Glazed Brake Lining-Sand			XX		X			X	X		X	X			
Incorrect Lining Material-Replace			X	X		X		X	X			X		X	
Contaminated Brake Lining-Replace				XX		X		XX	XX	X	X	X		X	
Linings Damaged by Abusive Use-Replace			X	XX				X	X	X	X	X		X	
Heat Spotted or Scored Discs				X				X	X		X	X	XX	X	
Out-of-Parallel Brake Discs	X												XX		
Excessive Run-Out Disc	X												X		
Automatic Adjuster Problem	X						X	X	X						X
Brake Assembly Attachments-Missing or Loose	X						X	X	X	X		X	X	X	
Restricted Brake Fluid Passage		X	X		X	X	X	X	X						X
Improperly adjusted Stoplight Switch or Cruise Control Vacuum Dump							X								
Metering Valve Problem		X	X	X	X	X	X		X						X
Proportioning Valve Problem		X	X	X	X	X	X		X						X
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								
Improperly Adjusted Parking Brake							X		X						
Improper Length Master Cylinder Push Rod	X			X		X	XX		X						
Incorrect Front End Alignment								XX							
Incorrect Tire Pressure								X	X						
Incorrect Wheel Bearing Adjustment	X									X			X		
Loose Front Suspension Attachments							X	X		XX			X	X	
Out-of-Balance Wheel Assemblies													XX		
Operator Riding Brake Pedal			X				X		X					X	
Sticking Caliper or Wheel Cylinder Pistons					X	X	XX	X	X						
Park Brake Switch Circuit Grounded															XX
Park Brake Not Releasing						X		X							XX

XX — Indicates more probable causes(s)
X — Indicates other causes

3B5A

Figure 2 Four Wheel Disc Brake Diagnosis

POWER BRAKE DIAGNOSIS

POWER BRAKE UNIT TROUBLE DIAGNOSIS

The same types of brake trouble are encountered with power brakes as with standard brakes. Before checking power brake system for source of trouble, refer to trouble diagnosis of drum brakes. After these possible causes have been eliminated, check for cause as outlined below:

HARD PEDAL

CAUSE	CORRECTION
Broken or damaged hydraulic brake lines.	Inspect and replace as necessary.
Vacuum failure.	Check for: Faulty vacuum check valve or grommet-replace. Collapsed or damaged vacuum hose-replace. Plugged or loose vacuum fitting-repair. Faulty air valve seal or support plate seal-replace. Damaged floating control valve-replace. Bad stud welds on front or rear housing or power head-replace unless easily repaired.
Defective diaphragm.	Replace
Restricted air filter element.	Replace
Worn or distorted reaction plate or levers.	Replace plate or levers.
Cracked or broken power pistons or retainer.	Replace power pistons and piston rod retainer.

GRABBY BRAKES
(Apparent Off-On Condition)

CAUSE	CORRECTION
Broken or damaged hydraulic brake lines.	Inspect and replace as necessary.
Insufficient fluid in master cylinder.	Fill reservoirs with approved brake fluid-check for leaks.
Defective master cylinder seals.	Repair or replace as necessary.
Cracked master cylinder casting.	Replace
Leaks at front disc brake calipers or rear wheel cylinders in pipes or connections.	Inspect and repair as necessary.
Air in hydraulic system.	Bleed system.

BRAKES FAIL TO RELEASE

CAUSE	CORRECTION
Blocked passage in power piston.	Inspect and repair or replace as necessary.
Air valve sticking shut.	Check for proper lubrication of air valve "O" ring.
Broken piston return spring.	Replace
Broken air valve spring.	Replace
Tight pedal linkage.	Repair or replace as necessary.

3B5B

Figure 3 Vacuum Booster Diagnosis

Tape measure

1. With engine off and key "Off," pump service brake pedal until all reserve is exhausted from the brake booster. (A definite change in pedal feel will occur.)
2. Install J 28662 on to brake pedal.
3. Hook end of tape measure over top edge of brake pedal and measure the distance to the rim of the steering wheel.
4. Apply service brake pedal with 445 N (100 lbs.) force and re-measure. The difference between both readings is the actual pedal travel and should not exceed specifications. See Section 5F for Brake Pedal Travel specifications.
5. If pedal travel is greater than specification, drive the car backward while intermittently applying the brakes. In rare cases excessive pedal travel develops if the car is not driven in reverse. Duo-Servo self-adjusting mechanisms will only actuate when the brakes are applied in reverse.

Most low pedal problems are caused by air in the hydraulic system. This means that the system should be bled until all air is purged. (See Bleeding Brake Hydraulic System.) Other less frequent causes of excessive pedal travel are incorrect push-rod length, improperly adjusted parking brake, rear shoe adjusters not functioning, shoe excessively worn, and hydraulic system leakage.

STOP LIGHT SWITCH

See Figure 4

Adjust

1. Insert switch into tubular clip until switch body seats on tube clip.
2. Pull brake pedal rearwards against internal pedal stop. Switch will be moved in tubular clip providing proper adjustment.
   - Proper switch adjustment is achieved when no clicks are heard when the pedal is pulled upward and the brake lights do not stay on without brake application.

FILLING MASTER CYLINDER RESERVOIRS

NOTICE: Do not use any fluid which contains a petroleum base. Do not use a container which has been used for petroleum based fluids or a container which is wet with water. Petroleum based fluids will cause swelling and distortion of rubber parts in the hydraulic brake system and water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent contamination.

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

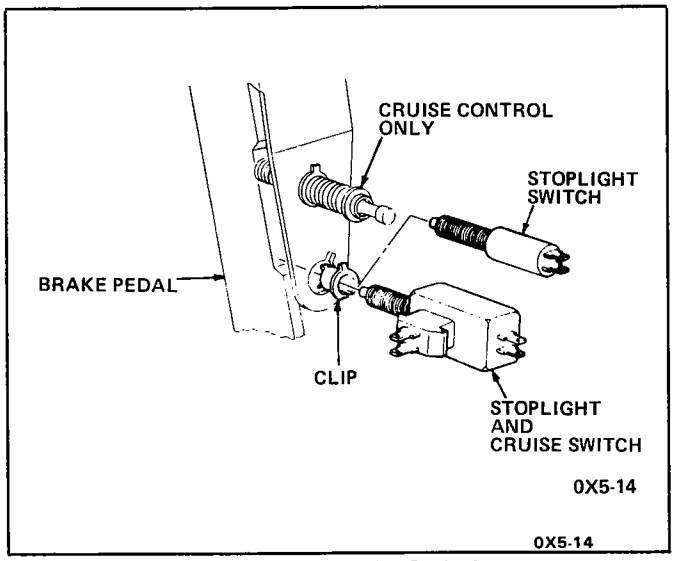


Figure 4 Stoplight Switch

The brake fluid reservoirs are on the master cylinder, which is located under the hood on the left side of the cowl.

Thoroughly clean reservoir cover before removal to avoid getting dirt into reservoirs. Remove cover and diaphragm. Add fluid as required to bring level to the full mark located inside the reservoir. Use Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent. Fluid must be "DOT 3".

- See Section 5D4 for filling Powermaster fluid reservoir.
- See Section 5E for filling the Anti-lock brake reservoir.

BLEEDING BRAKE HYDRAULIC SYSTEM

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

It may be necessary to bleed the hydraulic system at all four brakes if air has been introduced through a low fluid level or by disconnecting brake pipes at the master cylinder. If a brake pipe is disconnected at one wheel, only that wheel cylinder/caliper needs to be bled. If pipes are disconnected at any fitting located between master cylinder and brakes, then the brake system served by the disconnected pipe must be bled. For the bleeding of Powermaster, refer to Section 5D4. For the bleeding of Anti-lock brakes, refer to Section 5E.

Manual Bleed

See Figure 5

Tools Required:

J 21472 Bleeder Wrench

J 28434 Bleeder Wrench

Remove the booster reserve by applying the brakes several times with the engine off until all reserve is depleted.

1. Fill the master cylinder reservoirs with brake fluid and keep at least one-half full of fluid during the bleeding operation.

2. If the master cylinder is known or suspected to have air in the bore, then it must be bled before any wheel cylinder or caliper in the following manner:
   a. Disconnect the front brake pipe connection(s) at the master cylinder.
   b. Allow brake fluid to fill the master cylinder until it begins to flow from the front pipe connector port.
   c. Connect the forward brake pipe(s) to the master cylinder and tighten.
   d. Depress the brake pedal **slowly one time and hold.** Loosen the front brake pipe connection at the master cylinder to purge air from the cylinder. Tighten the connection and then **release the brake pedal slowly. Wait 15 seconds.** Repeat the sequence, including the 15 second wait, until all air is removed from the bore. Care must be taken to prevent brake fluid from contacting any painted surface.
   e. After all air has been removed at the forward connection(s), bleed the master cylinder at the rear (cowl) connection(s) in the same manner as the front in step "d" above.
   f. If it is known that the calipers and wheel cylinders do not contain any air, then it will not be necessary to bleed them.
3. Individual wheel cylinder or calipers are bled only after all air is removed from the master cylinder.
   a. Place a proper size box end wrench or Tool J 21472 over the bleeder valve. "G" Carline requires Tool J 28434 for rear wheel cylinder bleeder screw. Attach a transparent tube over valve and allow tube to hang submerged in brake fluid in a transparent container.

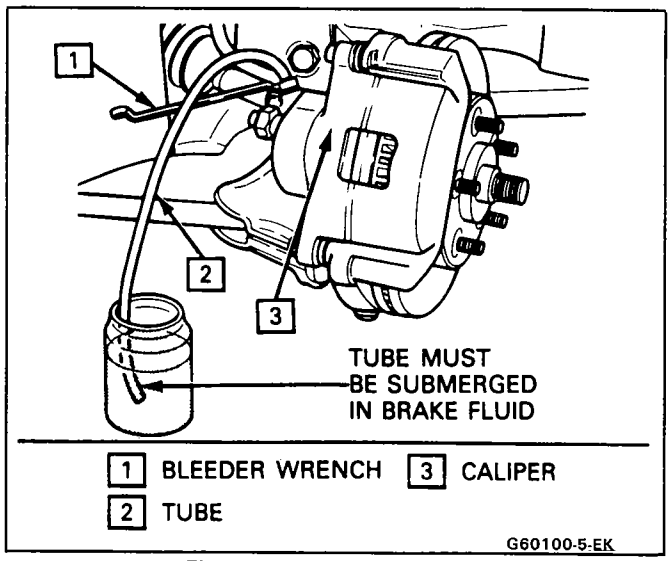


Figure 5 Bleeding Brakes

   b. Depress the brake pedal **slowly one time and hold.** Loosen the bleeder valve to purge the air from the cylinder. Tighten bleeder screw and **slowly release pedal. Wait 15 seconds.** Repeat the sequence, including the 15 second wait until all air is removed. It may be necessary to repeat the sequence 10 or more times to remove all the air. Rapid pumping of the brake pedal pushes the master cylinder secondary piston down the bore in a manner that makes it difficult to bleed the system.
4. Bleeding Sequence -
   Diagonal Split System:
   a. Right rear
   b. Left front
   c. Left rear
   d. Right front
   Conventional System
   a. Right rear
   b. Left rear
   c. Right front
   d. Left front
5. Check the brake pedal for "sponginess" and the brake warning light for indication of unbalanced pressure. Repeat entire bleeding procedure to correct either of these two conditions.

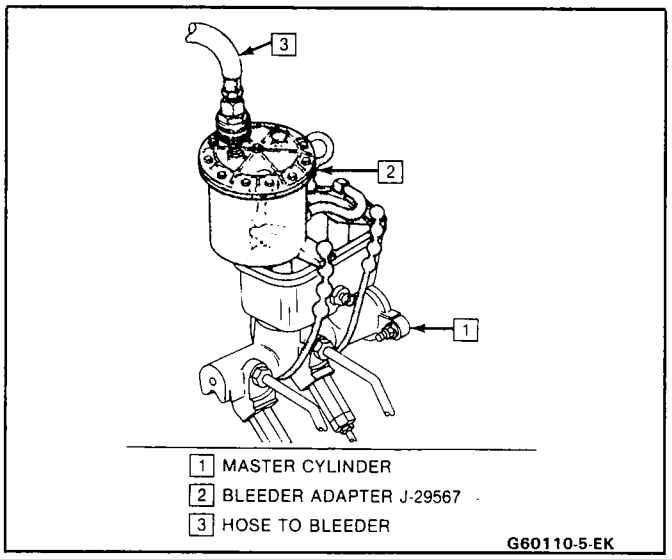


Figure 6 Pressure Bleeding Adapter

Pressure Bleeding

See Figures 6 thru 8

Tools Required:

J 29532 Bleeder
J 29567 Bleeder Adapter
J 35589 Bleeder Adapter (Compact Master Cylinder)
J 26819-30 Adapter Extension
J 23709 Combination Valve Depressor
J 21472 Bleeder Wrench
J 28434 Bleeder Wrench

Pressure bleeding equipment must be of the diaphragm type. It must have a rubber diaphragm

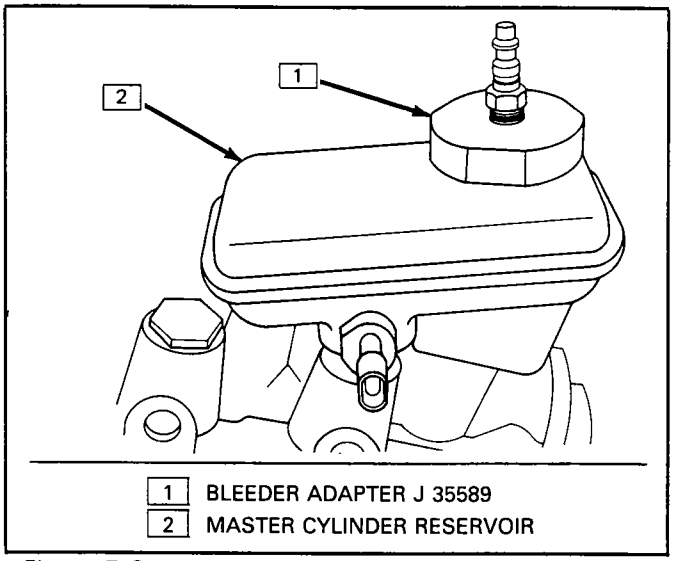


Figure 7 Compact Master Cylinder Pressure Bleeding Adapter

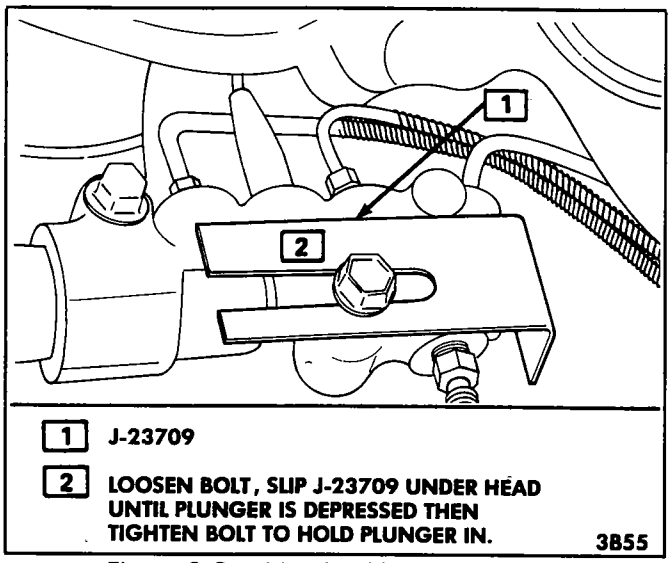


Figure 8 Combination Valve Depressor

between the air supply and the brake fluid to prevent air, moisture, oil and other contaminants from entering the hydraulic system.

1. Install the correct bleeder adapter to the master cylinder.
2. Charge bleeder ball to 20-25 psi.
3. Connect line to adapter and open line valve.
   - Bleeder adapter J 29567 has a bleed valve on the top of the adapter to help eliminate air from the adapter.
4. Raise car and suitably support. See Section 0A.
5. Attach bleeder hose to bleeder valve and submerge opposite end in clean container partially filled with brake fluid.
6. Open bleeder valve 1/2 to 3/4 turn and allow fluid to flow until no air is seen in fluid.
7. Cars equipped with a conventional brake system with front disc and rear drum may require manual override of the combination valve to permit flow to the front wheels when pressure bleeding.
   - To hold the metering valve open to pressure bleed the front brakes, the valve stem must be pushed in or pulled out. Loosen front mounting bolt and install Tool J 23709 on the combination valve. Stem should be fully extended or depressed.
8. Bleeding sequence:
   Diagonal Split System:
   a. Right rear
   b. Left front
   c. Left rear
   d. Right front
   Conventional System:
   a. Right rear
   b. Left rear
   c. Right front
   d. Left front

FLUSHING BRAKE HYDRAULIC SYSTEM

It is recommended that the entire hydraulic system be thoroughly flushed with clean brake fluid whenever new parts are installed in the hydraulic system. Approximately one quart of fluid is required to flush the hydraulic system.

The system must be flushed if there is any doubt as to the grade of fluid in the system or if fluid has been used which contains the slightest trace of mineral oil. All rubber parts that have been subjected to a contaminated fluid must be replaced.

BRAKE PIPE REPLACEMENT

Tools Required:
J 28629 I.S.O. Flaring Tool
J 23530 Double Lap Flaring Tool

CAUTION: Never use copper tubing because copper is subject to fatigue cracking and corrosion which could result in brake failure. Use double walled steel tubing.

ISO Flare

See Figure 9

1. Obtain the recommended tubing and steel fitting nuts of the correct size. (Outside diameter of tubing is used to specify size).
2. Cut tubing to length. Correct length may be determined by measuring old pipe using a string and adding 1/8" or 1.2 mm for each I.S.O. flare.
3. Make sure fittings are installed before starting flare.
   Flare tubing ends using an I.S.O. flaring tool such as J 28629. Follow instructions included in tool set.
4. Bend pipe assembly to match old pipe using a tubing bender. Clearance of .750" or 19 mm must be maintained to all moving or vibrating parts.

