STEERING, SUSPENSION, TIRES AND WHEELS

CONTENTS

Section 3

DIAGNOSIS

CAUTION: This vehicle is equipped with Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in SECTION 9J under "ON-VEHICLE SERVICE" and the SIR Component and Wiring Location View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

CONTENTS

GENERAL INFORMATION

Since the problems in steering, suspension, tires, and wheels involve several systems, they must all be considered when diagnosing a complaint. To avoid pursuing the wrong symptom, always road test the vehicle first. Proceed with the following preliminary checks and correct any substandard conditions which are found.

DIAGNOSIS

PRELIMINARY CHECKS

Inspect

- Tires for improper inflation and uneven wear.
- Joints from the column to the steering gear for loose connectors or wear.
- Front and rear suspension, and the steering gear or linkage for loose or damaged parts.
- For out-of-round or out-of-balance tires, bent wheels, and loose and/or rough wheel bearings.
- Power steering system for leaks. Also check the power steering fluid level and the pump drive belt tension.

Vehicle Pulls (Leads)

Inspect

- For mismatched or uneven tires.
- For broken or sagging springs.
- Radial tire lateral force.
- Wheel alignment.
- Front brakes for dragging.

Abnormal or Excessive Tire Wear

Inspect

- Wheel alignment.
- For excessive toe.
- Springs for sags or breaks.
- Tire balance.
- Strut or shock absorbers for wear or damage.
- Vehicle for signs of abuse.
- Vehicle for uneven or excessive loading.
- Tires for proper inflation.

Scuffed Tires

Inspect

- Wheel alignment.
- Vehicle for signs of abuse.
- Suspension arm for damage or deformation.

Wheel Tramp

Inspect

- Tire or wheel for proper balance.
- Strut or shock absorber for wear and proper operation.

Shimmy, Shake or Vibration

Inspect

- Wheel alignment.
- Tire treads for blisters or separation.
- Tire or wheel for proper balance.
- Wheel stud for excessive runout.
- Brake drum or rotor for damage or deformation.
- Tie rod ends for wear.
- Wheel trim.
- Lower ball studs for wear or damage.
- Wheel for excessive runout.
- Tire and wheel assembly for excessive loaded radial runout.

Excessive Play or Looseness in Steering System

Inspect

- Wheel bearings for wear or damage.
- Steering gear mounting for proper and secure installation.
- Joints from column to steering gear for proper and secure installation.
- Tie rod ends and ball studs for proper and secure installation.
- Steering gear adjustment.

Abnormal Noise, Front End

Inspect

- Ball studs and tie rod ends for lack of lubrication.
- Suspension components for wear or damage.
- Control arm bushings or tie rod ends for wear or damage.
- Wheel nuts for proper and secure installation.
- Suspension bolts for proper and secure installation.
- Steering gear adjustment.
- Strut, shock absorbers or mountings for wear or damage.
- Springs for proper positioning.
- Wheel bearings for excessive wear.

Wander or Poor Steering Stability

Inspect

- Tires for mismatch or uneven wear.
- Strut or shock absorbers for wear or damage.

- Springs for breaks or sags.
- Steering gear adjustment.
- Wheel alignment.
- Lack of lubrication in ball joints or tie rod ends.

Erratic Steering When Braking

Inspect

- Wheel bearings for wear or damage.
- Springs for breaks or sags.
- Wheel cylinder or caliper for leaks.
- Rotors for warpage.
- Caster adjustment.
- Tires for adequate inflation.

Low or Uneven Trim Height

Inspect

- Springs for breaks or sags.
- Vehicle for signs of abuse and overloading.
- Springs for correct part number installation, wear, and damage.

Ride Too Soft

Inspect

- Strut or shock absorbers for wear or damage.
- Springs for breaks, sags, or incorrect installation.

Ride Too Harsh

Inspect

- Strut, shock absorbers or springs for incorrect part number installation.

Body Leans or Sways In Corners

Inspect

- Strut, shock absorbers, and mounting for wear or damage.
- Springs for breaks or sags.
- Vehicle for signs of abuse and overloading.

Suspension Bottoms

Inspect

- Vehicle for signs of abuse and overloading.
- Strut or shock absorbers for wear or damage.
- Springs for breaks, sags, or incorrect installation.

"Dog" Tracking

Inspect

- Rear suspension arm and bushings for wear or damage.
- Rear axle for damage.
- Frame and underbody alignment for damage.

Cupped Tires

Inspect

- Wheel alignment.
- Strut or shock absorbers for wear or damage.
- Wheel bearings for wear or damage.
- Tire and wheel for excessive runout.
- Ball studs for wear or damage.
- Steering gear adjustment.

MANUAL STEERING GEAR

Rattle or Chucking Noise in Steering Gear

Inspect

- Steering gear for proper and sufficient lubrication.
- Steering gear mounting for proper and secure installation.

Hard Steering

Inspect

- Ball studs, tie rod ends, and steering gear for wear, damage, and lack of lubrication.
- Wheel alignment.
- Steering gear adjustment.
- Tires for adequate inflation.

Poor Returnability

Inspect

- Ball studs and tie rod ends for lack of lubrication.
- Ball studs for binding.
- Steering column for binding.
- Wheel alignment.
- Steering gear adjustment.

POWER STEERING GEAR

Hissing Noise

There is some noise in all power steering systems. One of the most common is a hissing sound when the steering wheel is turned and the car is not moving. This noise will be most evident when turning the wheel while the brakes are applied. There is no relationship between this noise and steering performance. Do not replace the valve unless the "hissing" noise is extremely objectionable. A replacement valve will also have a slight noise, and is not always a cure for the condition.

Rattle or Chucking Noise

Inspect

- Pressure hose for proper and secure installation.
- Tie rod ends for proper and secure installation.
- Steering gear mounting for proper and secure installation.

Poor Return of Steering Wheel to Center

Inspect

- Wheel alignment.
- Wheel bearings for wear or damage.
- Joints from the column to the steering gear for free movement and secure installation.
- Tie rod ends for free movement.
- Ball joints for free movement.
- Steering shaft bearings for free movement.
- Steering gear adjustment.
- Steering gear valve for proper operation.

Poor Returnability

Inspect

- Ball studs and tie rod ends for lack of lubrication.
- Ball studs for binding.
- Steering column for binding.
- Wheel alignment.
- Valve for sticking and proper operation.
- Steering gear adjustment.
- Steering gear for binding on lower coupling.
- Tires for adequate inflation.

Steering Wheel Surges or Jerks

Inspect

- Power steering hydraulic system for air in pipes/hoses or reservoir.
- Drive belt for damage or improper installation.

Momentary Increase in Effort When Turning Wheel Fast to Right or Left

Inspect

- Power steering hydraulic system for internal leakage.

Steering Wheel Surges or Jerks When Turning With Engine Running Especially During Parking

Inspect

- Power steering pump for sufficient pressure output.
- Steering gear valve for proper operation.

Steering Wheel Kick-Back

Inspect

- Power steering hydraulic system for air in pipes/hoses and reservoir.
- Joints from column to steering gear for wear and proper and secure installation.
- Tie rod ends for proper and secure installation.
- Wheel bearings for wear or damage.

Excessive Wheel Kickback or Loose Steering

Inspect

- Power steering hydraulic system for air in lines and reservoir.
- Steering gear for proper and secure installation.
- Joints from column to steering gear for proper and secure installation.
- Wheel bearings for wear and damage.