Double Lap Flare

See Figure 10

1. Obtain the recommended tubing and steel fitting nuts of the correct size. (Outside diameter of tubing is used to specify size).

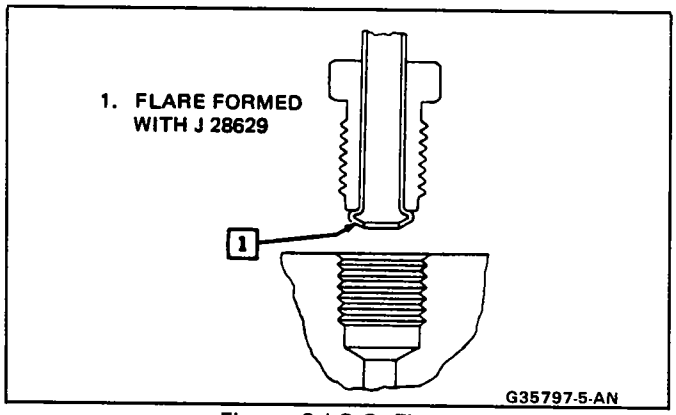


Figure 9 I.S.O. Flare

2. Cut tubing to length. Correct length may be determined by measuring old pipe using a cord and adding 1/8" or 1.2 mm for each double flare.
3. Make sure fittings are installed before starting flare. Double flare tubing ends using a suitable flaring tool such as Tool J 23530. Follow instructions included in tool set.
   Double flaring tool must be used as single flaring tools cannot produce a flare strong enough to hold the necessary pressure.
4. Bend pipe assembly to match old pipe using a tubing bender. Clearance of .750" must be maintained to all moving or vibrating parts.

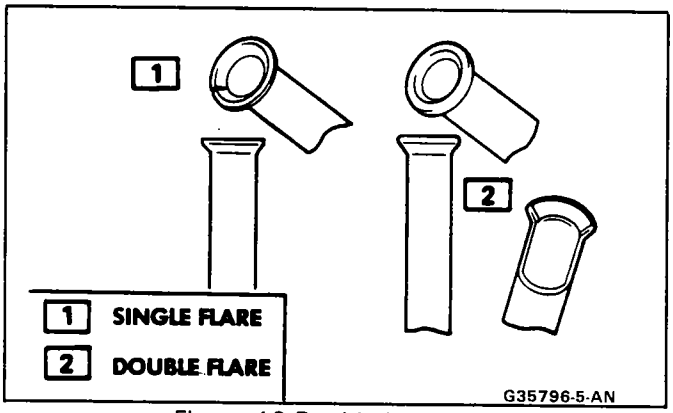


Figure 10 Double Lap Flare

BRAKE HOSE INSPECTION

The hydraulic brake hoses should be inspected at least twice a year. The brake hose assembly should be checked for road hazard damage, cracks and chafing of the outer cover, and for leaks and blisters. Inspect for proper routing and mounting of the hose. A brake hose that rubs on suspension components will wear and eventually fail. A light and mirror may be needed for an adequate inspection. If any of the above conditions are observed on the brake hose, adjust or replace the hose as necessary.

Important

Do not allow brake components such as calipers to hang from the flexible hoses as damage to the hoses may occur. Some brake hoses have protective rings or covers to prevent direct contact of the hose with other chassis parts. Besides causing possible structural damage to the hose, excessive tension could cause the hose rings to move out of their proper locations.

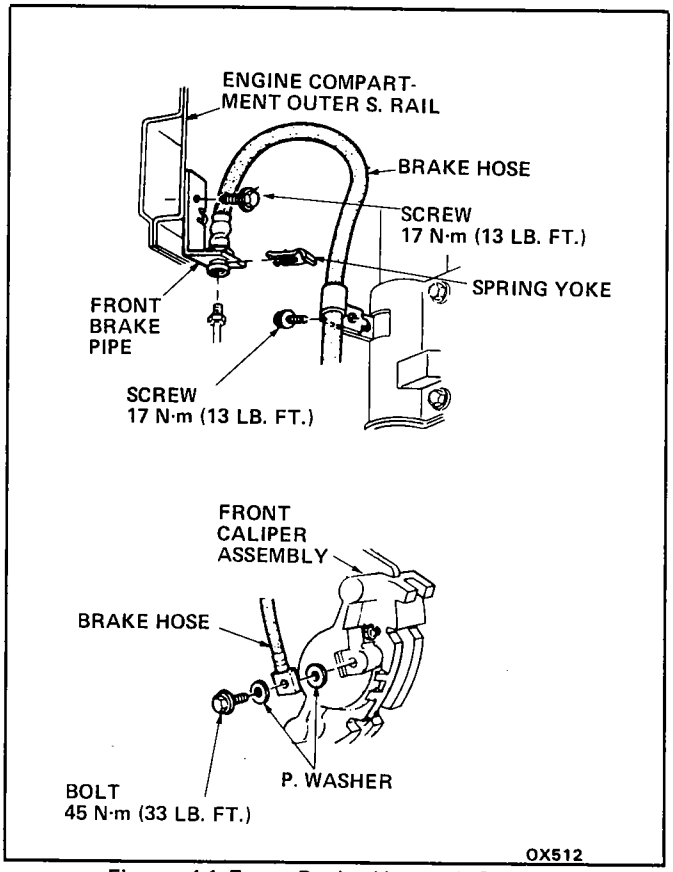


Figure 11 Front Brake Hoses-A Carline

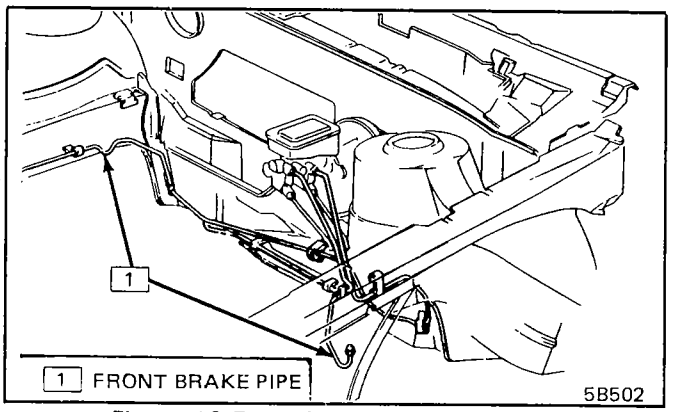


Figure 12 Front Brake Pipes-A Carline

PARKING BRAKE

The parking brake cables have the wire strand coated with a plastic material which slides against nylon seals inside the conduit end fittings. This is for corrosion protection and reduced parking brake effort.

Important

- Plastic coated parking brake cables do not need periodic lubrication.

Handling of these cables during servicing of the parking brake system requires a little extra care. Damage to the plastic coating will reduce corrosion protection and if the damaged area passes through the

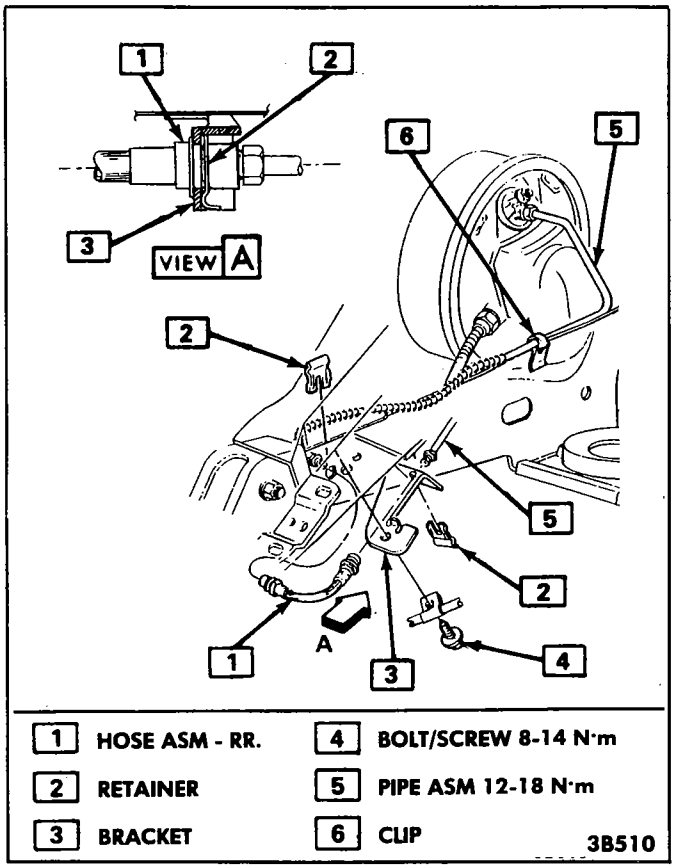


Figure 13 Rear Brake Pipes and Hoses-A Carline

seal, increase parking brake effort could result. Contact of the coating with sharp-edged tools, or with sharp surfaces of the vehicle underbody, should be avoided.

To prevent damage to the threaded parking brake adjusting rod when servicing the parking brake and cables, the following is recommended:

- Before attempting to turn the adjusting nut, clean the exposed threads on each side of the nut.
- Lubricate the threads of the adjusting rod before turning the nut.

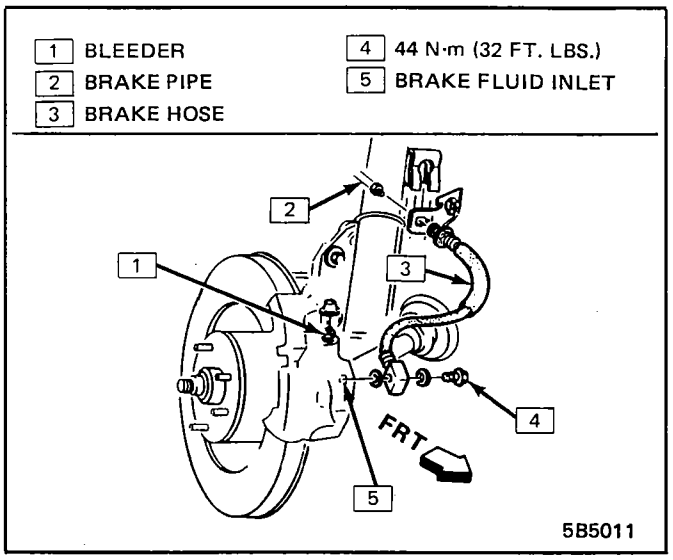


Figure 15 Front Brake Hoses-J-N Carlines

Parking Brake Release Handle

A-C-H Carlines

See Figure 35

Remove or Disconnect

1. Release handle cable from right side of control assembly with screwdriver
2. Front parking brake cable and casing from control assembly
3. Release the handle locking tabs behind I.P. and pull cable and casing through dash.

Install or Connect

1. Front parking brake cable and casing through dash and lock into position
2. Cable and casing to control assembly
3. Release handle cable to right side of control assembly and lock into position

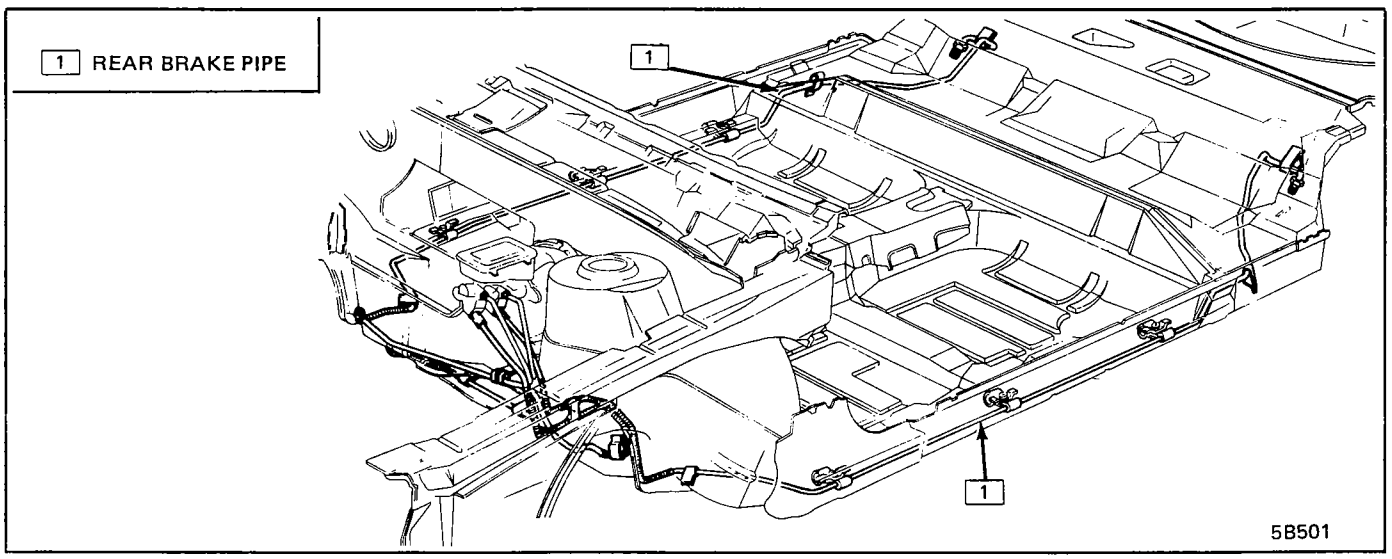


Figure 14 Center Brake Pipe Routing-A Carline

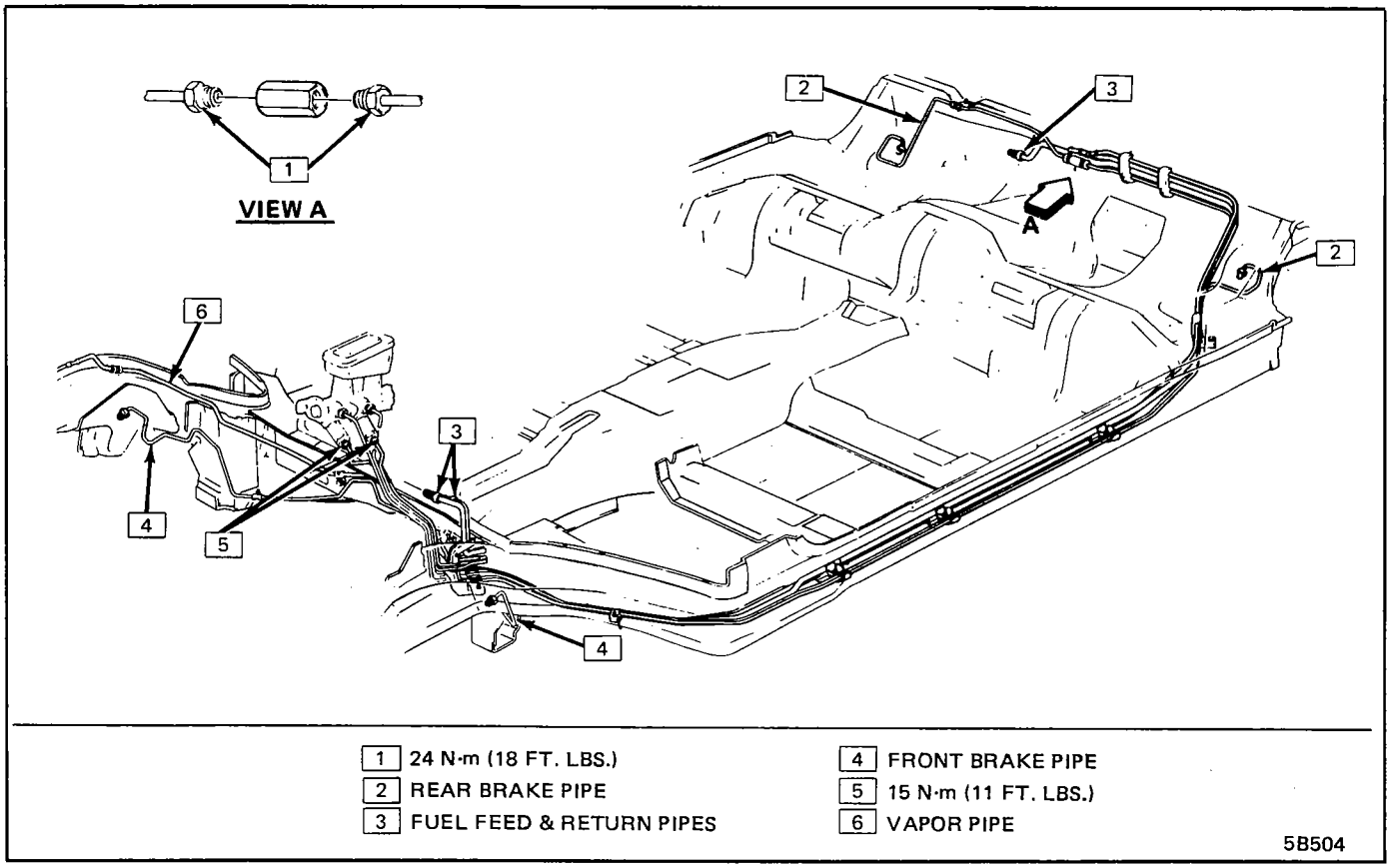


Figure 16 Brake Pipe Routing-J-N Carlines

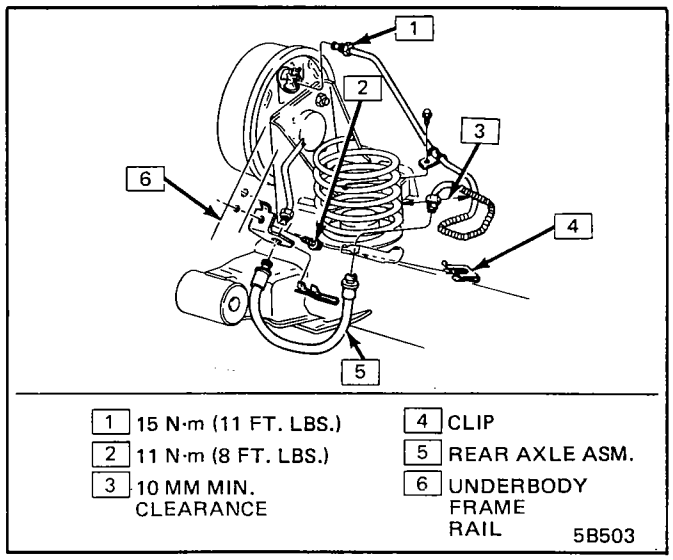


Figure 17 Rear Brake Pipes and Hoses-J-N Carlines

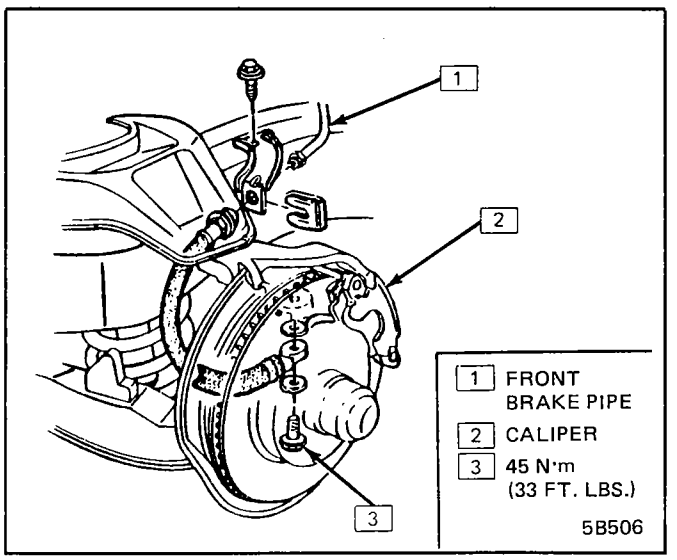


Figure 18 Front Brake Hose-G Carline

Parking Brake Control Assembly

A-C-H Carlines

See Figure 35

Remove or Disconnect

1. Release handle cable at lever assembly
2. Front parking brake cable and casing at control assembly after removing retaining clip
3. Control assembly attaching screws
4. Control assembly

Install or Connect

1. Control assembly and attaching screws
2. Front parking brake cable and casing at control assembly
3. Cable retaining clip
4. Release handle cable at lever assembly

Adjust

- Parking brake cable

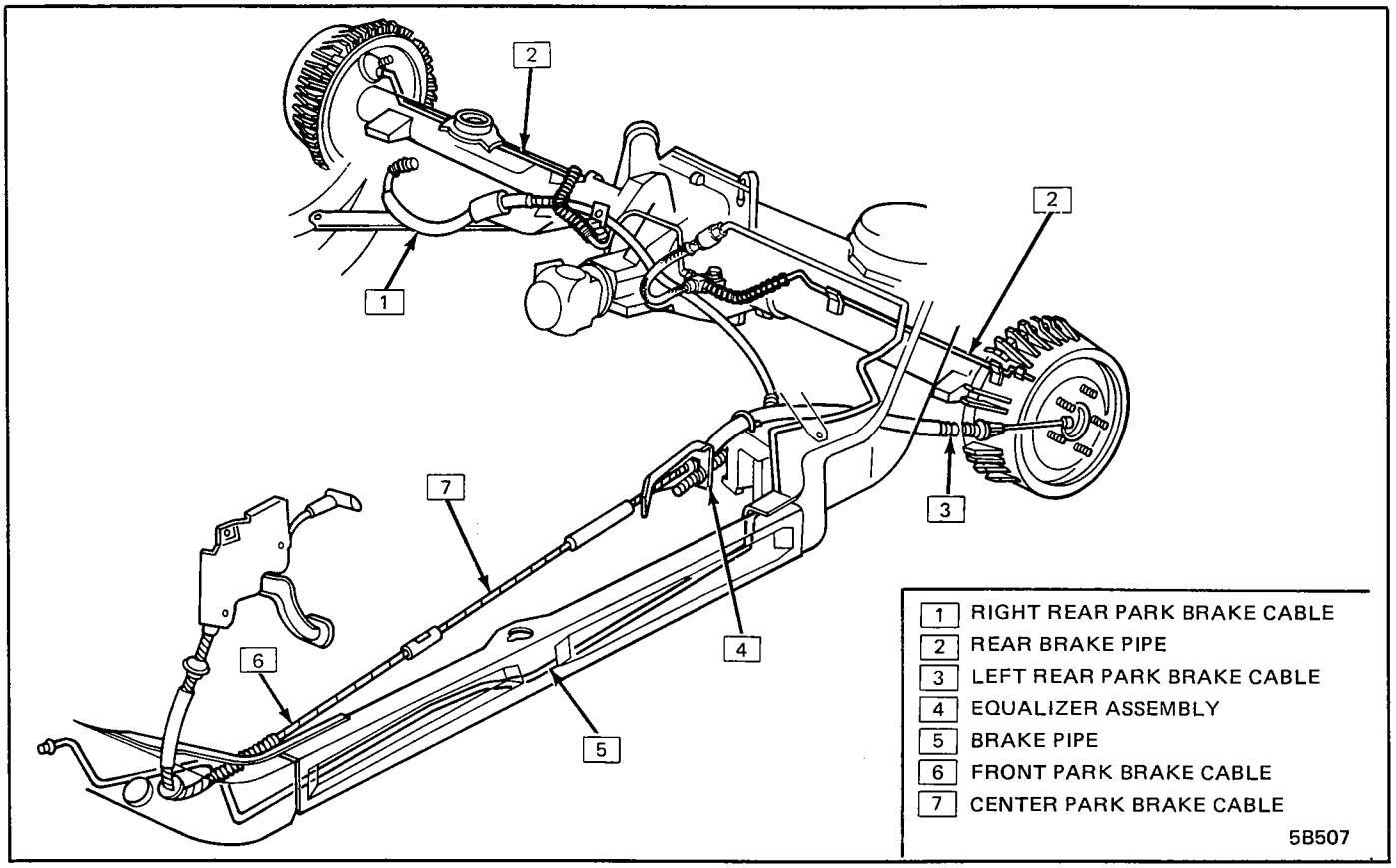


Figure 19 Brake Pipes and Park Brake Cables-G Carline

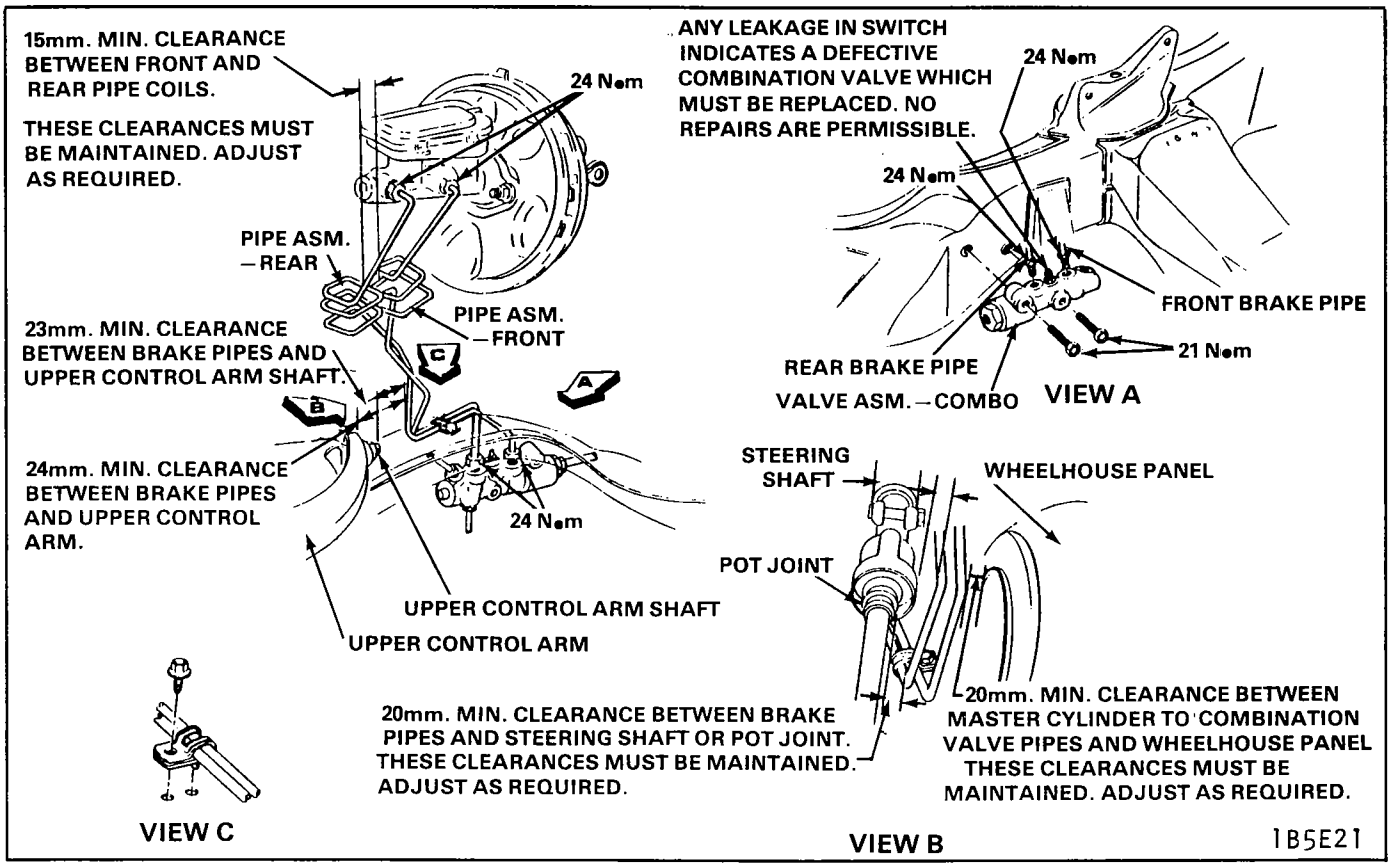


Figure 20 Combination Valve Mounting-G Carline

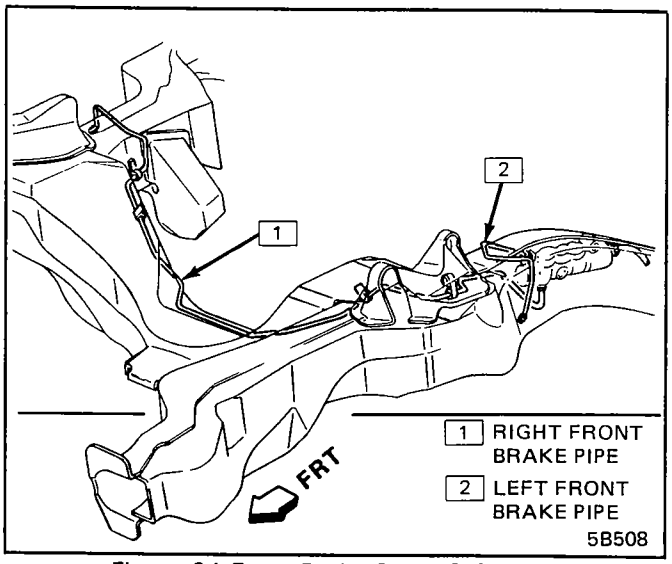


Figure 21 Front Brake Pipes-G Carline

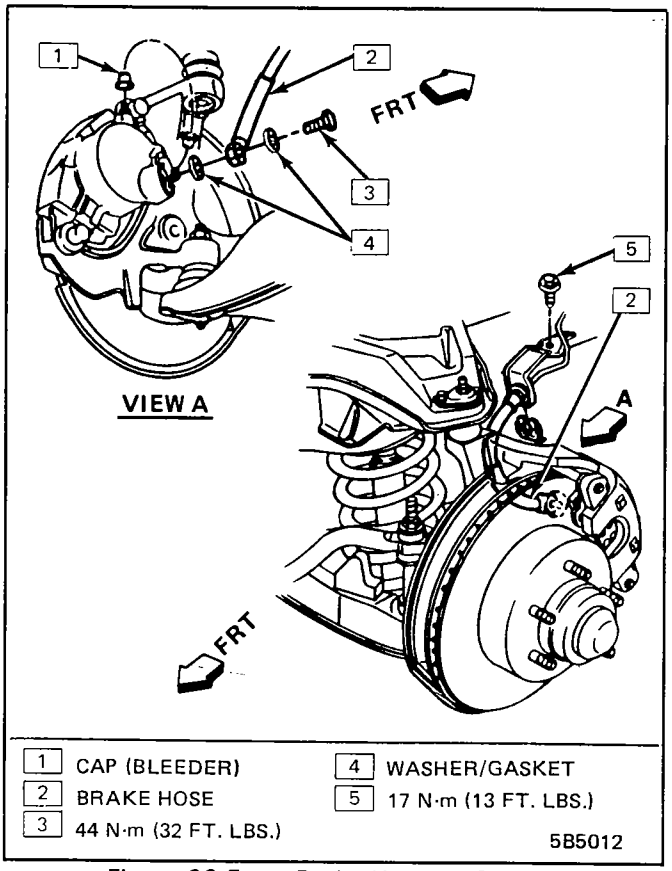


Figure 22 Front Brake Hoses-B Carline

Front Parking Brake Cable

A Carline

See Figure 36

Remove or Disconnect

1. Loosen cable at equalizer nut to allow cable to be disconnected at the foot brake clevis.
2. Conduit fitting from boot brake assembly while depressing fitting retaining tangs
3. Screw and retainer while lifting carpet in cable and grommet area
4. Lift cable retaining clips and unseat grommet by pushing it toward the passenger compartment.
5. Front cable conduit fitting from equalizer and cable end button from connector
6. Pull cable forward out thru the floor pan hole.

Install or Connect

1. Push cable rearward in thru the floor pan hole
2. Front cable conduit fitting to equalizer and cable end button to connector
3. Reseat grommet and cable into retaining clips.
4. Screw and retainer while lifting carpet in cable and grommet area
5. Conduit fitting to boot brake assembly and seat retaining tangs
6. Cable to foot brake clevis

Adjust

- Parking brake cable at equalizer nut

Front Parking Brake Cable
C-H Carlines

See Figure 37

Remove or Disconnect

1. Raise car and suitably support. See Section 0A.
2. Loosen equalizer assembly at front parking brake cable
3. Front parking brake cable from equalizer assembly
4. Cable casing retaining nut at underbody
5. Cable casing and cable from control assembly

Install or Connect

1. Cable casing and cable to control assembly
2. Cable casing retaining nut at underbody and tighten to 30N·m (22 lbs. ft.)
3. Front parking brake cable to equalizer assembly

Adjust

- Parking brake cable
- Lower car.

Intermediate Parking Brake Cable
C-H Carline

See Figure 36

Remove or Disconnect

1. Raise car and suitably support. See Section 0A.
2. Intermediate cable at front equalizer assembly
3. Intermediate cable housing at front bracket
4. Intermediate cable housing clip and guide at underbody
5. Intermediate cable at rear equalizer assembly

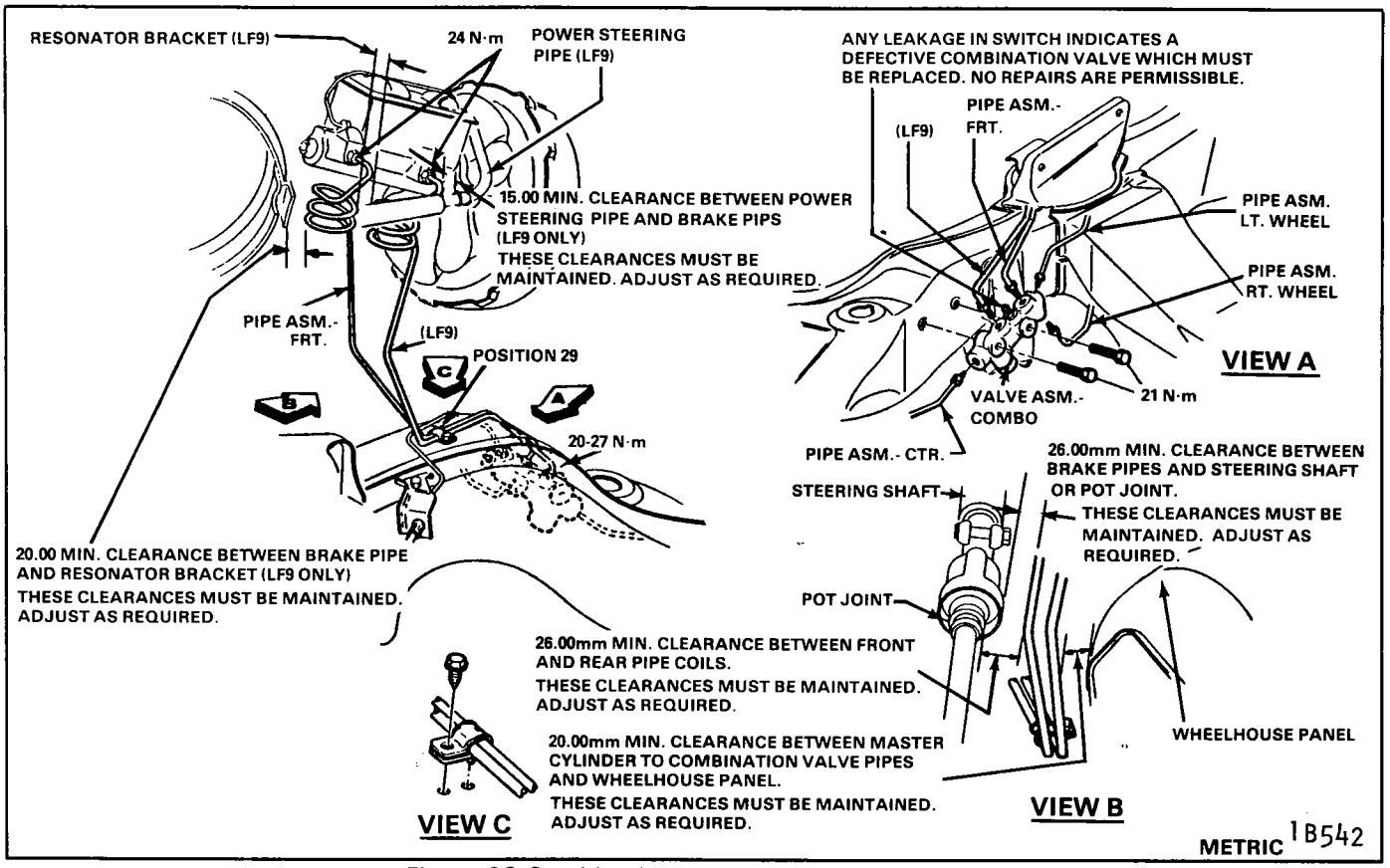


Figure 23 Combination Valve Mounting-B Carline

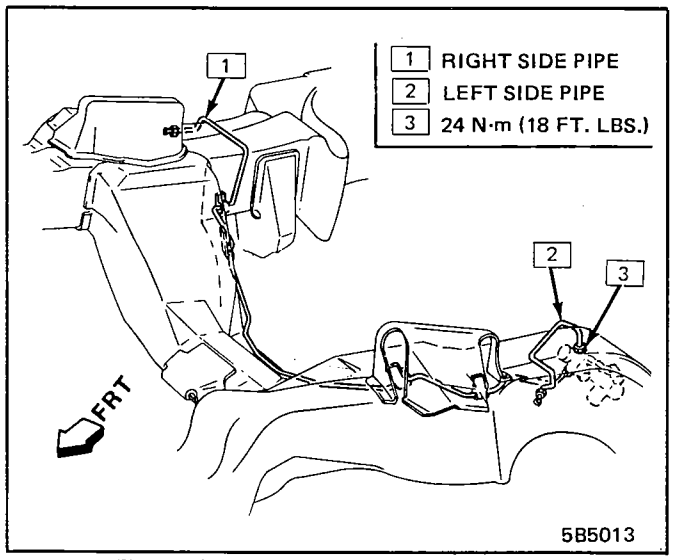


Figure 24 Front Brake Pipes-B Carline

Install or Connect

1. Cable at rear equalizer assembly
2. Housing clip and guide at underbody
3. Cable housing at front bracket
4. Cable at front equalizer assembly

Adjust

- Parking brake. See Section 5C4.
- Lower car.