Hard Steering or Lack of Assist (Especially During Parking)

Inspect

- Joints from column to steering gear for wear and improper installation.
- Steering gear valve for proper installation.
- Power steering pump for sufficient pressure output.
- Power steering pump for internal leakage.
- Steering gear for internal leakage.

Hard Steering

Inspect

- Power steering hydraulic system.
- Steering gear adjustment,
- Steering gear for binding and rough movement.
- Steering gear mounting for proper and secure installation.
- Tires for adequate inflation.

POWER STEERING PUMP

Foaming, Milky Power Steering Fluid, Low Fluid Level, and Possible Low Pressure

These conditions can be caused by air in the fluid, and loss of fluid due to internal pump leakage causing overflow. Check for leaks and correct fluid level. Bleed the system. Extremely cold temperatures will cause air bubbles in the system if the fluid level is low. If the fluid level is correct and fluid still foams, remove pump from vehicle and check pump housing for cracks. If housing is cracked, replace the pump.

Low Pressure Due to Steering Pump

Inspect

- Flow control valve for proper operation.
- Pressure plate for proper mating with cam ring.
- Cam ring for wear or damage.
- Pressure plate, thrust plate, and rotor for wear or damage.

- Rotor slots for proper vane operation.
- Pump for high internal leakage.

Low Pressure Due to Steering Gear

Inspect

- Housing bore for scoring or other damage.
- Valve rings and seals for leaking.

Growling Noise in Steering Pump

Inspect

- Steering gear for restriction which causes excessive backpressure.
- Pressure plates, thrust plate, or rotor for wear or damage.
- Cam ring for wear or damage.

Groaning Noise in Steering Pump

Inspect

- Power steering hydraulic system for air in pipes/hoses or reservoir.
- Fluid level.
- Power steering pump mounting for proper and secure installation.

Rattling Noise in Steering Pump

Inspect

- Rotor slots for proper vane operation.
- Vane for proper installation.

Swishing Noise in Steering Pump

Inspect

- Flow control valve for damage.

Whining Noise in Steering Pump

Inspect

- Power steering pump shaft bearing for damage.
- Pressure plates and vanes for damage.

STEERING COLUMN

LOCK SYSTEM

Will Not Unlock

Inspect

- Lock cylinder for damage.
- Park lock cable for damage.

Will Not Lock

Inspect

- Lock cylinder for damage.
- Shift linkage for proper adjustment.
- Ignition switch for free movement.
- Park/lock cable for damage.

High Lock Effort

Inspect

- Lock cylinder for damage.
- Ignition switch for damage.
- Shift linkage adjustment.

Key Cannot Be Removed With Ignition Switch in "Off-Lock" Position

Inspect

- Lock cylinder for damage.
- Linkage adjustment.

COLUMN

Noise in Column

Inspect

- Joints from the column to the steering gear for proper and secure installation.
- Column alignment.
- Bearings for sufficient lubrication.
- Lower and upper steering shaft bearings for wear or damage.
- Shaft lock snap ring for proper seating.

High Steering Shaft Effort

Inspect

- Upper and lower bearing for damage.

Lash in Steering Column

Inspect

- Instrument panel-to-column upper and lower bracket mounting bolts for proper and secure installation.

COMBINATION SWITCH

This diagnosis covers mechanical problems only. Refer to SECTION 8A for combination turn/signal switch electrical diagnosis.

Turn Signal Will Not Stay in Turn Position

Inspect

- Combination Switch for proper and secure installation.
- Cancelling mechanism for broken or missing components.

Turn Signal Will Not Cancel

Inspect

- Cancelling mechanism for broken or missing components.

Turn Signal Difficult to Operate

Inspect

- Switch for proper and secure installation.
- Combination switch for foreign material.

Turn Signal Will Not Indicate Lane Change

Inspect

- Combination switch for proper and secure installation.

IGNITION SWITCH

This diagnosis covers mechanical problems only. Refer to SECTION 8A for ignition switch electrical diagnosis.

Electrical System Will Not Function

Inspect

- Ignition switch for damage.
- Ignition switch for proper and secure installation.
- Ignition switch electrical connector for proper and secure installation.

Ignition Switch Will Not Turn

Inspect

- Ignition switch for proper and secure installation or damage.

IGNITION KEY REMINDER

This diagnosis covers mechanical problems only. Refer to SECTION 8A for audible warning system electrical diagnosis.

Reminder Continues To Operate With Key Out

Inspect

- Ignition switch for proper and secure installation.

STEERING GEAR AND PUMP LEAKS

General Procedure

1. Check for the following conditions:
   - Overfilled reservoir.
   - Fluid aeration and overflow.
   - Loose pipe/hose connections.
2. When service is required:
   - Clean leakage area upon disassembly.
   - Replace leaking seal.
   - Check component sealing surfaces for damage.
   - Reset bolt torque to specifications, where required.
3. Some complaints about the power steering system may be reported as:
   - Fluid leakage on garage floor.
   - Fluid leaks visible on steering gear or pump.
   - Growling noise from steering gear or pump, especially when parking or when engine is cold.
   - Loss of power steering when parking.
   - Heavy steering effort.
4. When troubleshooting these kinds of complaints, check for an external leak in the power steering system.

EXTERNAL LEAKAGE CHECK

The purpose of this procedure is to pinpoint the location of the leak. In some cases, the leak can easily be located. However, seepage-type leaks may be more difficult to isolate. To locate seepage leaks, use the following method.

1. With the engine off, wipe dry the entire power steering system.
2. Check the fluid level in the pump's reservoir. Add fluid if necessary.
3. Start the engine, then turn the steering wheel from stop to stop several times. Do not hold it at a stop for any length of time, as this can damage the power steering pump. It is easier if an assistant operates the steering wheel while you search for the seepage.

NOTICE: To prevent damage to the power steering pump, do not hold the steering wheel at a stop for any length of time.

4. Find the exact area of the leak and repair leak.

SEAL REPLACEMENT RECOMMENDATIONS

Lip seals, which seal rotating shafts, require special treatment. This type of seal is used on the steering gear and on the drive shaft of the pump. When there is a leak in one of these areas, always replace the seal(s), after inspecting and thoroughly cleaning the sealing surfaces. Replace the shaft only if very severe pitting is found. If the corrosion in the lip seal contact zone is slight, clean the surface of the shaft with crocus cloth. Replace the shaft only if the leakage cannot be stopped by first smoothing with crocus cloth.

STRUT AND SHOCK ABSORBER

The strut is basically a shock absorber. Strut assemblies are easier to extend and retract by hand than shock absorbers.

The following procedure includes both on-vehicle and bench checks to be done when evaluating the performance of struts and shock absorbers.

ON-VEHICLE CHECKS

Struts or Shock Absorbers Seem Weak

For struts, follow Steps 1 through 4.