Rear Parking Brake Cables

See Figure 37

Remove or Disconnect

1. Raise car and suitably support. See Section 0A.
2. Back off equalizer nut until cable tension is eliminated.
3. Tire and wheel assembly
4. Brake drum
5. Insert screwdriver between brake shoe and top part of brake adjuster bracket.
6. Push bracket to the front and release the top adjuster bracket rod.
7. Rear hold down spring, actuator lever and lever return spring
8. Adjuster screw spring
9. Top rear brake shoe return spring
10. Parking brake cable from parking brake lever
11. Depress conduit fitting retaining tangs and remove conduit fitting from backing plate
12. Left Rear Cable:
    - Left cable from equalizer by backing off equalizer nut
    - Depress conduit fitting retaining tangs and conduit fitting from axle bracket

    C-H Carlines
    - Conduit fitting from underbody bracket after removing two attaching screws.
13. Right Rear Cable:

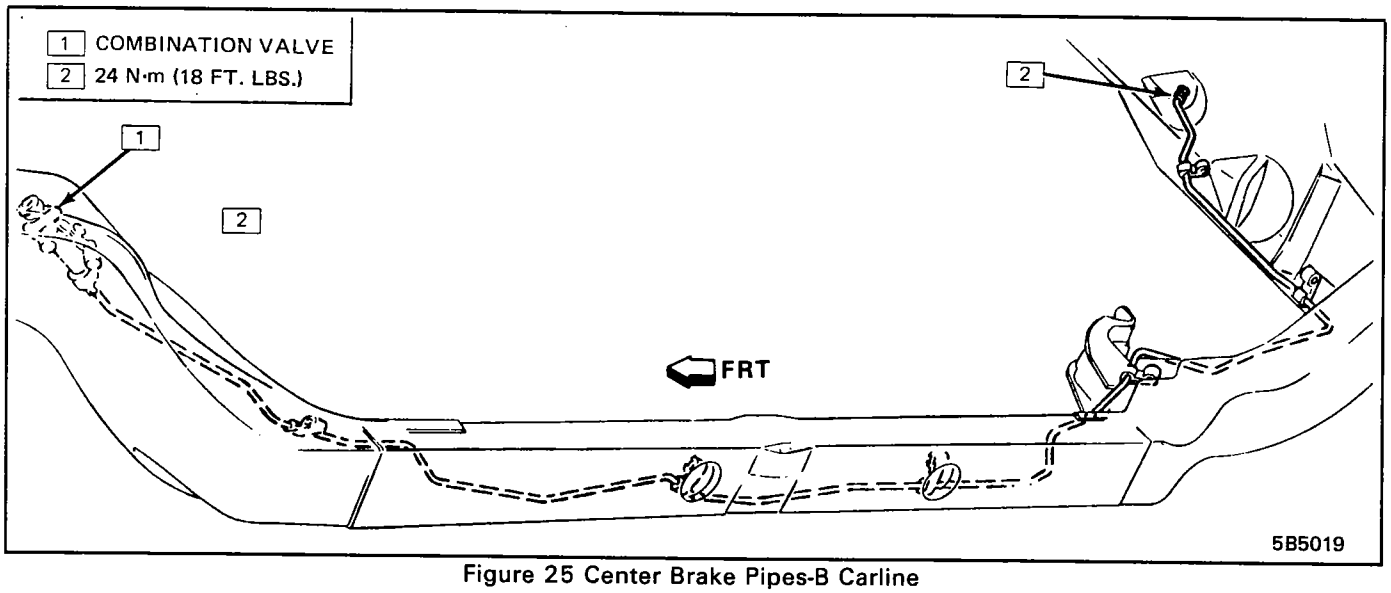


Figure 25 Center Brake Pipes-B Carline

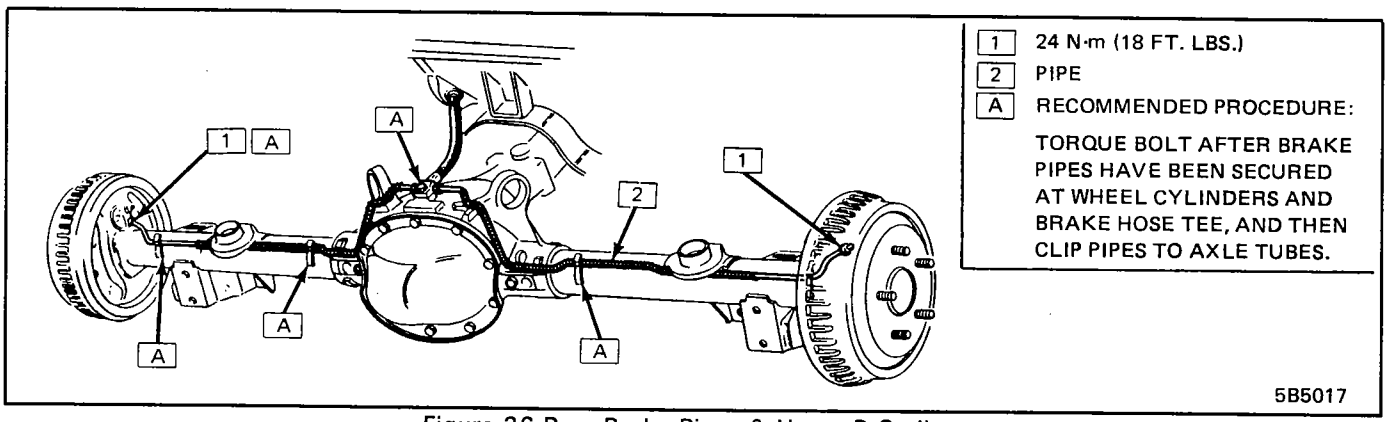


Figure 26 Rear Brake Pipes & Hoses-B Carline

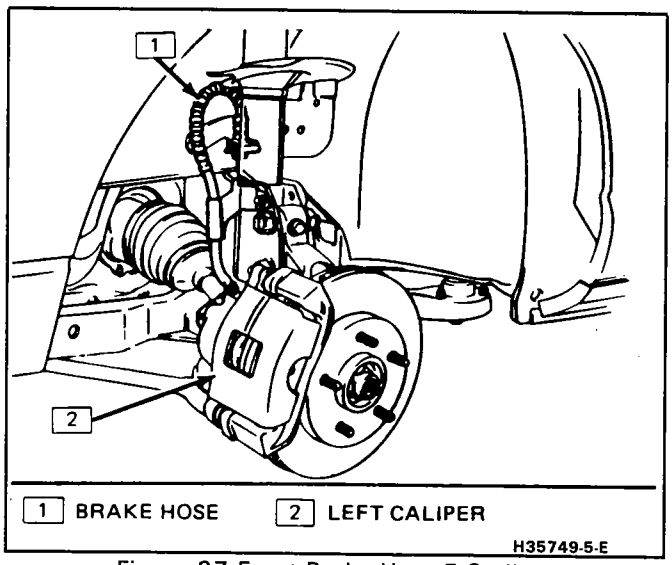


Figure 27 Front Brake Hose-E Carline

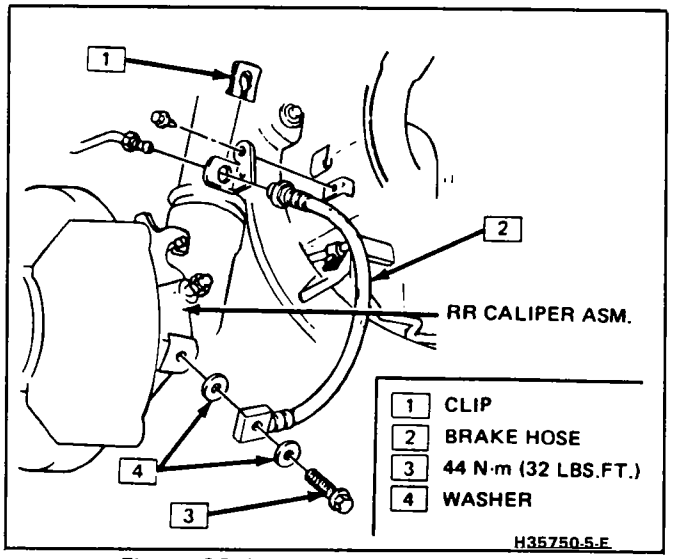


Figure 28 Rear Brake Hose-E Carline

- Cable end button from connector
- Depress conduit fitting retaining tangs and conduit fitting from axle bracket

Install or Connect

1. Right Rear Cable:
   - Conduit fitting retaining tangs and conduit fitting into axle bracket
   - Cable end button to connector
2. Left Rear Cable:
   - Conduit fitting retaining tangs and conduit fitting into axle bracket
   - Left cable to equalizer nut

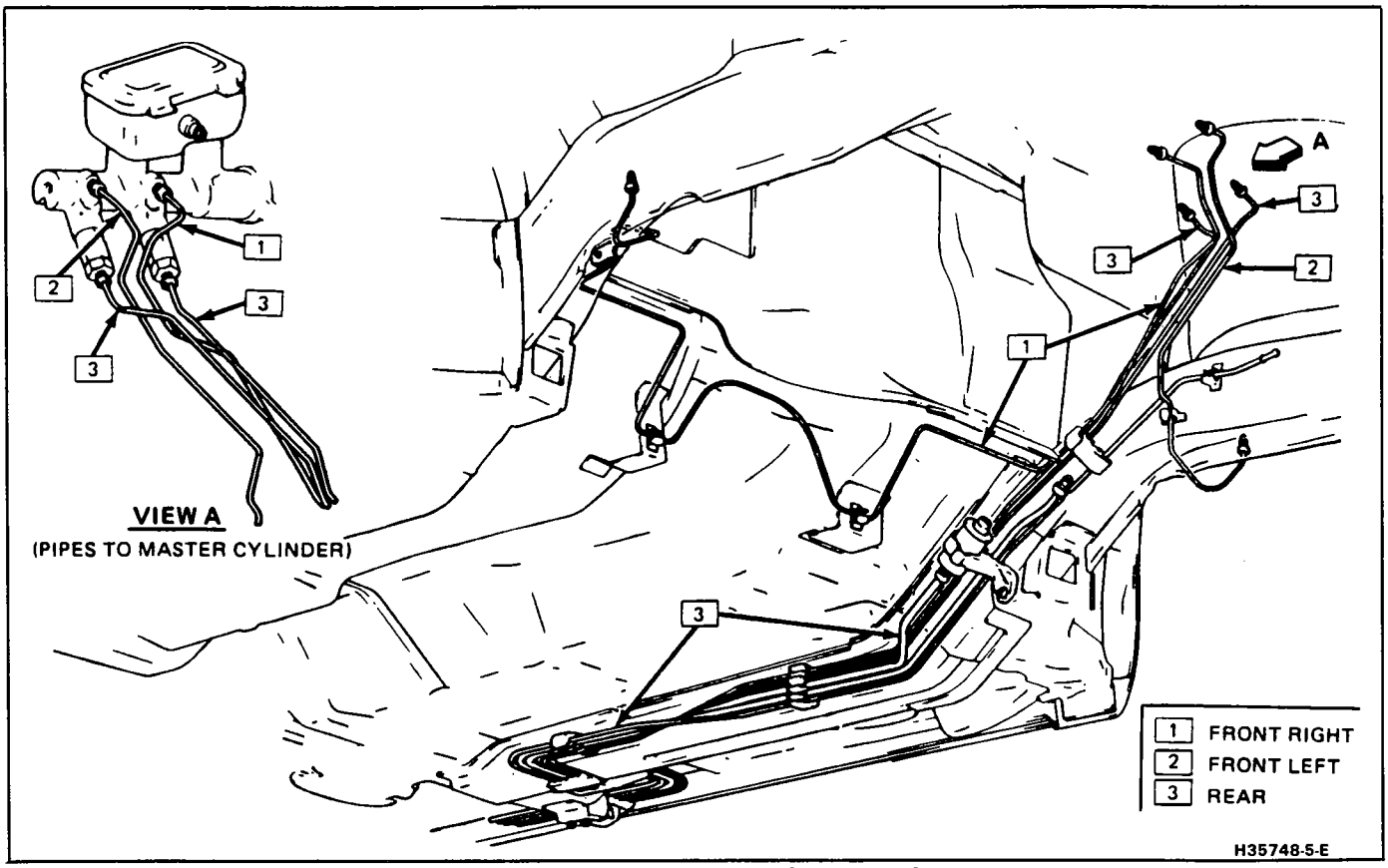


Figure 29 Brake Pipes to Master Cylinder-E Carline

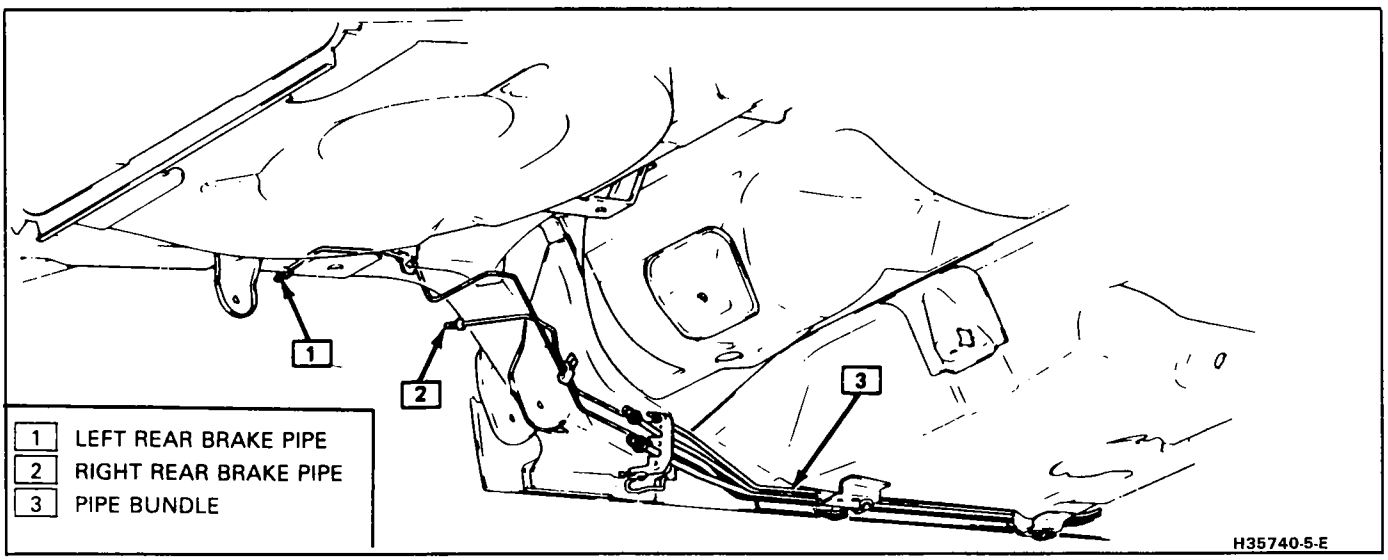


Figure 30 Rear Brake Pipe Bundle-E Carline

C-H Carlines

- Conduit fitting to underbody bracket and tighten attaching screws to 10 N·m (84 lbs. in.).

3. Conduit fitting into backing plate
4. Parking brake cable to parking brake lever
5. Top rear brake shoe return spring
6. Adjuster screw spring
7. Lever return spring, actuator lever and rear hold down spring
8. Top adjuster bracket rod
9. Brake drum, tire and wheel assembly

Adjust

- Parking brake cable

10. Lower car.

PARKING BRAKE

J-N CARLINES

The parking brake cables have the wire strand coated with a plastic material which slides against nylon seals inside the conduit end fittings. This is for corrosion protection and reduced parking brake effort.

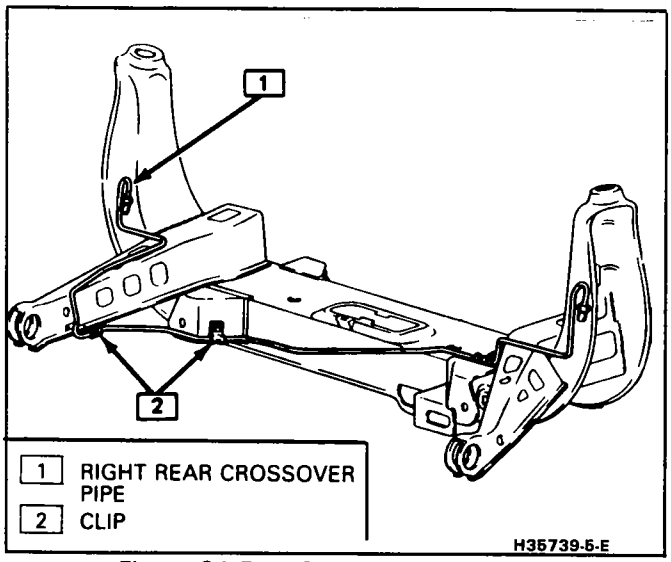


Figure 31 Rear Brake Pipes-E Carline

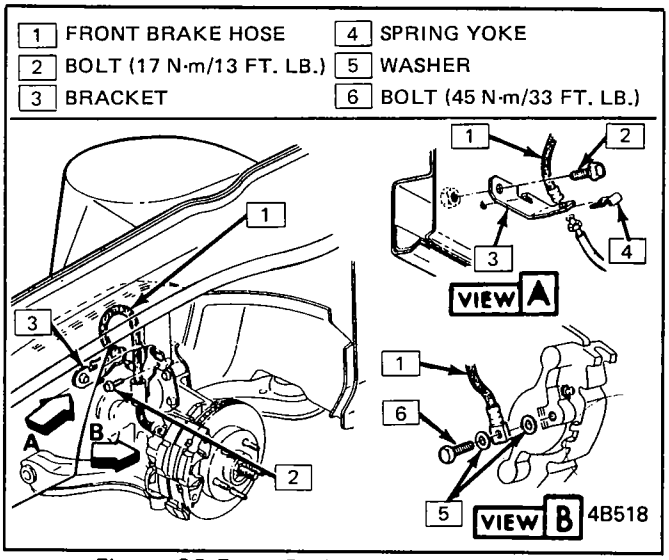


Figure 32 Front Brake Hose-C-H Carlines

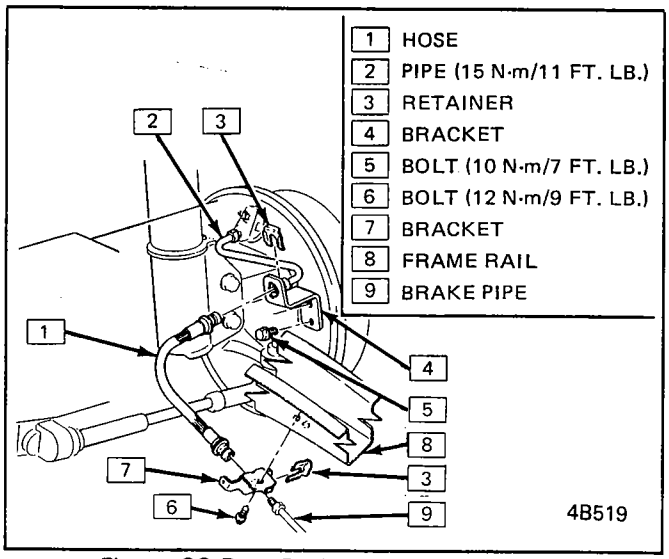


Figure 33 Rear Brake Hose-C-H Carlines

Important

- Plastic coated parking brake cables do not need periodic lubrication.

Handling of these cables during servicing of the parking brake system requires a little extra care. Damage to the plastic coating will reduce corrosion protection and if the damaged area passes through the seal, increase parking brake effort could result. Contact of the coating with sharp-edged tools, or with sharp surfaces of the vehicle underbody, should be avoided.

To prevent damage to the threaded parking brake adjusting rod when servicing the parking brake and cables, the following is recommended:

- Before attempting to turn the adjusting nut, clean the exposed threads on each side of the nut.
- Lubricate the threads of the adjusting rod before turning the nut.

Parking Brake Lever

See Figure 38

Remove or Disconnect

1. Block wheels to prevent car from rolling.
2. Place gear selector in neutral.
3. Loosen cable adjustment to allow cable to be disconnected from lever.
4. Front ash tray and two torx screws located below
5. Snap ring retaining shift knob and shift knob
6. Trimplate by pulling front end up first
7. Three screws under trimplate
8. Rear ash tray, screws under ash tray, and lift off console
9. Parking brake switch
10. Parking brake cable from lever assembly
11. Three screws securing lever to floor pan and lever

Install or Connect

1. Lever and attaching screws
2. Parking brake cable to lever assembly
3. Parking brake switch
4. Console and attaching screws
5. Rear ash tray and attaching screws
6. Three screws under trimplate
7. Trimplate, shift knob and retaining clip
8. Screws located below front ash tray and ash tray

Adjust

- Parking brake cable

Front Parking Brake Cable

J-N Carlines

See Figure 38

Remove or Disconnect

1. Block wheels to prevent car from rolling
2. Place gear selector in neutral
3. Raise car and suitably support. See Section 0A.

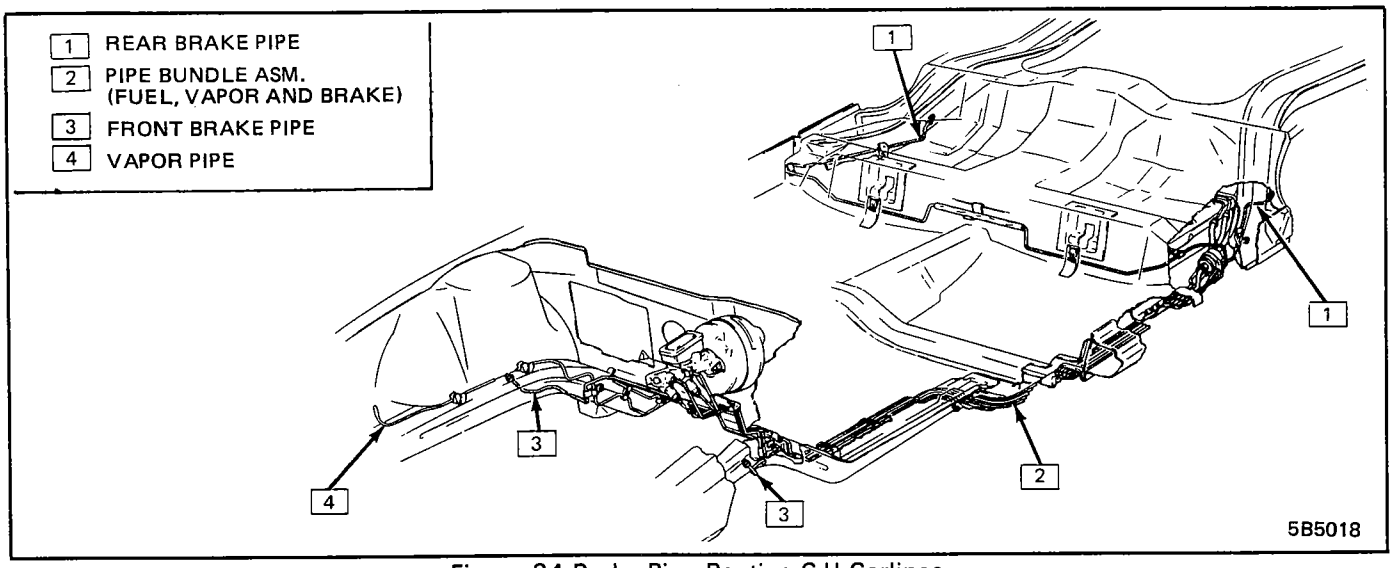


Figure 34 Brake Pipe Routing-C-H Carlines

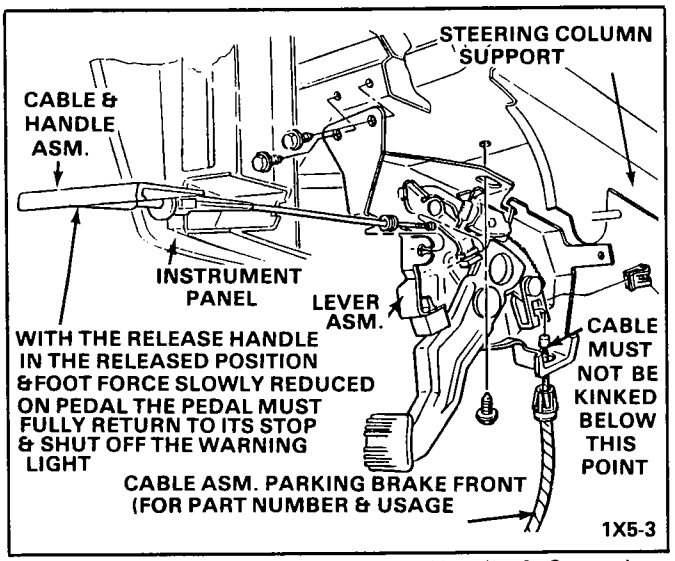


Figure 35 Parking Brake Release Handle & Control Assembly-A Carline

4. Loosen equalizer nut.
5. Console
6. Parking brake cable from lever
7. Cable retaining nut securing front cable to floor panel
8. Loosen catalytic converter shield and parking brake cable from body
9. Cable from equalizer and cable from guide and underbody clips

Install or Connect

1. Cable or equalizer and cable to guide and underbody clips
2. Parking brake cable to underbody and tighten converter shield
3. Cable retaining nut securing front cable to floor panel
4. Parking brake cable to lever
5. Console

Adjust

- Parking brake cable

6. Lower car.

Rear Parking Brake Cables

J-N Carlines

See Figure 38

Remove or Disconnect

1. Raise car and suitably support. See Section 0A.
2. Back off equalizer nut, (must be separated from threaded rod if removing left cable), until cable tension is eliminated.
3. Tire, wheel and brake drum
4. Insert screwdriver between brake shoe and top part of brake adjuster bracket
5. Push bracket to the front and release the top adjuster bracket rod.
6. Hold down spring, actuator lever and lever return spring.
7. Adjuster screw spring
8. Top rear brake shoe return spring
9. Parking brake cable from parking brake lever
10. Conduit fitting from backing plate while depressing conduit fitting retaining tangs
11. Cable end button from connector, (right side only)
12. Conduit fitting from axle bracket while depressing conduit fitting retaining tangs.

Install or Connect

1. Conduit fitting retaining tangs and conduit fitting into axle bracket
2. Cable end button to connector (right side only)
3. Conduit fitting into backing plate
4. Parking brake cable to parking brake lever.
5. Top rear brake shoe return spring
6. Adjuster screw spring