1. Check and adjust tire pressures to the pressures shown on the tire placard, located on the driver's side door lock pillar.
2. Note the load conditions under which the vehicle is normally driven.
3. If practical, ride with the owner to be sure you understand the complaint before proceeding to next step.
4. Test each strut dampener/shock in turn by quickly pushing down, then lifting up, the corner of the bumper nearest the strut dampener/shock being checked. Use the same amount of effort on each test and note the resistance on compression and rebound. Compare this with a similar vehicle having acceptable ride quality. Both strut dampeners/shocks should provide the same feeling of resistance.
5. Support the rear suspension at least enough to unload the shock mounts.
6. Disconnect the lower shock mountings on one axle set. Stroke the shocks at various rates of speed, through maximum travel in both directions. Compare the two sides for rebound and compression resistance. Rebound resistance is normally twice as strong as compression. The right and left shocks must feel comparable. Differences between front and rear are normal. If in doubt about the condition, compare with a shock known to be good.

Struts or Shock Absorbers are Noisy

For struts, follow Steps 1 through 3.

1. Check all mountings for proper torque. A loose mounting will cause noise.
2. If all mountings are intact, bounce the vehicle as in Step 4 to isolate the suspected unit.
3. If practical, ride with the owner to be sure you understand the complaint.
4. If one of the rear shocks is noisy, the rear axle should be supported at least enough to unload the shock mounts. Disconnect the lower mounting of the suspected shock. Quickly push the shock all the way in, then all the way out. A hissing noise is normal.
5. Other objectionable noises may be detected by stroking. Any sound other than hissing is abnormal; replace the shock.

Leaks

1. Fully extend the struts/shocks (wheels unsupported) to expose the seal cover area for inspection.
2. Look for signs of leaks in the seal cover area.
3. A slight trace of fluid is NOT cause for replace-ment; the seal permits some seepage to lubricate the piston rod. There is a built in fluid reserve to allow for seepage.
4. A leaking strut/shock can easily be found because there will be fluid around the seal cover and an excessive amount of fluid on the strut/shock. A leaking strut/shock must be replaced.

TIRES

Irregular And Premature Wear

Figure 1

Irregular and premature tire wear has many causes. Some of them are: incorrect inflation pressures, lack of regular rotation, driving habits, or improper wheel alignment. If wheel alignment is reset due to tire wear condition, always reset toe as close to zero degrees as the specification allows.

If the following conditions are noted, rotate the tires:

- Front tire wear is different from rear.
- Left and right front tire wear is unequal.
- Left and right rear tire wear is unequal.

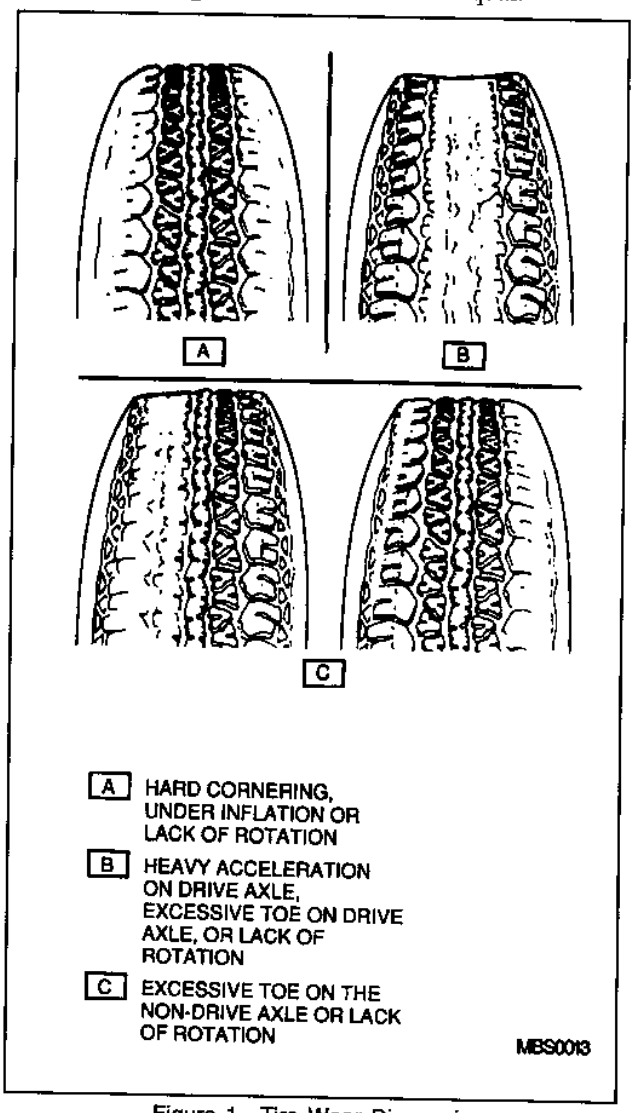


Figure 1—Tire Wear Diagnosis

Check wheel alignment if the following conditions are noted:

- Left and right tire wear is unequal.
- Wear is uneven across the tread of any front tire.
- Front tire treads have a scuffed appearance with "feather" edges on one side of the tread ribs or blocks.

Tread Wear Indicators

Figure 2

The original equipment tires have built-in tread wear indicators to show when tires need replacement. These indicators will appear as bands when the tire tread depth becomes shallow. When the indicators appear in three or more grooves at six locations, tire replacement is recommended.

Radial Tire Waddle

Figure 3

Waddle is side-to-side movement at the front and/or rear of the vehicle. It is caused by the steel belt not being straight within the tire, or by excessive lateral runout of the tire or wheel. It is most noticeable at low speeds, 8 to 48 km/h (5 to 30 mph). It may also appear, however, as ride roughness at 80 to 113 km/h (50 to 70 mph).

The vehicle can be road tested to determine which end of the vehicle has the faulty tire. If the waddle tire is on the rear, the rear end of the vehicle will shake from side to side or "waddle." From the driver's seat it feels as though someone is pushing on the side of the vehicle.

If the faulty tire is on the front, the waddle is more visual. The front sheet metal appears to be moving back and forth and the driver feels as though he is at the pivot point in the vehicle.

Waddle can be quickly diagnosed by using a tire problem detector. (TPD) and following the equipment manufacturer's recommendations.

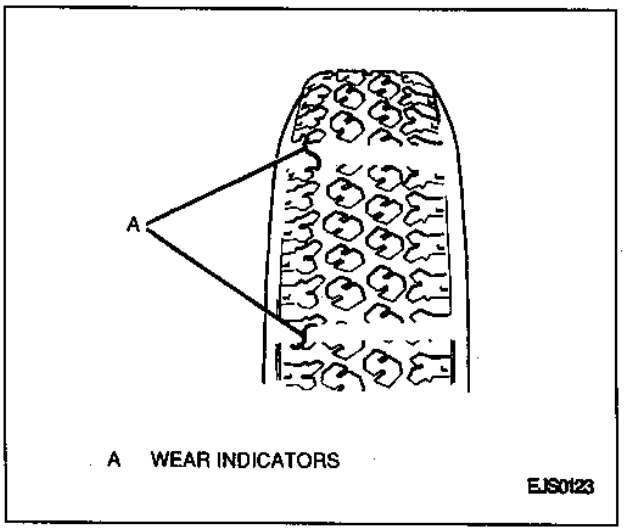


Figure 2—Tire Wear Indicators

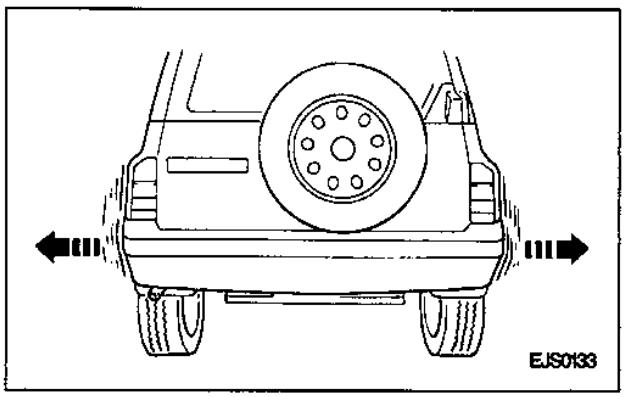


Figure 3—Radial Tire Waddle

If a TPD is not available, the more time consuming method of substituting known good tire/wheel assemblies on the problem vehicle can be used as follows:

1. Road test vehicle to determine if the waddle is coming from the front or rear.
2. Install tires and wheels that are known to be good (from a similar vehicle) in place of those on the offending end of the vehicle. If the waddle cannot be isolated to front or rear, start with the rear tires.
3. Road test again. If improvement is noted, install originals one at time until offender is found. If no improvement is noted, install known good tires in place of all four. Then, install originals one at a time until offender is found.