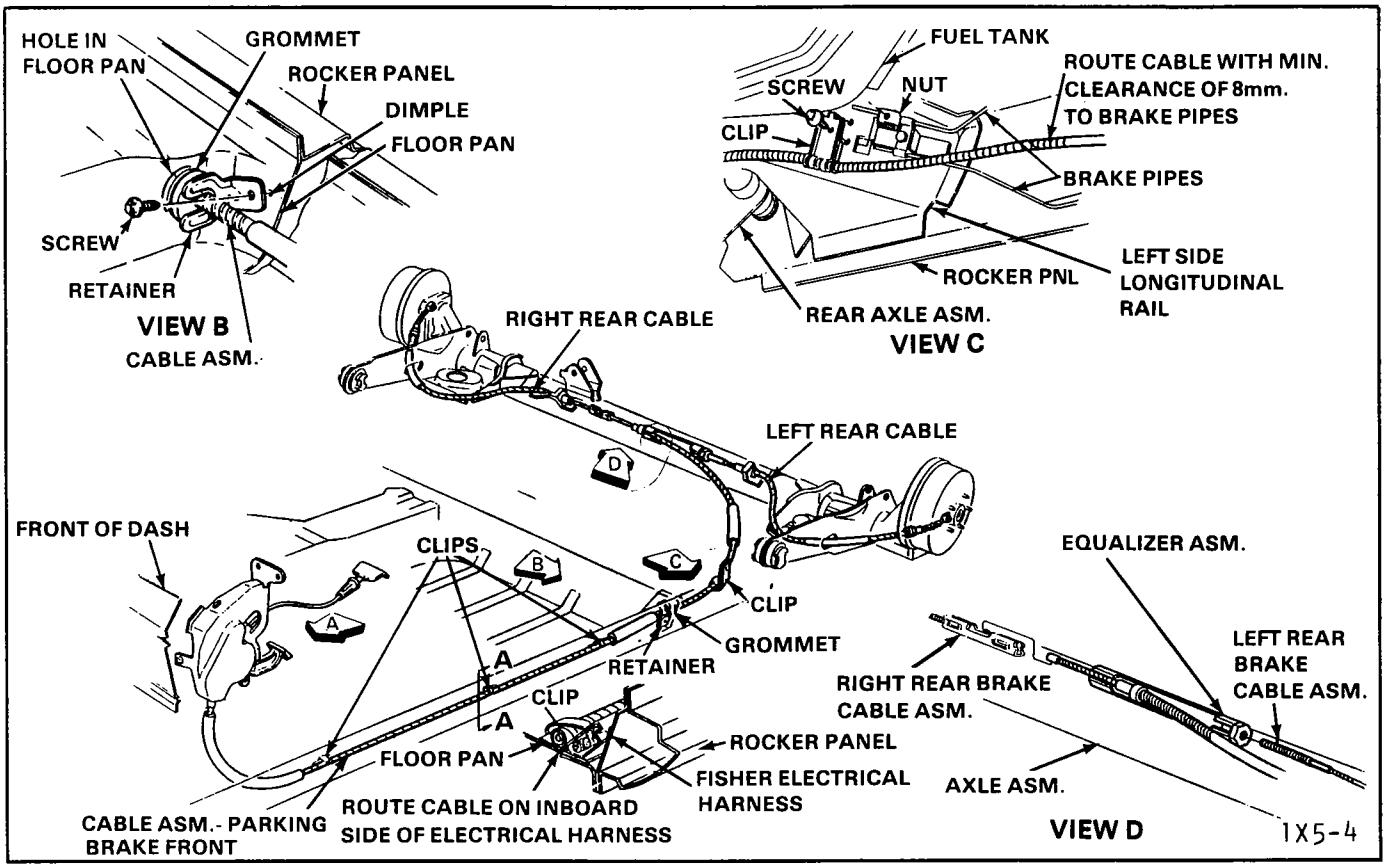


Figure 36 Parking Brake Cable A Carline

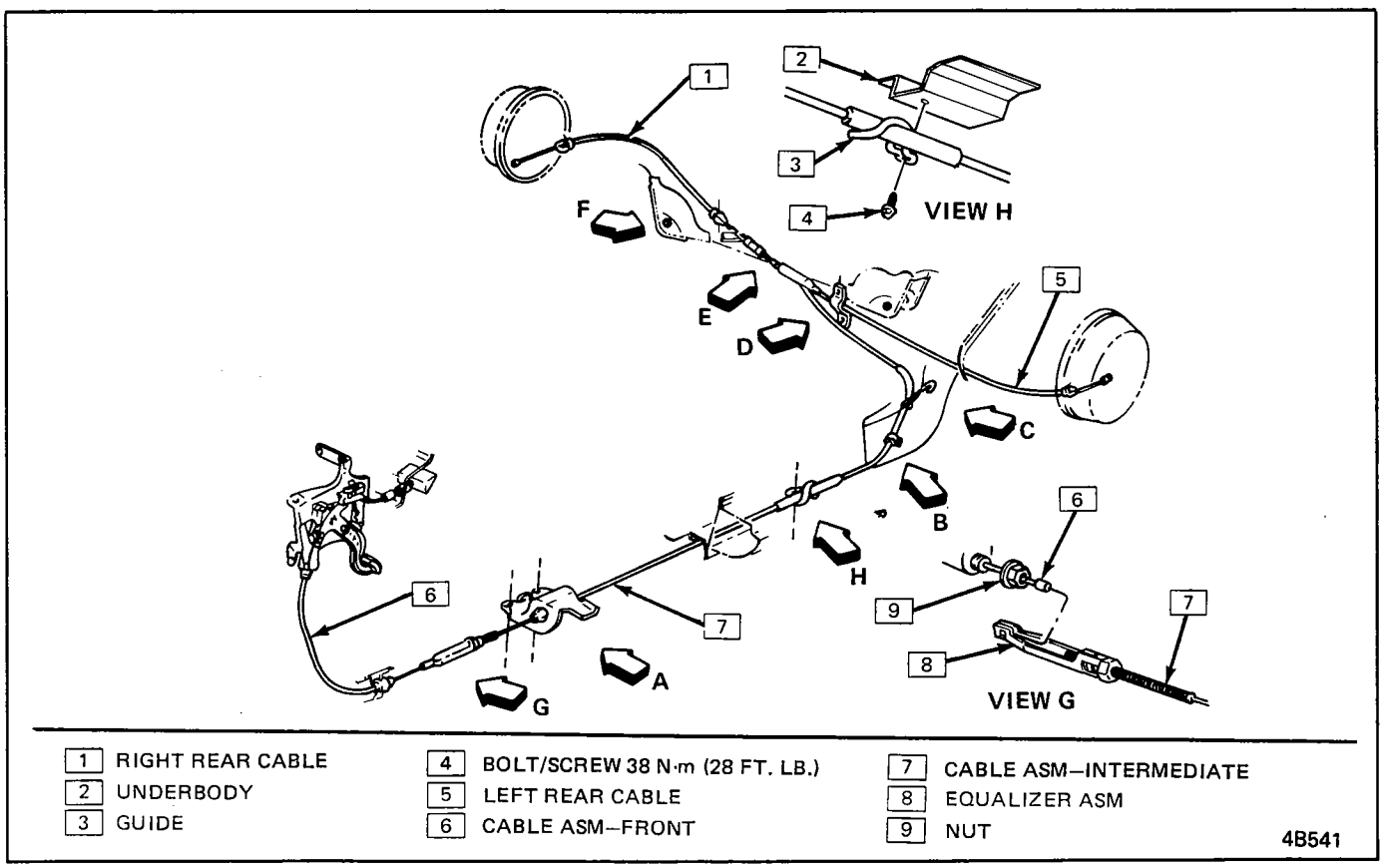


Figure 37 Parking Brake Cable-C-H Carlines

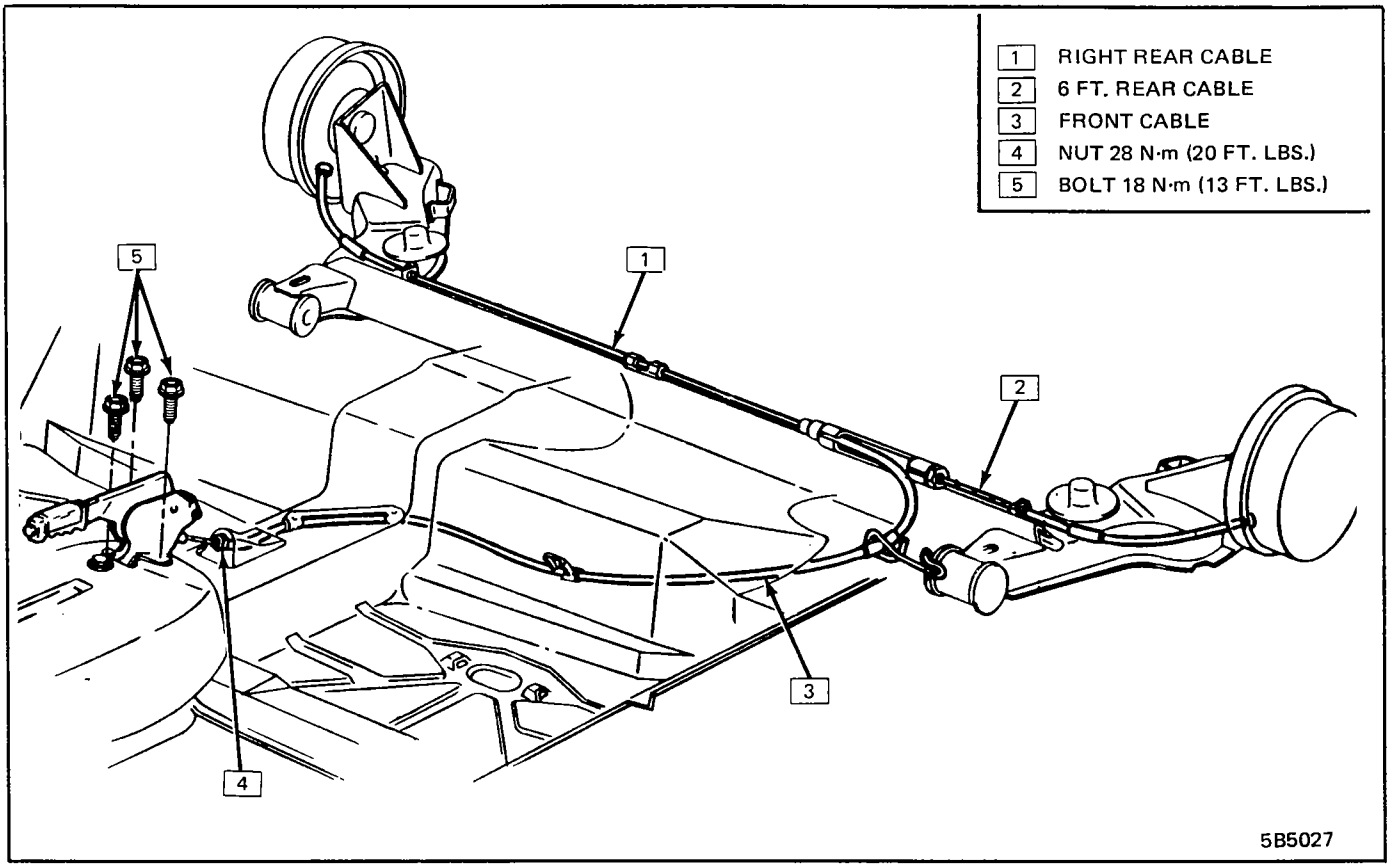


Figure 38 Parking Brake-J-N Carlines

7. Lever return spring, actuator lever and rear hold down spring
8. Top adjuster bracket rod
9. Brake drum, tire and wheel assembly

Adjust

- Parking brake cable

10. Lower car.

PARKING BRAKE

B-G Carlines

Parking Brake Release Handle

See Figures 39 and 40

The parking brake cables have the wire strand coated with a plastic material which slides against nylon seals inside the conduit end fittings. This is for corrosion protection and reduced parking brake effort.

Important

- Plastic coated parking brake cables do not need periodic lubrication.

Handling of these cables during servicing of the parking brake system requires a little extra care. Damage to the plastic coating will reduce corrosion protection and if the damaged area passes through the seal, increase parking brake effort could result. Contact of the coating with sharp-edged tools, or with sharp surfaces of the vehicle underbody, should be avoided.

To prevent damage to the threaded parking brake adjusting rod when servicing the parking brake and cables, the following is recommended:

- Before attempting to turn the adjusting nut, clean the exposed threads on each side of the nut.
- Lubricate the threads of the adjusting rod before turning the nut.

Remove or Disconnect

1. Cable end from release mechanism
2. Cable casing from control assembly
3. Handle from lower instrument panel

Install or Connect

1. Handle to lower instrument panel
2. Cable casing to control assembly
3. Cable end to release mechanism

Adjust

- Parking brake cable

Parking Brake Control Assembly

B-G Carlines

See Figures 39 and 40

Remove or Disconnect

1. Release handle at lever assembly
2. Front parking brake cable and casing at control assembly

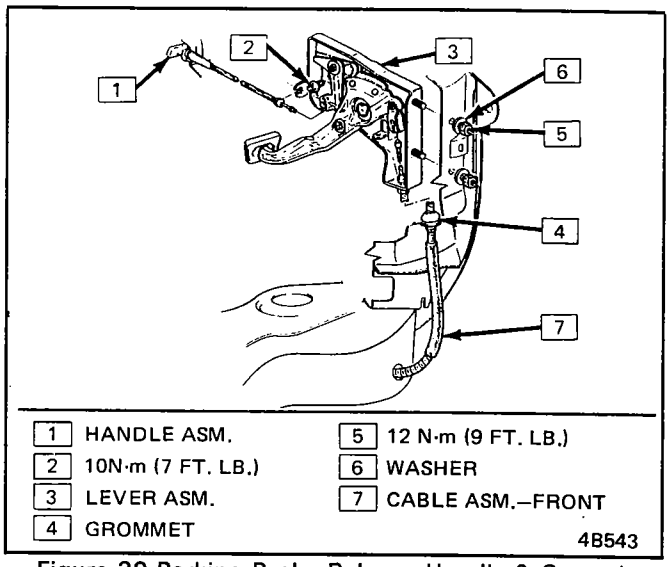


Figure 39 Parking Brake Release Handle & Control Assembly-B Carline

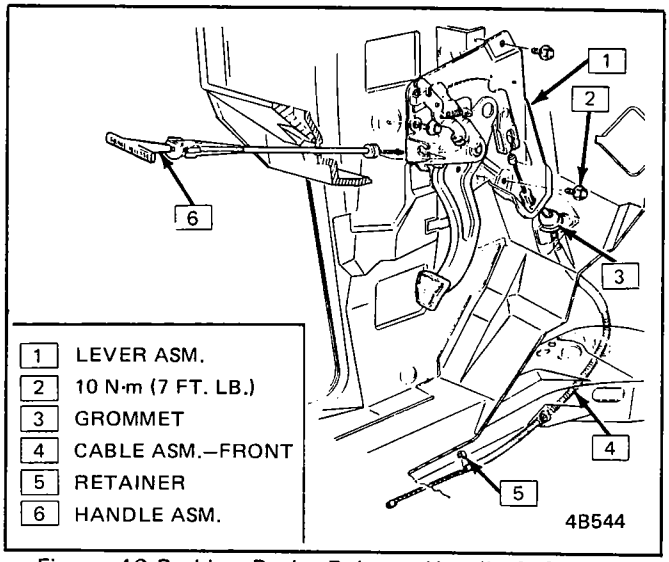


Figure 40 Parking Brake Release Handle & Control Assembly-G Carline

3. Control assembly attaching screws and nuts
4. Control assembly

Install or Connect

1. Control assembly and attaching screws and nuts to 10 N·m (84 lbs. in.)
2. Front parking brake cable and casing at control assembly
3. Release handle at lever assembly

Front Parking Brake Cable

B-G Carline

See Figures 19 and 41

Remove or Disconnect

1. Raise car and suitably support. See Section 0A.
2. Front cable from connector after loosening adjuster nut
3. Compress retainer fingers and loosen at frame
4. Lower car.
5. Lower rear bolt from wheelhouse panel and pull panel out to gain access to front cable
6. Cable from parking brake control assembly while depressing retainer fingers

Install or Connect

1. Cable and casing at control assembly making sure retainer fingers are properly seated
2. Wheelhouse panel and retaining bolt
3. Raise car and suitably support. See Section 0A.
4. Cable casing at frame and seat retainer
5. Front cable at connector

Adjust

- Parking brake cable

6. Lower car.

Left Rear Parking Brake Cable

B-G Carline

See Figures 19 and 41

Remove or Disconnect

1. Raise car and suitably support. See Section 0A.
2. Loosen adjuster nut and compress retainer fingers at equalizer and loosen cable.
3. Cable from connector and equalizer
4. Tire, wheel and brake drum
5. Primary shoe return spring and parking brake strut
6. Cable from backing plate while depressing tangs
7. Cable from parking brake lever

Install or Connect

1. Cable into backing plate and seat retaining tangs
2. Cable to parking brake lever
3. Primary shoe return spring and parking brake strut
4. Brake drum, tire and wheel
5. Cable to connector and equalizer

Adjust

- Parking brake cable

6. Lower car.

Right Rear Parking Brake Cable

B-G Carline

See Figures 19 and 41

Remove or Disconnect

1. Raise car and suitably support. See Section 0A.
2. Adjuster nut at equalizer
3. Cable from retainers at frame and from axle housing clip
4. Tire, wheel and brake drum
5. Primary shoe return spring and parking brake strut

6. Cable from backing plate while depressing retaining tangs
7. Cable from parking brake lever

Install or Connect

1. Cable into backing plate and seat retaining tangs
2. Cable to parking brake lever
3. Primary shoe return spring and parking brake strut
4. Brake drum, tire and wheel
5. Cable retainers at frame and axle housing clip
6. Adjuster nut at equalizer

Adjust

- Parking brake cable

7. Lower car.

PARKING BRAKE

E CARLINE

The parking brake cables have the wire strand coated with a plastic material which slides against nylon seals inside the conduit end fittings. This is for corrosion protection and reduced parking brake effort.

Important

- Plastic coated parking brake cables do not need periodic lubrication.

Handling of these cables during servicing of the parking brake system requires a little extra care. Damage to the plastic coating will reduce corrosion protection and if the damaged area passes through the seal, increase parking brake effort could result. Contact of the coating with sharp-edged tools, or with sharp surfaces of the vehicle underbody, should be avoided.

To prevent damage to the threaded parking brake adjusting rod when servicing the parking brake and cables, the following is recommended:

- Before attempting to turn the adjusting nut, clean the exposed threads on each side of the nut.
- Lubricate the threads of the adjusting rod before turning the nut.

Parking Brake Pedal Assembly

Remove or Disconnect

1. Remove close out panel.
2. Unbolt the hazard/turn signal relay and move to the side.
3. Three attaching nuts
4. Instrument panel to pedal assembly bolt
5. Cable from pedal assembly
6. Brake light sensor wire from switch
7. Pedal assembly

Install or Connect

1. Pedal assembly with three nuts, tighten to 17 N·m (12 lbs. ft.)
2. Instrument panel to pedal assembly bolt
3. Cable to pedal assembly

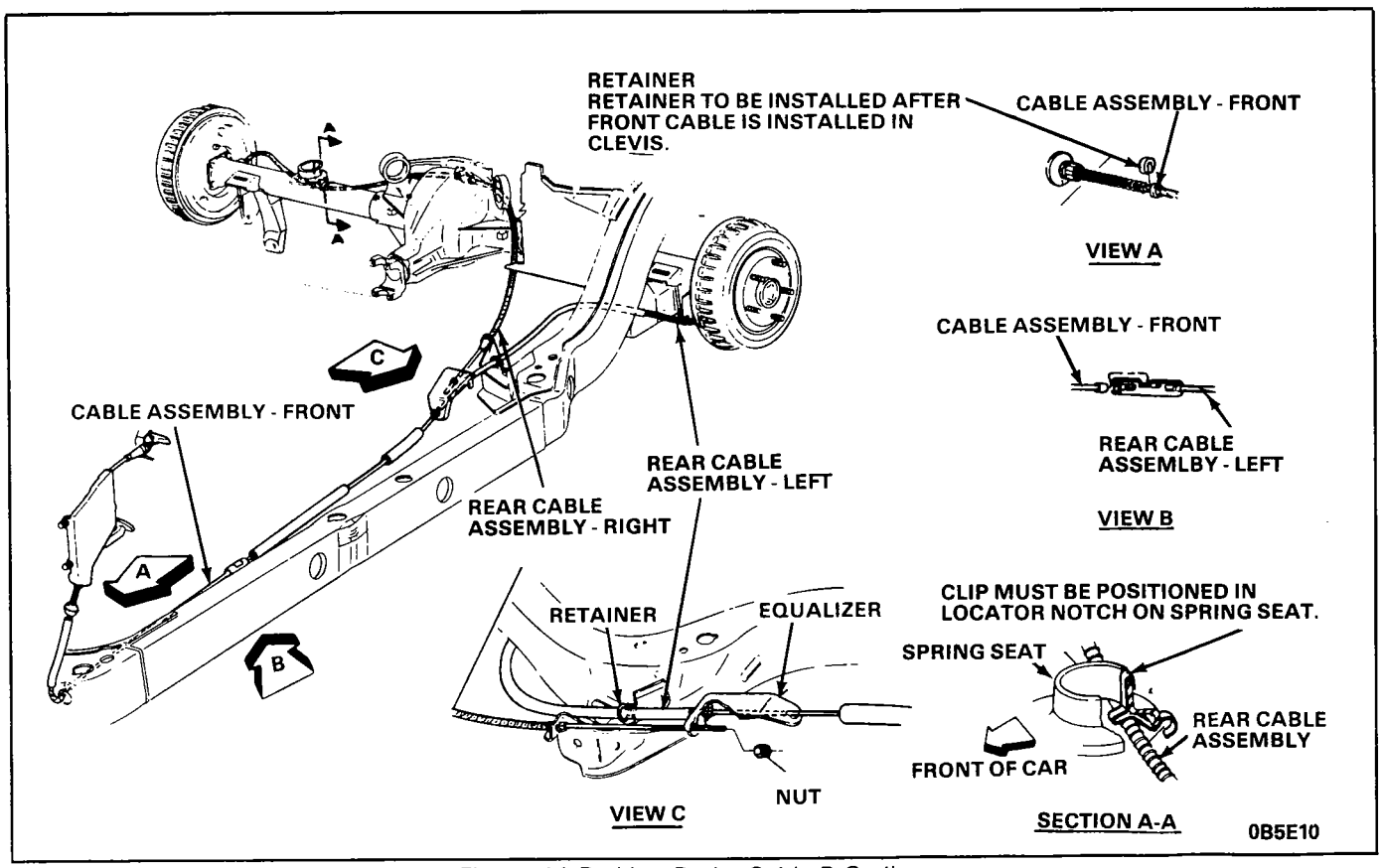


Figure 41 Parking Brake Cable-B Carline

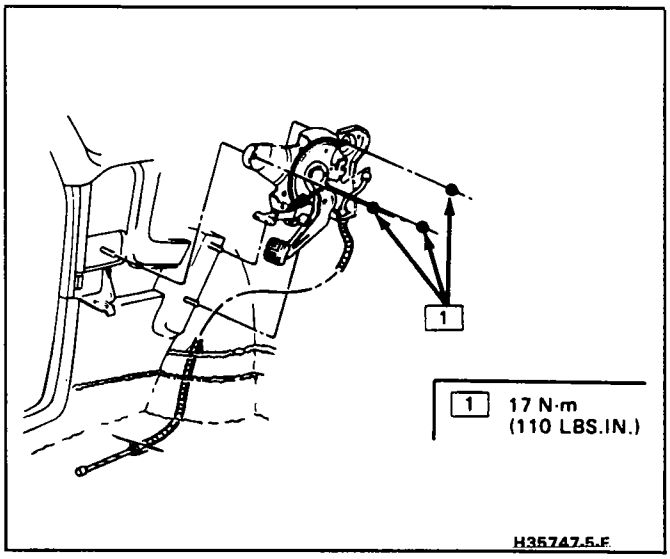


Figure 42 Parking Brake Release Handle & Control-E Carline

4. Brake light sensor wire to switch
5. Hazard/turn signal relay
6. Close out
7. Adjust the parking brake.

Front Parking Brake Cable

Remove or Disconnect

1. Raise car and suitably support. See Section 0A.
2. Loosen the cable adjuster enough to unhook the front cable.
3. Cable to underbody nut
4. Lower car
5. Close out panel
6. Unbolt the hazard/turn signal relay and move to the side.
7. Cable from the pedal assembly
8. Cable from car

Install or Connect

1. Place the cable thru the floor pan
2. Cable to pedal assembly
3. Hazard/turn signal relay
4. Close out panel
5. Raise car and suitably support
6. Cable to floor pan nut, tighten to 22 N·m (16 lbs. ft.)
7. Cable to adjuster
8. Adjust parking brake
9. Lower car

Intermediate Parking Brake Cable

Remove or Disconnect

1. Raise car and suitably support. See Section 0A.
2. Loosen the adjuster nut far enough to separate the cable from the adjuster.
3. Right rear cable from the equalizer
4. Equalizer from the intermediate cable
5. Cable from the underbody bracket
6. Cable

Install or Connect

1. Cable to underbody bracket
2. Intermediate cable to equalizer
3. Right rear cable to the equalizer
4. Intermediate cable to the adjuster
5. Adjust parking brakes.
6. Lower car.