Radial Tire Lead/Pull

Figure 4

"Lead/Pull" is the deviation of the vehicle from a straight path on a level road with no pressure on the steering wheel.

Lead is usually caused by:

A. Incorrect alignment.
B. Uneven brake adjustment.
C. Tire construction.

The way in which a tire is built can produce lead in the vehicle. An example of this is placement of the belt. Offcenter belts on radial tires can cause the tire to develop a side force while rolling straight down the road. If one side of the tire is a little larger diameter than the other, the tire will tend to roll to one side. This will also cause the tire to develop a side force which can produce vehicle lead.

The radial tire lead/pull diagnosis chart should be used to make sure that front wheel alignment is not mistaken for tire lead (Figure 4).

1. Part of the lead diagnosis procedure is different from the proper tire rotation pattern currently in the owner and service manuals. If a medium to high mileage tire is moved to the other side of the vehicle, be sure to check that ride roughness does not develop.
2. Rear tires will not cause lead.

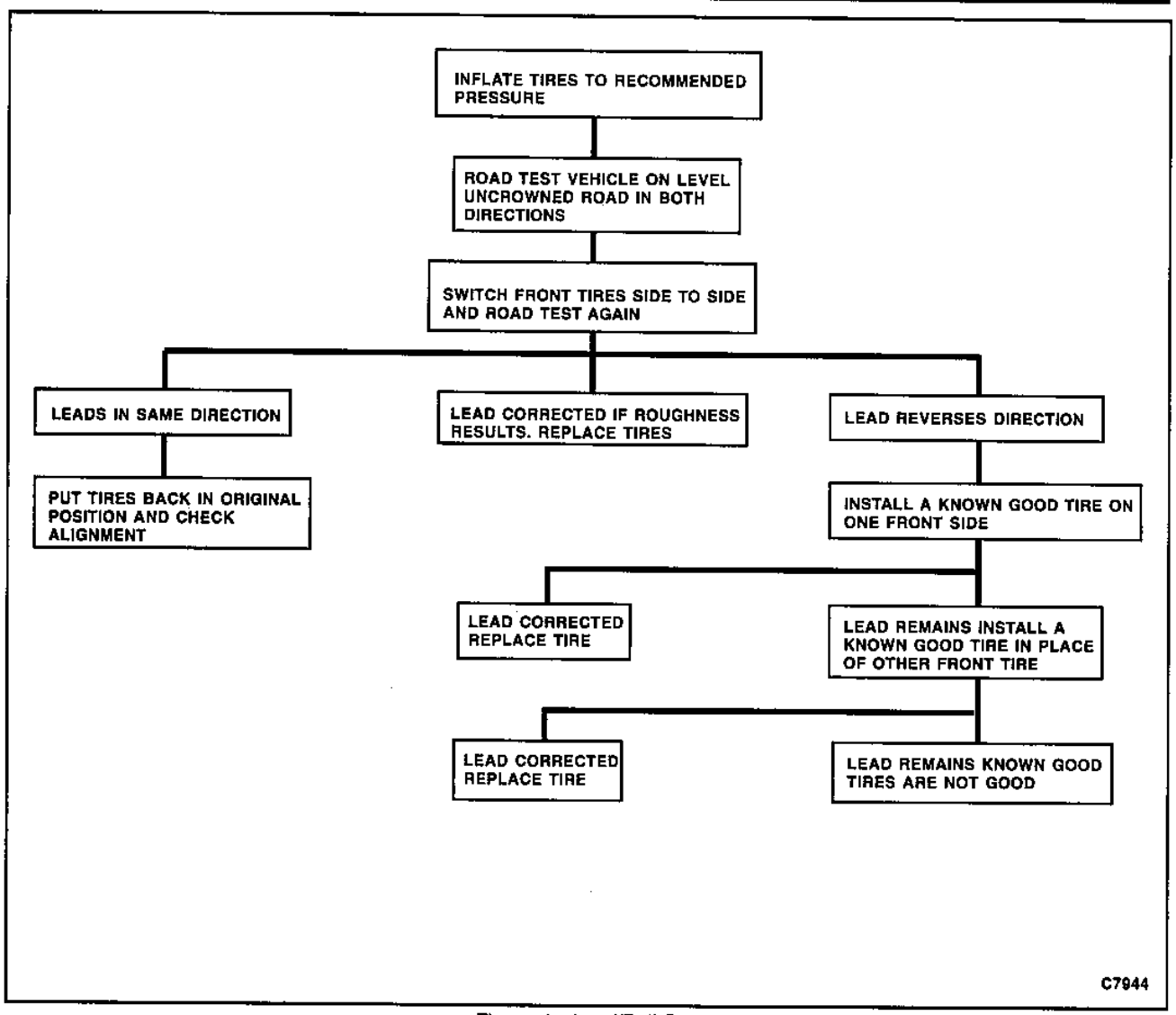


Figure 4—Lead/Pull Diagnosis

VIBRATIONS

Figure 5 and 6

Wheel unbalance causes most of the highway speed vibration problems. If a vibration remains after dynamic balancing, it can be caused by three things. For further information, refer to Vibration Complaint Chart and Causes of Vibration (Figures 5 and 6).

1. Tire runout.
2. Wheel runout.
3. Tire stiffness variation.

Measuring tire and/or wheel free runout will uncover only part of the problem. All three causes, known collectively as loaded radial runout, must be checked by using a tire problem detector (TPD). If a TPD is not available, the more time consuming method of substituting known good tire and wheel assemblies on the problem vehicle can be used.

Low-speed vibrations, those occurring at less than 64 km/h (40 mph), are usually runout related. Highway speed vibrations, those speeds above 64 km/h (40 mph), can be caused by either imbalance or runout.

Prior to performing any work, always road test the car and perform a careful visual inspection for:

- Obvious tire and wheel runout.
- Obvious drive axle or propeller shaft runout.
- Proper tire inflation.
- Incorrect trim height.
- Bent or damaged wheels.
- Debris build-up on the tire or wheel.
- Loose or missing wheel weights or wheel nuts.
- Irregular or excessive tire wear.
- Proper tire bead seating on rim.
- Damaged tires: tread deformations, separations or bulges from impact damage. Slight sidewall indentations are normal and will not affect ride quality.

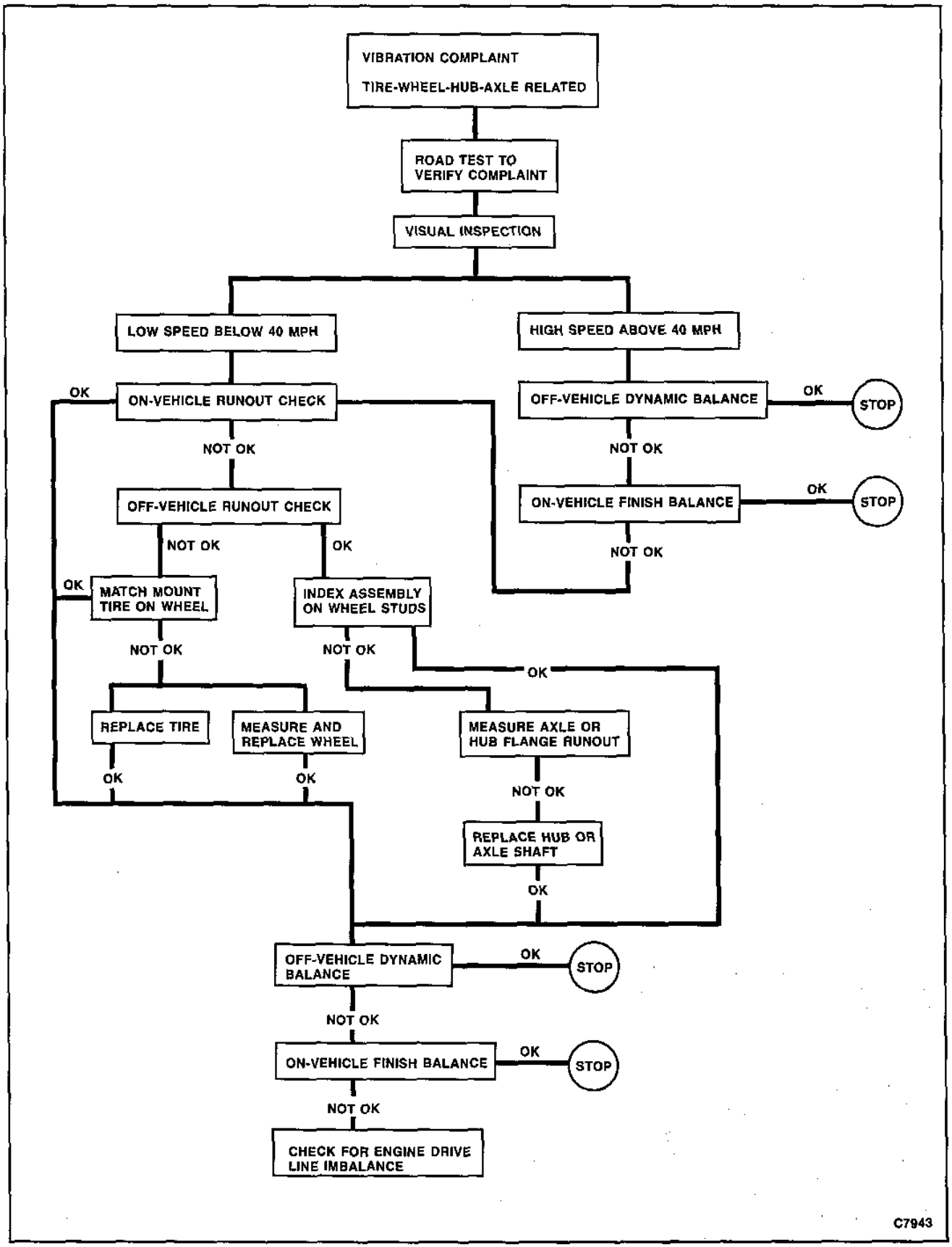


Figure 5—Vibration Complaint Chart

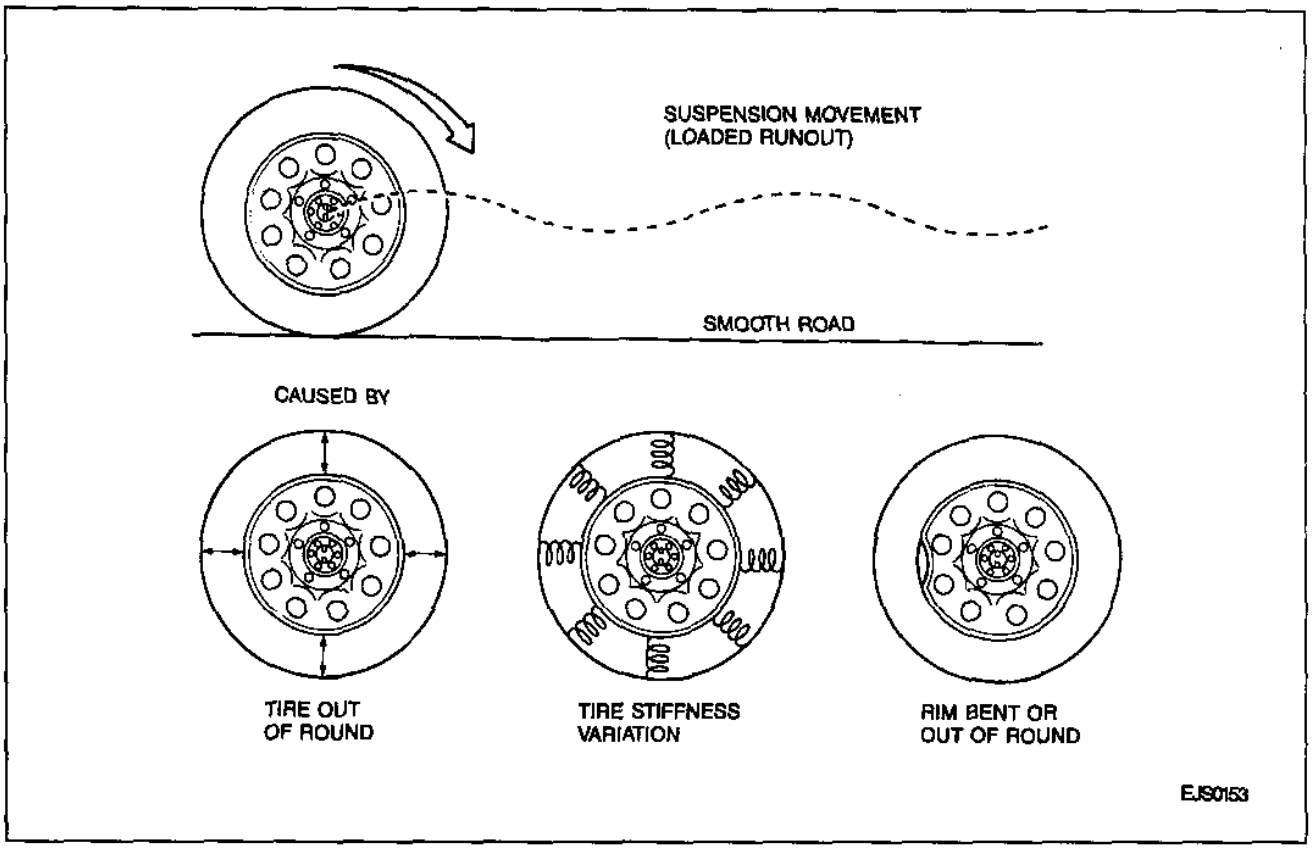


Figure 6—Causes of Vibration

Balance is the easiest procedure to perform and should be done first if the vibration occurs at highway speeds. An offvehicle, two-plane dynamic balance should be performed first. This will correct any imbalance in the tire and wheel assembly.