Right Rear Cable

Remove or Disconnect

1. Raise car and suitably support. See Section 0A.
2. Loosen the adjuster far enough to separate the cable from the adjuster.
3. Right rear cable from the equalizer

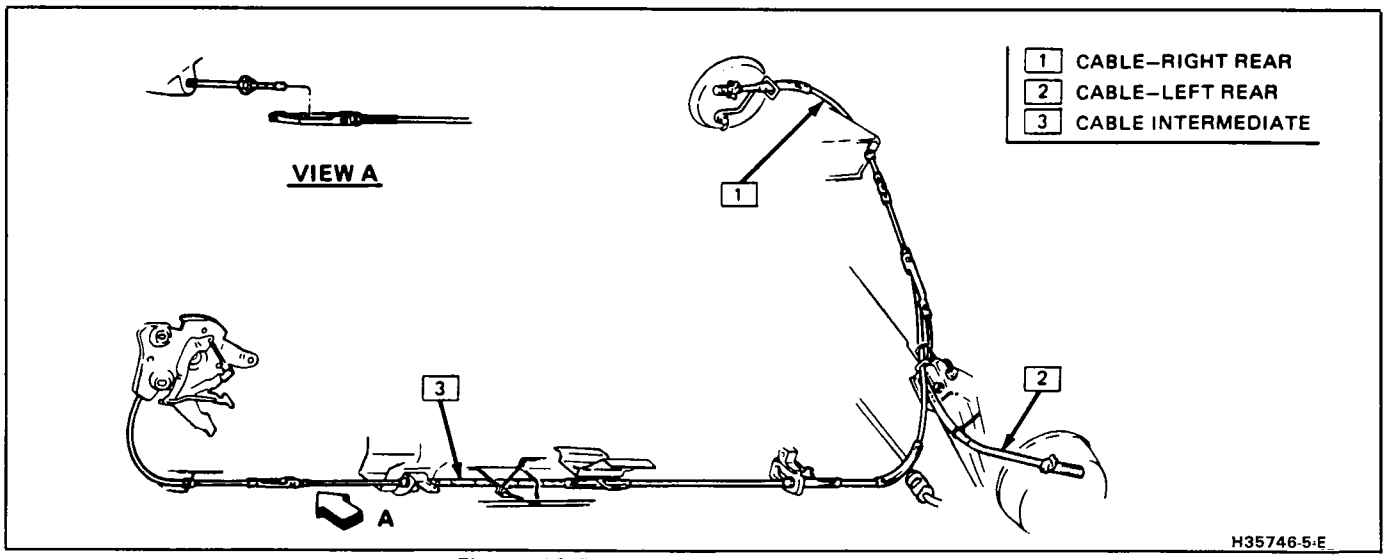


Figure 43 Parking Brake Cable-E Carline

4. Cable from parking brake lever
5. Compress caliper lever return spring and remove.
6. Cable from caliper bracket
7. Cable from the rear suspension support bracket

Install or Connect

1. Cable to rear suspension support bracket
2. Cable to caliper bracket
3. Caliper lever return spring
4. Cable to caliper lever
5. Cable to equalizer
6. Intermediate cable to adjuster and adjust the parking brakes
7. Lower car.

Left Rear Cable

Remove or Disconnect

1. Raise car and suitably support. See Section 0A.
2. Loosen adjuster nut far enough to separate the intermediate cable from the adjuster.
3. Cable from equalizer
4. Cable from caliper lever
5. Compress return spring and remove.
6. Cable from cable to caliper bracket
7. Cable from rear suspension support

Install or Connect

1. Cable to rear suspension support
2. Cable to caliper bracket
3. Return spring
4. Cable to caliper lever
5. Cable to equalizer
6. Intermediate cable to the adjuster
7. Adjust parking brake
8. Lower car.

COMBINATION VALVE

Testing Electrical Circuit

See Figures 20 & 23

When removing the electrical wire connector from the pressure differential switch, it is recommended that you squeeze the eliptical-shaped plastic locking ring and then pull up. This will move the locking tangs away from the switch. A pair of pliers can be used to aid in the removal of the connector.

1. Disconnect wire from switch terminal and use a jumper to connect wire to a good ground.
2. Turn ignition key to "ON" - warning lamp should light. If lamp does not light, bulb is burned out or electrical circuit is defective. Refer to Section 8A for specific electrical information.
3. Turn ignition switch "Off" and reconnect wire to switch terminal.

The combination valve is not repairable and must be serviced as a complete assembly.

On some cars, hoisting may be necessary.

B-G Carlines

Remove or Disconnect

1. Hydraulic lines at combination valve
   - Plug lines to prevent fluid loss and to prevent dirt from entering system.
2. Warning switch wiring connector
3. Bolts attaching combination valve to bracket
4. Combination valve

Install or Connect

1. Combination valve
2. Attaching bolts
3. Warning switch wiring connector
4. Hydraulic lines at combination valve
5. Bleed entire brake system
   - Do not move car until a firm brake pedal is obtained.

Testing Warning Light Switch (Hydraulic)

See Figures 20 & 23

1. Attach a bleeder hose to a brake bleeder screw and immerse the other end of the hose in a container partially filled with clean brake fluid. Be sure master cylinder reservoirs are full.
2. Turn ignition switch to "On" - open bleeder screw while a helper applies moderate pressure to the brake pedal. Warning lamp should light. Close bleeder screw before helper releases brake pedal. Apply brake pedal with moderate-to-heavy pressure. Light should go out.
3. Conventional System:
   a. If the front brakes were used in step 1, then attach bleeder hose to the rear brakes and repeat test.
   b. If the rear brakes were used in step 1, then attach the bleeder hose to the front brakes and repeat test.
4. If warning lamp does not light during Steps 2 and 3 but does light when a jumper is connected to ground, the hydraulic warning light switch is inoperative. Replace hydraulic warning light switch.

BRAKE BOOSTER LOW VACUUM SWITCH

Some cars use a low vacuum switch mounted in the brake vacuum booster or in the brake vacuum hose. This switch operates a warning lamp which indicates when there is low vacuum or a vacuum loss to the system.

Testing Brake Booster Low Vacuum Switch

1. With engine off, key in "Off" position, and park brake released, apply service brake pedal until all booster reserve is depleted (3-5 strokes). The IP brake warning light should be off.
2. Turn key to run position (do not start engine). Brake warning light will come on in 15-45 seconds.

3. After light comes on, start engine and run at idle. Brake warning light will go out in less than 10 seconds.
4. If the warning lamp does not light during step 2 but does when a jumper connects the two switch leads, the vacuum warning light switch is inoperative. Replace vacuum warning light switch.
5. If the warning lamp did not light in Step 4, refer to page 8A-41-0 for specific electrical information.

LINING INSPECTION

Inspect the brake linings every 6,000 miles and any time that the wheels are removed (tire rotation, etc.). Check both ends of the outer pad by looking in at each end of the caliper. These are the points at which the highest rate of wear normally occurs. However, at the same time, check the lining thickness on the inner shoe to make sure that it has not worn prematurely. Some inboard shoe and linings have a thermal layer against the shoe, integrally molded with the lining. This extra layer should not be confused with uneven inboard-outboard lining wear. Look down through the inspection hole in the top of the caliper to view the inner shoe. Whenever the thickness of any lining is worn to within .030" or .76 mm of rivet at either end of the shoe, all disc brake shoe and lining assemblies should be replaced at the same time.

THICKNESS VARIATION CHECK

1. Thickness variation can be checked by measuring the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor.
2. A rotor that varies by more than .013 mm (. 0005") can cause pedal pulsation and/or front end vibration during brake applications. A rotor that does not meet these specifications should be refinished to specifications or replaced.

ROTOR TOLERANCE AND SURFACE FINISH

In manufacturing the brake rotor, tolerances of the braking surfaces for flatness, parallelism and lateral runout are held very close. The maintenance of close tolerances on the shape of the braking surfaces is necessary to prevent brake roughness.

In addition to these tolerances, the surface finish must be held to a specified range. The control of the braking surface finish is necessary to avoid pulls and erratic performance and to extend lining life.

Light scoring of the rotor surfaces not exceeding .015" or .38 mm in depth, which may result from normal use, is not detrimental to brake operation.

LATERAL RUNOUT CHECK

1. Remove caliper and install 2 lug nuts to retain rotor.
2. Fasten a dial indicator to the steering knuckle so that the indicator stylus contacts the rotor about 1 inch from the rotor edge.
3. Zero the dial indicator.
4. Move the rotor one complete revolution and observe total indicated runout (T.I.R.).

Lateral runout of the rotor, if excessive, can often be improved by indexing the rotor on the hub one or two bolt positions from the original position. If the lateral runout cannot be corrected by indexing the rotor, check the hub and bearing assembly for excessive lateral runout. If the hub & bearing assembly lateral runout exceeds .040 mm (.0015) then replace the hub and bearing assembly. If lateral runout is within specifications then resurface or replace the rotor as necessary.

REFINISHING BRAKE ROTORS

Since accurate control of the rotor tolerances is necessary for proper performance of the disc brakes, machining of the rotor should be done only with precision equipment.

All brake rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. Do not use a brake rotor that will not meet the specifications, as shown in the specification chart, see Section 5F.

When refinishing rotors, always use sharp cutting tools or bits. Dull or worn tools leave a poor surface finish which will affect initial braking performance. Vibration dampening attachments should always be used when refinishing braking surfaces. These attachments eliminate tool chatter and will result in better surface finish.

The optimum speed for refinishing braking surfaces is a spindle speed of 200 rpm. Crossfeed for rough cutting should range from .254-.152 mm (.010-. 006) per revolution. Finish cuts should be made at crossfeeds no greater than .051 mm (.002) per revolution.

INSPECTING AND REFINISHING BRAKE DRUMS

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

Cracked, Scored, or Grooved Drum

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

Smooth up any slight scores. Heavy or extensive scoring will cause excessive brake lining wear, and it may be necessary to resurface the drum braking surface.

If the brake linings are slightly worn (but still re-usable) and the drum is grooved, the drum should be polished with fine emery cloth but should not be refinished. Eliminating all grooves in drum and smoothing the ridges on lining would necessitate removal of too much metal and lining, while if left alone, the grooves and ridges match and satisfactory service can be obtained.

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

Out-Of-Round or Tapered Drum

An out-of-round tapered drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum can also cause severe and irregular tire tread wear as well as a pulsating brake pedal. When the drum exceeds the specification limits in taper and/or out-of-round, the drum should be refinished to true up the braking surface. Out-of-round as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

When measuring a drum for out-of-round, taper and wear, take measurements at the open and closed edges of machined surface and at right angles (90°) to each other.

Refinishing Brake Drums

If a drum is to be refinished, only enough metal should be removed to obtain a true, smooth braking surface. If a drum does not clean-up when refinished to a maximum rebore diameter as shown in Section 5F, Specifications and Special Tools, it must be replaced. Removal of more metal will affect dissipation of heat and may cause distortion of the drum.

All brake drums have a maximum diameter cast into them. This diameter is the maximum wear diameter and not a refinish diameter. Do not refinish a brake drum that will not meet the specifications. Any drum which does not meet the specifications as shown in Section 5F should be replaced.

When refinishing drums, always use sharp cutting tools or bits. Dull or worn tools leave a poor surface finish which will affect initial braking performance. Vibration dampening attachments should always be used when refinishing braking surfaces. These attachments eliminate tool chatter and will result in better surface finish.

The optimum speed for refinishing braking surfaces is a spindle speed of 200 rpm. Crossfeed for rough cutting should range from .254-.152 mm (.010-.006) per revolution. Finish cuts should be made at crossfeeds no greater than .051 mm (.002) per revolution.