An on-vehicle finish balance may also be required. This will correct any brake drum, rotor, or wheel cover imbalance. If balancing does not correct the highway speed vibration, or if the vibration occurs at low speeds, runout is the probable cause. Runout can be caused by the tire, wheel, or the way the wheel is attached to the vehicle. To investigate the possibility of wheel runout, refer to the following procedures:

Tools Required:
J 8001 Dial Indicator Set
J 26900-13 Magnetic Base

A. If runout is suspected, the free runout of the tire and wheel assembly should first be measured on the vehicle using a J 8001 and a J 26900-13. Refer to SECTION 3A for lateral wheel runout measurement procedures. To measure radial tire runout, position the J 8001 and J 26900-13 on the center of the tire tread. Rotate the tire to read radial tire runout. For tire lateral runout, position the dial indicator on the tire sidewall, as close to the tread as possible and rotate wheel. The total tire and wheel onvehicle runout should be less than 1.5 mm (0.060-inch); if either measurement exceeds this number, proceed to Step B.

B. If the on-vehicle radial or lateral tire runout measured in Step A exceeds specification, mount the tire and wheel on a dynamic balancing machine and measure again. Using the same runout measuring procedure found in Step A, record the amount of tire runout at its highest point. Then measure wheel runout. If the wheel exceeds specifications, replace it (Refer to SECTION 3A). If the tire and wheel radial or lateral runout exceeds 1.3 mm (0.050-inch) at the tire tread, proceed to Step C.

C. If the off-vehicle tire and wheel radial or lateral runout measured in Step B exceeds 1.30 mm (0.050-inch), match mount the high radial runout point of the tire to the low radial runout point of the wheel. Reinflate, mount on the dynamic balance machine, and again measure and record the radial and lateral runout and its location, as in Step B. In many cases, match mounting the tire on the wheel will bring the assembly's runout into acceptable range of less than 1.30 mm (0.050-inch).

D. If the runout of the tire and wheel assembly is within specification limits when measured off the vehicle, yet exceeds the limits when measured on the vehicle, the attachment of the tire and wheel assembly to the hub is the probable cause. Rotate the assembly's two wheel studs and recheck the runout. Several positions may have to be tried to find the best location.

E. If the tire and wheel assembly runout cannot be reduced to an acceptable level, remove the assembly and measure wheel stud runout using a J 8001 and a J 26900-13. Zero the dial

indicator button on one stud. Gently lift the button off the stud and rotate flange to position the next stud on the indicator. Record the runout of all studs. The dial indicator should read zero when repositioned on the first stud that was checked. If runout exceeds 0.76 mm (0.030-inch), the hub or axle shaft should be replaced.

Whenever a tire is rotated on the wheel, or a tire or wheel is replaced, the assembly must be rebalanced. In addition to balance and tire and wheel runout, tire stiffness variation (loaded radial runout) can also cause a vibration. Stiffness variation, however, is impossible to measure without a tire problem detector (TPD) or a loaded radial runout buffer.

The TPD is a roller drum that slowly rotates the tire while under load and mounted on the vehicle. Tire stiffness variation causes wheel spindle movement which can be measured.

The loaded radial runout buffer is a more automated machine that slowly rotates the tire and wheel off the vehicle under load with a roller drum and measures the tire's stiffness variation. It will then "match" the tire to the wheel by buffing off small amounts of rubber from the outer tread rows at the stiff spot. This procedure is usually effective in balancing, especially when used as a measuring device and for fine buffing only.

The TPD and loaded radial runout buffer are two methods that will measure or correct tire stiffness variation, tire runout and wheel runout. However, because such equipment is not always available, and both have their disadvantages, the more basic procedure of measuring free runout with a dial indicator (as previously detailed) is more practical. The free runout of the tire will usually correspond with the tire's stiff spot.

The substitution method of vibration diagnosis can also be used. Install a know good set of tire and wheel assemblies. If these correct the vibration, the original assemblies should be reinstalled one at a time until the vibration returns. This will point out the tire with excess stiffness variation.

Tire stiffness variation will fluctuate depending upon the direction of the tire's rotation.

TRIM HEIGHT

Figure 7

Trim height refers to the distance from the bottom of the vehicle's body to the ground. In other words, the body trim's ground clearance. Several factors can influence what a vehicle's trim height will be at any given time: tire inflation, additional weight in the vehicle, the condition of the struts and springs after the vehicle has accumulated some mileage, and non-original tire brand and size can all affect trim height.

Before measuring trim height, perform the following steps; then refer to the specifications shown in Figure 7:

- Make sure all tires are properly inflated.
- Remove all extraneous weight from the vehicle.
- Bounce the front and rear of the vehicle up and down a few times to stabilize the suspension.
- Make sure the fuel tank is at least 1/2 full.
- Securely fasten the spare tire and jack within the rear luggage compartment.
- Measure the vehicle body-to-ground clearance several times in between bouncing the vehicle's suspension. The true trim height should be an average of several measurements.
- Close hood and all doors.

WHEEL BEARINGS

The four wheel drive version of this vehicle has nonserviceable sealed cartridge bearings both front and rear. The two wheel drive version has sealed bearings in the rear and serviceable, non-sealed bearings in front. If any fault is found with a sealed wheel bearing, it must be replaced.

Wheel Bearing Noise

A road test can usually indicate excessive wheel bearing noise. Although it is difficult to verbally describe sound, sealed wheel bearings generally emit a kind of "howling" sound when they go bad. This sound is only present when the vehicle is moving, it is constant and unwavering, and it increases in loudness and pitch with vehicle speed. If wheel bearing noise cannot be positively diagnosed, or if the front or rear origin of the noise cannot be determined, perform the following wheel bearing test:

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Spin wheels by hand; check for out-of-round tires, out-ofbalance tires, bent rims or loose wheel bearings.
3. On two wheel drive vehicles, spin front wheels using a commercial wheel spinner. Spin all driven wheels using engine.
4. If noise can be heard from the passenger compart-ment, replace the noisy wheel bearing cartridge. Refer to SECTION 3C for front wheel bearing replacement procedures, or SECTION 3D for rear wheel bearing replacement procedures.
5. Lower vehicle.

Loose Wheel Bearings

Figures 8 and 9

Tools Required:
J 8001 Dial Indicator Set
J 26900-13 Magnetic Base

Perform the following test to check for play in the bearing cartridge assembly:

1. Raise and suitably support vehicle. Refer to SECTION 0A.

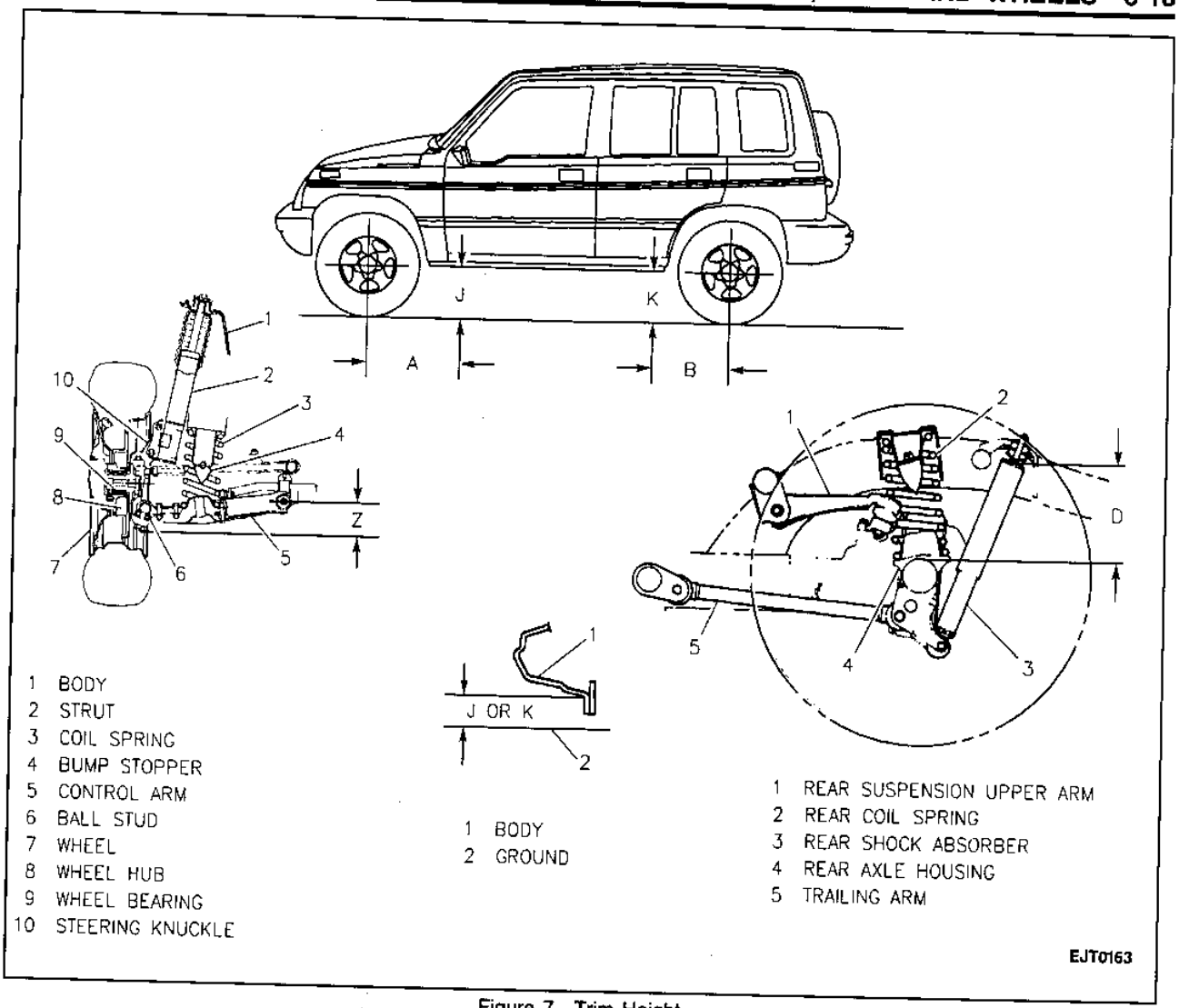


Figure 7—Trim Height

MODEL	A	B	D	J	K	Z
2WD FOLDING TOP	500 mm (19.70")	500 mm (19.70")	212 mm (8.35")	282 mm (11.10")	303 mm (11.93")	91 mm (3.60")
4WD FOLDING TOP	500 mm (19.70")	500 mm (19.70")	212 mm (8.35")	301 mm (11.85")	322 mm (12.68")	91 mm (3.60")
2WD FOUR DOOR	500 mm (19.70")	500 mm (19.70")	212 mm (8.35")	282 mm (11.10")	303 mm (11.93")	91 mm (3.60")
4WD FOUR DOOR	500 mm (19.70")	500 mm (19.70")	212 mm (8.35")	301 mm (11.85")	322 mm (12.68")	91 mm (3.60")

2. Remove front or rear tire and wheel assemblies. Refer to SECTION 3E.
3. For disc brakes:
   A. Reinstall two wheel nuts to hold rotor tight.
   B. Compress caliper piston to free caliper assembly.
   C. Mount a J 8001 and a J 26900-13 on front wheel hub (Figure 8).
   D. Push and pull brake rotor by hand. If rotor movement exceeds 0.05 mm (0.0020-inch), replace the wheel bearing. Refer to SECTION 3C.
4. For drum brakes:
   A. Remove brake drum.
   B. Mount a J 8001 and a J 26900-13 on rear hub unit (Figure 9).