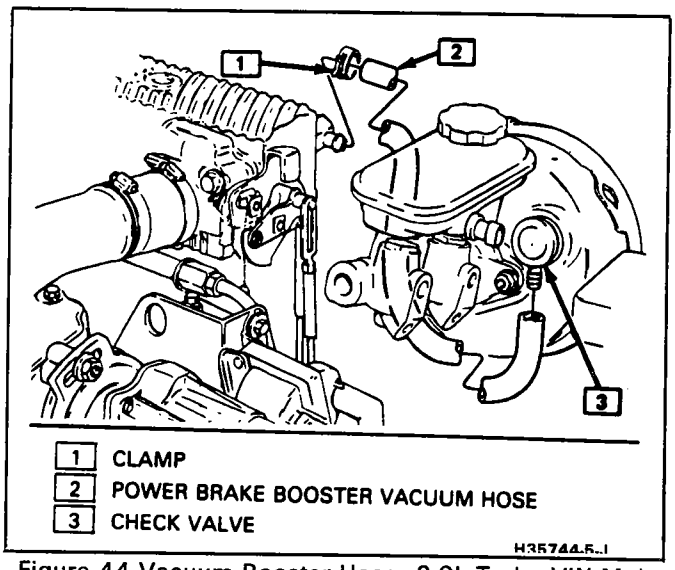


Figure 44 Vacuum Booster Hoses-2.0L Turbo VIN M J Carline

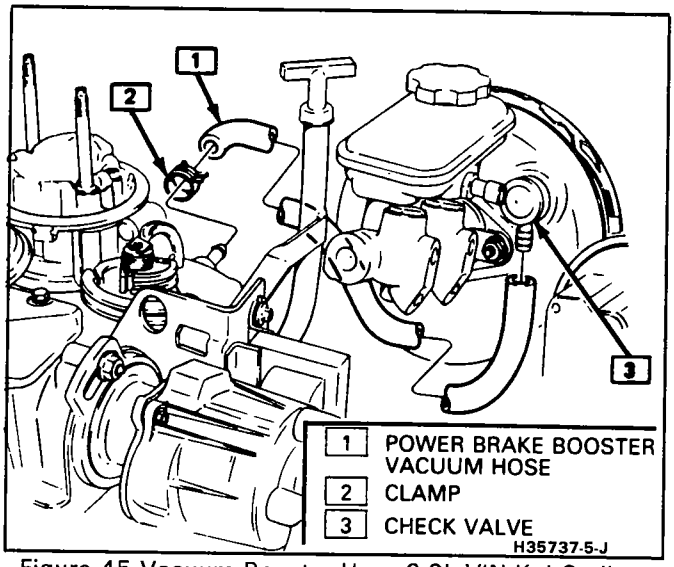


Figure 45 Vacuum Booster Hose-2.0L VIN K J Carline

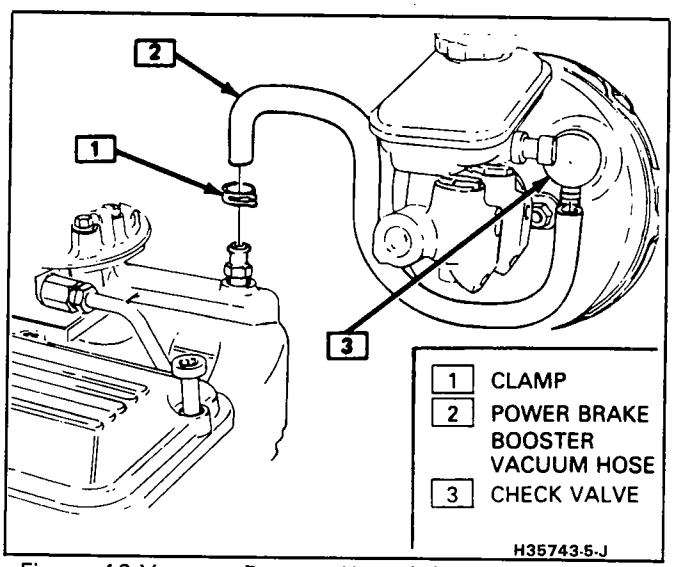


Figure 46 Vacuum Booster Hose-2.0L VIN 1 J Carline

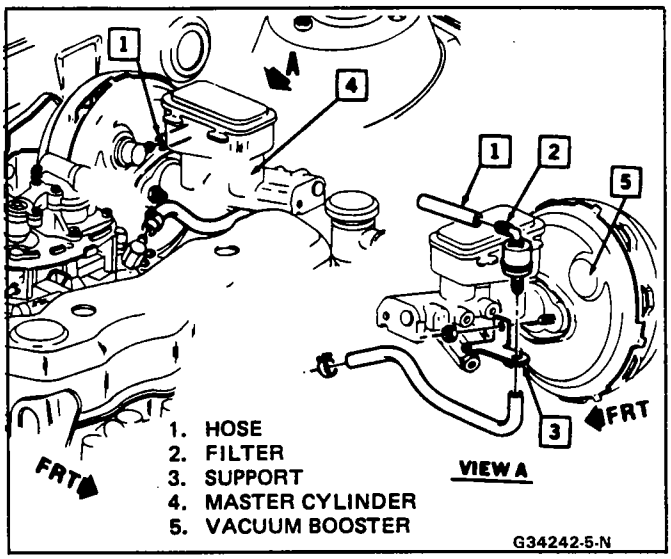


Figure 47 Vacuum Booster Hose-2.5L-VIN U-N Carline

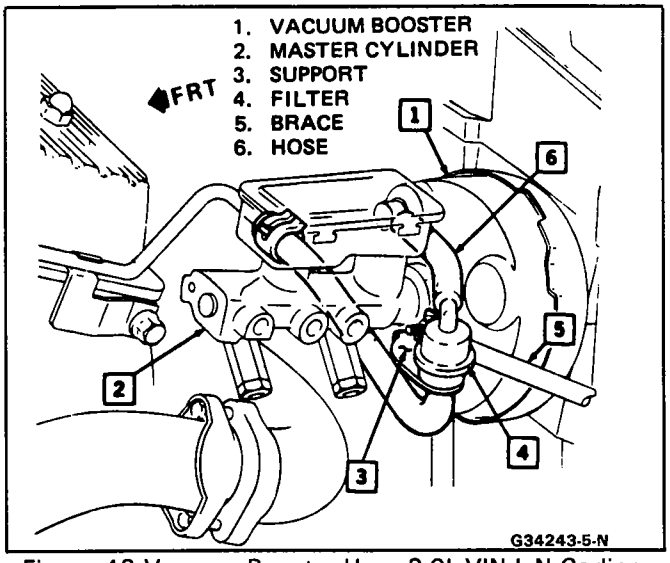


Figure 48 Vacuum Booster Hose-3.0L-VIN L-N Carline

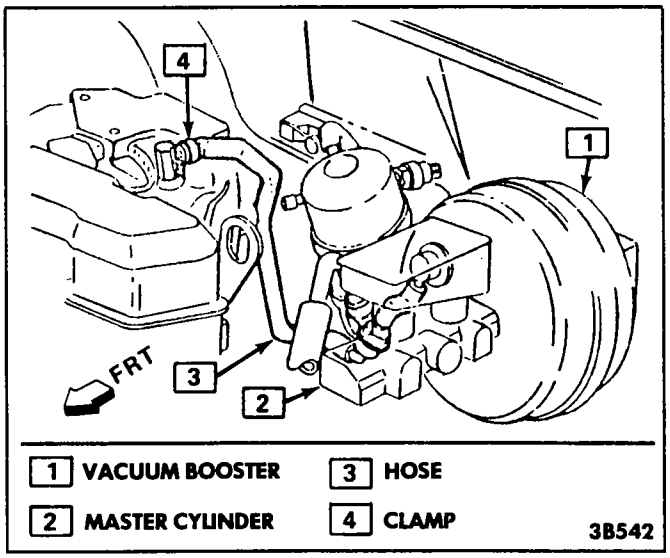


Figure 49 Vacuum Booster Hose-2.5L-VIN R-A Carline

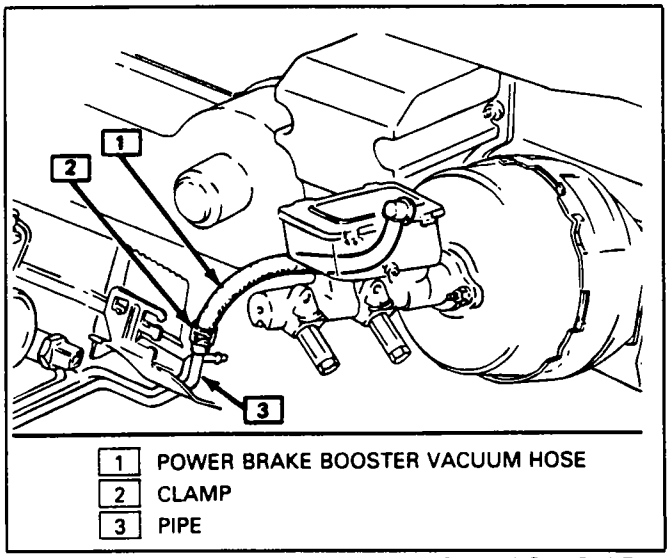


Figure 50 Vacuum Booster Hose-3.8L VIN 3 A-C-H-E Carlines

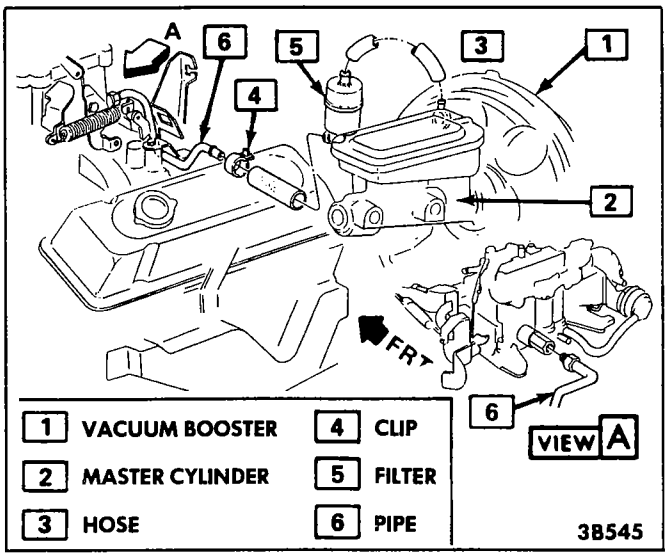


Figure 51 Vacuum Booster Hose-3.8L-VIN A-G Carline

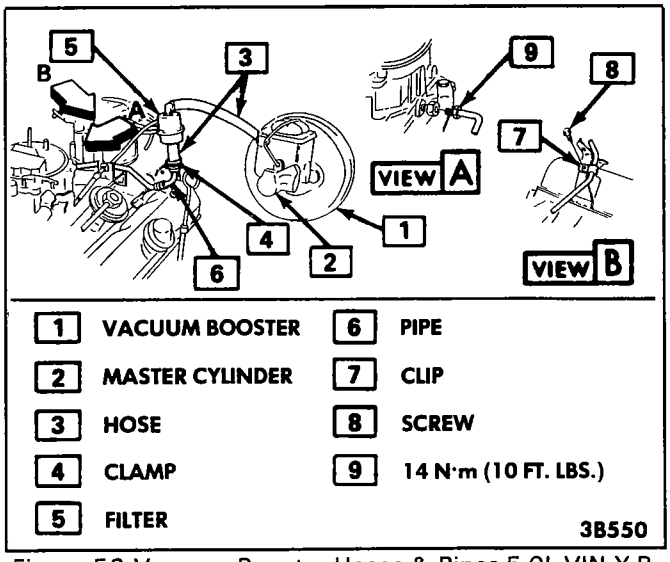


Figure 52 Vacuum Booster Hoses & Pipes-5.0L-VIN Y-B Carline

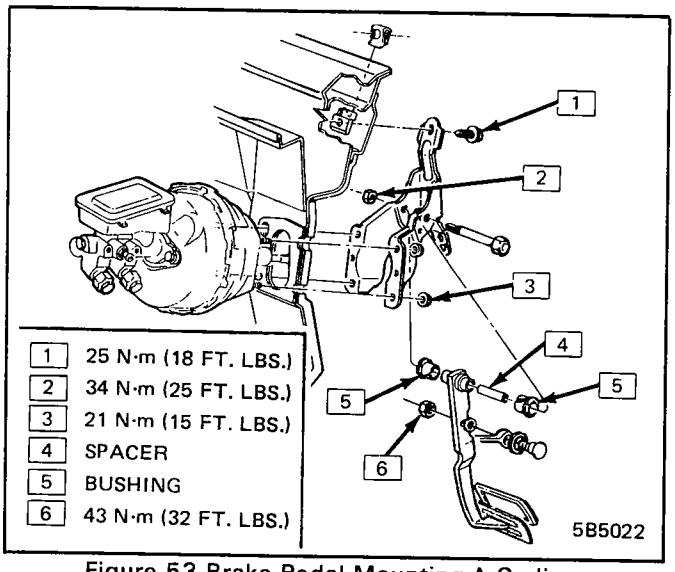


Figure 53 Brake Pedal Mounting-A Carline

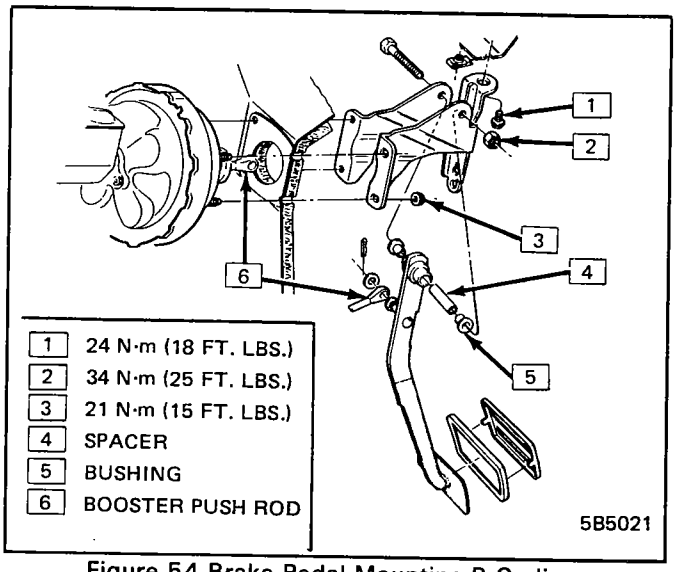


Figure 54 Brake Pedal Mounting-B Carline

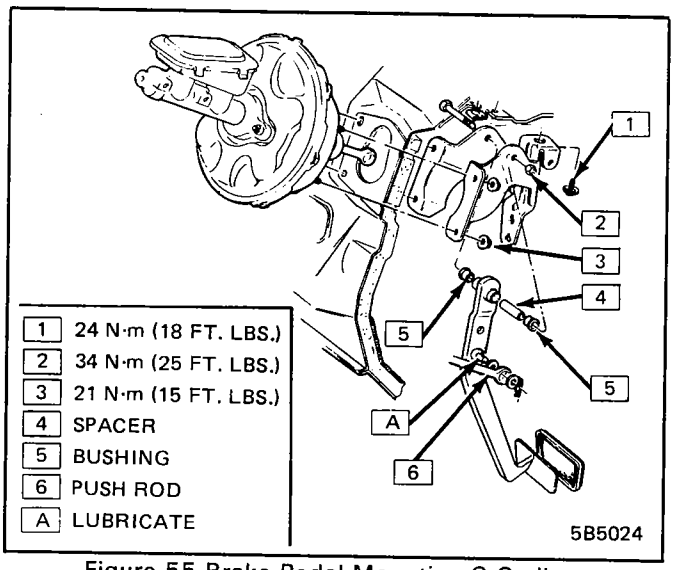


Figure 55 Brake Pedal Mounting-G Carline

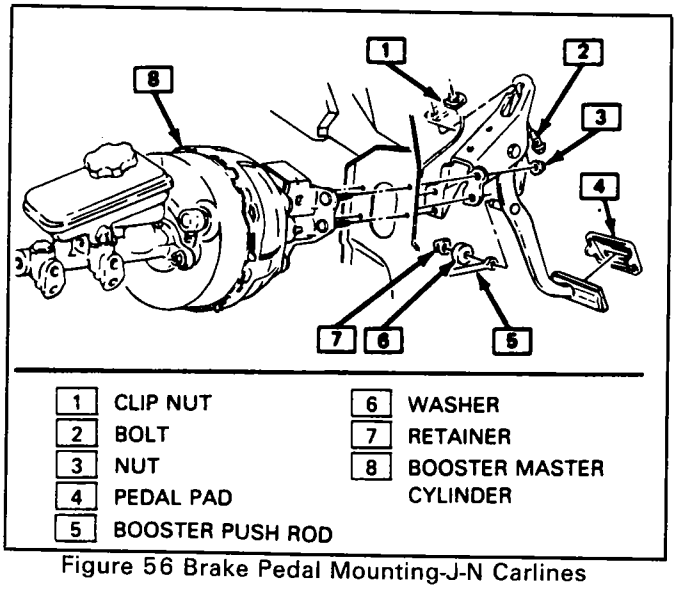


Figure 56 Brake Pedal Mounting-J-N Carlines

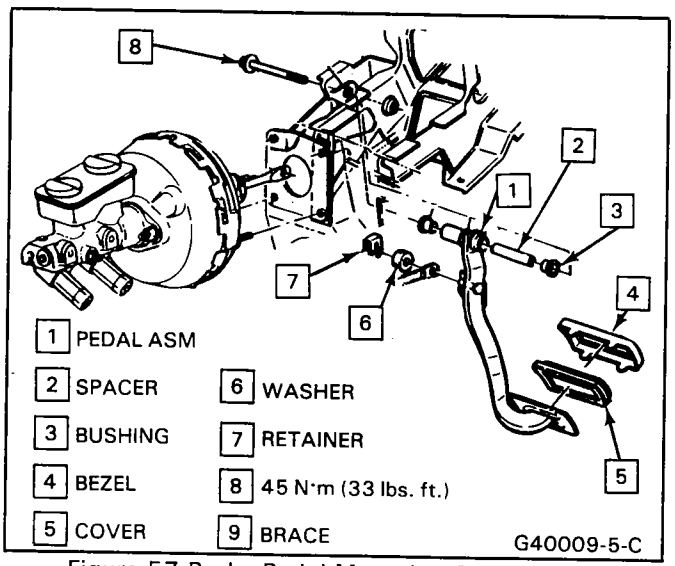


Figure 57 Brake Pedal Mounting-C-H Carlines

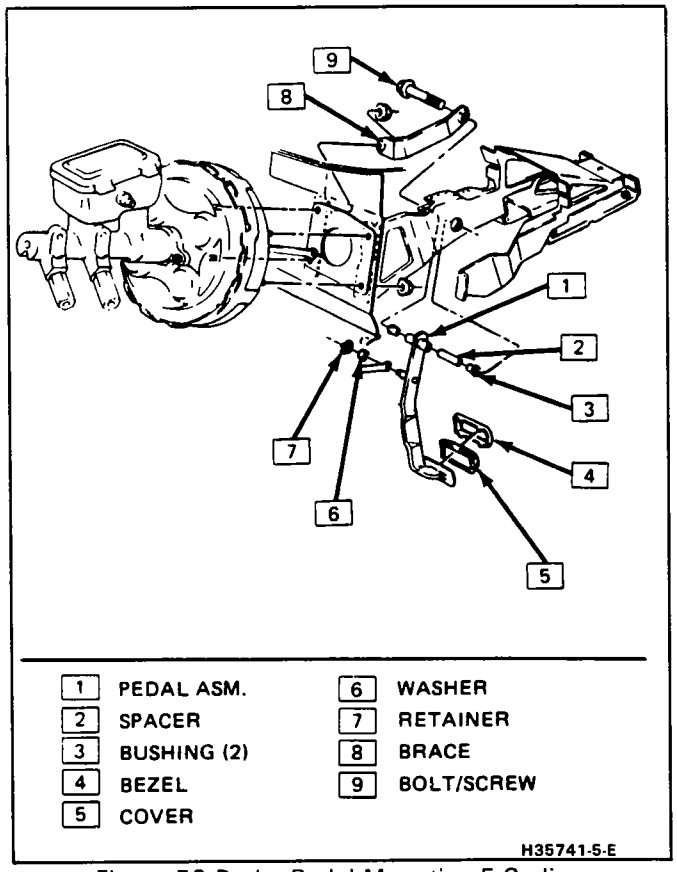
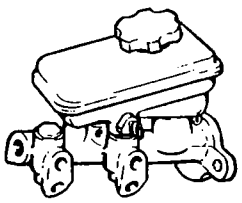


Figure 58 Brake Pedal Mounting-E Carline

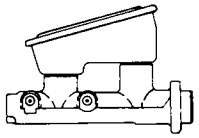
MASTER CYLINDER ASSEMBLIES

A-J-N CARLINES



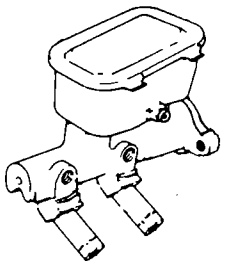
COMPACT MASTER CYLINDER
PAGE 5A1

B & G CARLINES



COMPOSITE
PAGE 5A3

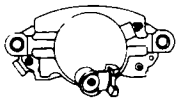
C-E-H CARLINES



DIAGONAL SPLIT W/FLS
5A4-1

DISC BRAKE ASSEMBLIES

B & G CARLINES

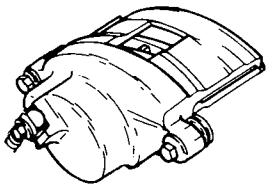


3000 FRONT
PAGE 5B1

A-J-N & A-C-H CARLINES

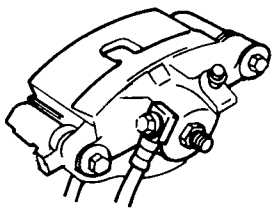
3200 FRONT
PAGE 5B2 & 5B2A

E CARLINE



3264M FRONT
PAGE 5B3

E CARLINE



3738M REAR
PAGE 5B7

DRUM BRAKE ASSEMBLIES

A-J-N CARLINES

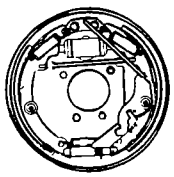
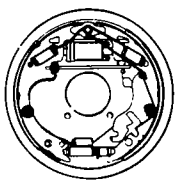


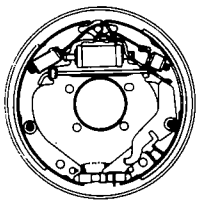
PLATE ANCHOR
PAGE 5C2

G CARLINE



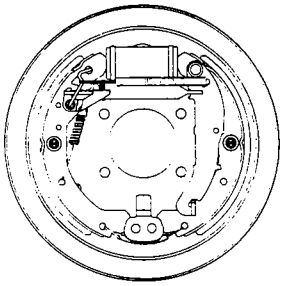
DIRECT TORQUE ANCHOR
PAGE 5C3

B CARLINE



CONVENTIONAL ANCHOR
PAGE 5C1A

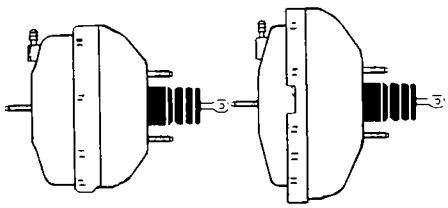
C-H CARLINES



LEADING – TRAILING
PAGE 5C4

POWER HEAD ASSEMBLIES

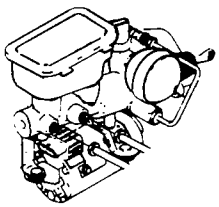
A-B-C-E-G-H-J-N CARLINES



200 MM 240 MM

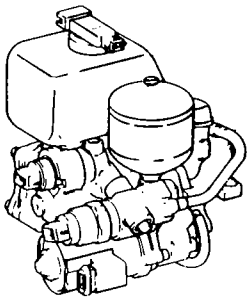
TANDEM DIAPHRAGM
PAGE 5D2

G CARLINE



POWERMASTER
PAGE 5D4

C-H CARLINE



ANTI-LOCK
PAGE 5E