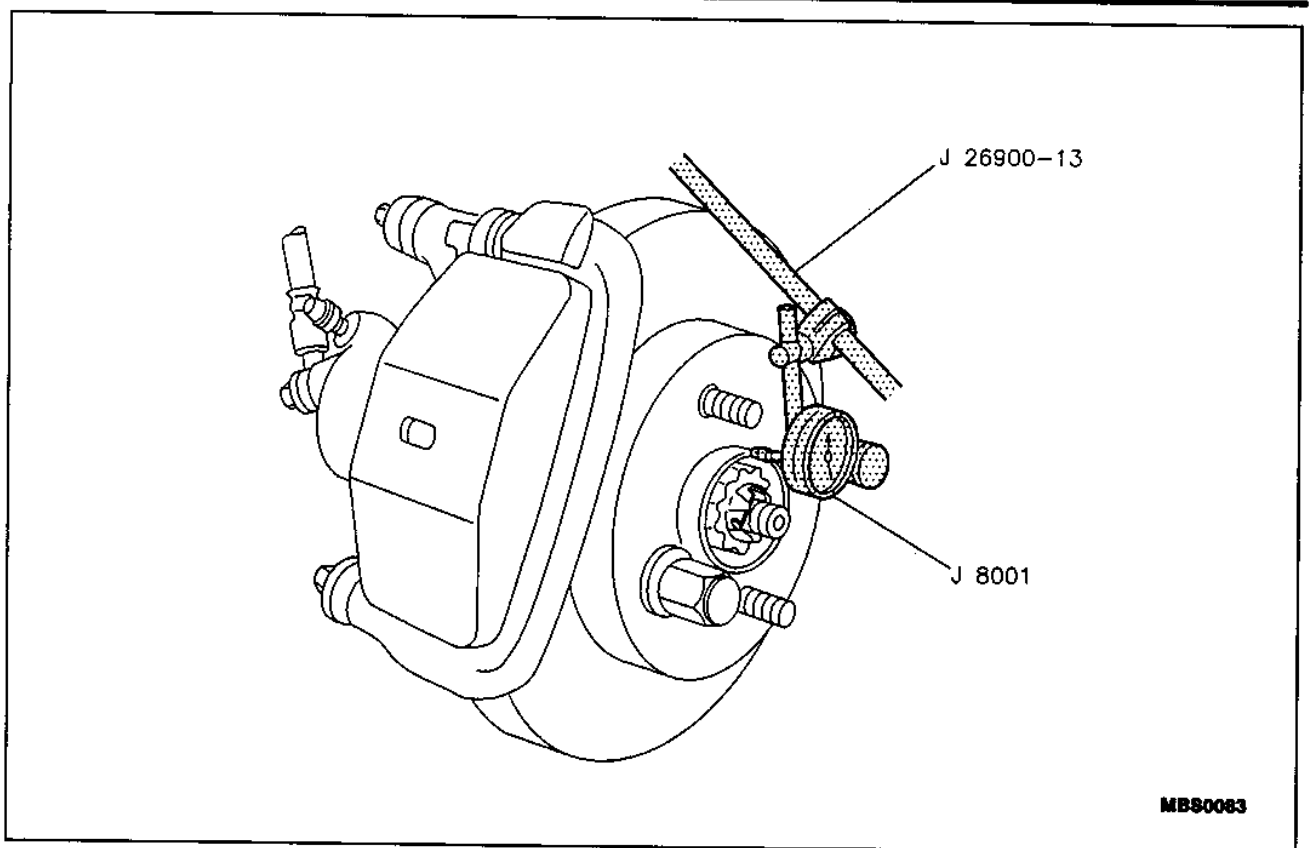


Figure 8—Checking Front Wheel Bearing Play—Typical

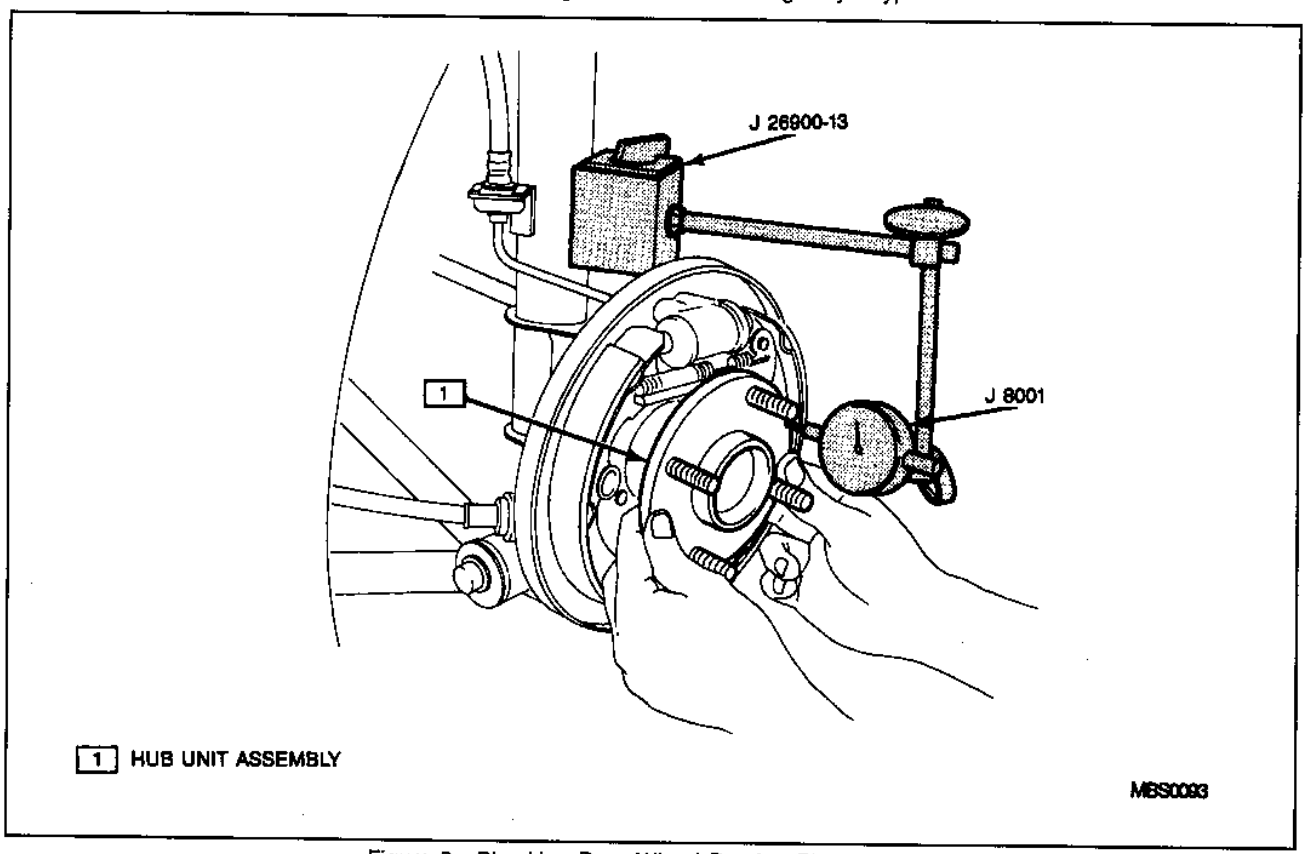


Figure 9—Checking Rear Wheel Bearing Play—Typical

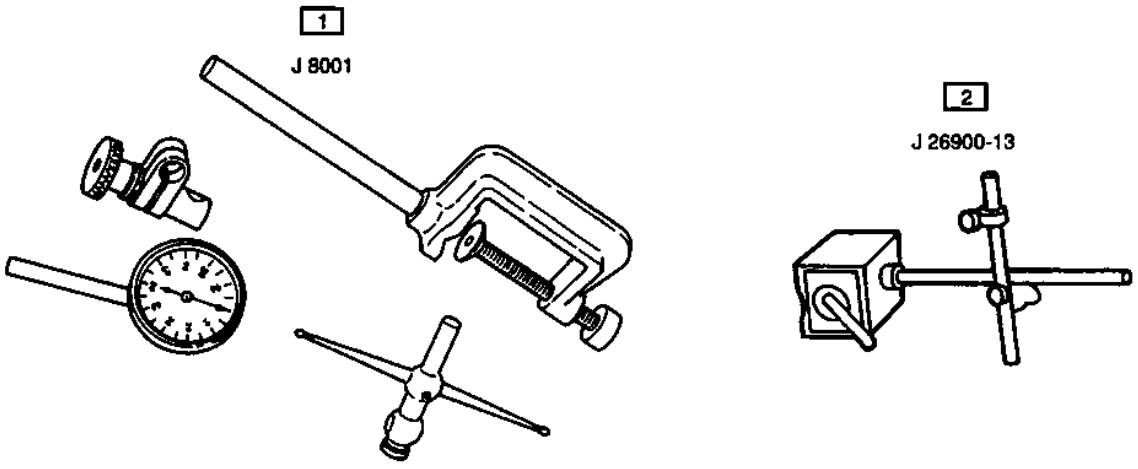
C. Push and pull hub unit by hand. If hub movement exceeds 0.05 mm (0.0020-inch), replace the wheel bearing. Refer to REAR SECTION 3D.

5. Install tire and wheel assemblies. Refer to SECTION 3E.
6. Lower vehicle.

SPECIFICATIONS

Maximum Wheel Bearing Cartridge Play	0.05 mm (0.0020 in.)
Maximum Tire and Wheel Radial or Lateral Runout	1.30 mm (0.050 in.)
Maximum Wheel Stud Runout	0.76 mm (0.030 in.)

SPECIAL TOOLS



1 DIAL INDICATOR SET
2 MAGNETIC BASE

MBS0263A