CHAPTER 25
Front Suspension and Service
After studying Chapter 25, the reader will be able to:

1. Prepare for ASE Suspension and Steering (A4) certification test content area “B” (Suspension System Diagnosis and Repair).
2. Explain how to perform a road test, a dry park test, a visual inspection, and a bounce test.
3. Discuss the procedures for testing load-carrying and follower-type ball joints.
4. Describe ball joint replacement procedures.
5. List the steps required to replace control arm and stabilizer bar bushings.
6. Explain routine service procedures of the suspension system.
KEY TERMS

- A-arm
- Cow catcher
- Cuppy tire wear
- Dry park test
- Durometer
- Indicator ball joints
- Kingpin
- Pinch bolt
- Radius rod
- SLA
- Steering knuckle
- Strut suspension
- Twin I-beam
FRONT SUSPENSION TYPES

SOLID AXLES

- Early cars and trucks used a solid (or straight) front axle to support the front wheels.
- A solid-axle front suspension is very strong and is still being used in the manufacture of medium and heavy trucks.
  - The main disadvantage of solid-axle design is its lack of ride quality.

FIGURE 25–1 Most early vehicles used single straight axles.
FRONT SUSPENSION TYPES
KINGPINS

- At the end of many solid I-beam or tube axles are **kingpins** that allow the front wheels to rotate for steering.

- Kingpins are hardened steel pins that attach the steering knuckle to the front axle, allowing the front wheels to move for steering.
FIGURE 25–2 Typical kingpin used with a solid axle.
A twin I-beam front suspension was used for over 30 years on Ford pickup trucks and vans, beginning in the mid-1960s.

Strong steel twin beams that cross provide independent front suspension operation with the strength of a solid front axle.

Early versions of the twin I-beam systems used kingpins, while later models used ball joints to support the steering knuckle and spindle.

Coil springs are usually used on twin I-beam suspensions, even though the original design and patent used leaf springs.
FIGURE 25–3 Twin I-beam front suspension. Rubber bushings are used to support the I-beams to the frame and help isolate road noise.
Radius Rod Bushing Noise

TECH TIP

- When the radius rod bushing on a Ford truck or van deteriorates, the most common complaint from the driver is noise. Besides causing tire wear, worn or defective radius rod bushing deterioration can cause the following:
  - A clicking sound when braking (it sounds as if the brake caliper may be loose).
  - A clunking noise when hitting bumps.
FIGURE 25-4 The rubber radius rod bushing absorbs road shocks and helps isolate road noise.
SHORT/LONG-ARM SUSPENSIONS

- The short/long-arm suspension uses a short upper control arm and a longer lower control arm and usually is referred to as the *SLA-type suspension*.
- The two main links in a **short/long-arm (SLA)** suspension are the upper control arm and the lower control arm.
- The upper control arm is shorter than the lower one.
FIGURE 25–5 The upper control arm is shorter than the lower control arm on a short/long-arm (SLA) suspension.
FIGURE 25–6 A typical SLA front suspension using coil springs.
SHORT/LONG-ARM SUSPENSIONS

SLA SUSPENSION - COIL SPRING ON UPPER ARM

FIGURE 25–7 An SLA-type suspension with the coil spring placed on top of the upper control arm.
FIGURE 25–8 A torsion bar SLA suspension can use either the lower or the upper control arm.
**STRUT SUSPENSION**

- **Strut suspension** can be of several types.
- A MacPherson strut includes the suspension spring that transfers the weight of the body to the wheel.
- A MacPherson strut is the main, load-carrying suspension spring.

**FIGURE 25–9** A typical MacPherson strut showing all of the components of the assembly. A strut includes the shock and the spring in one structural assembly.
FIGURE 25–10 The modified strut front suspension is similar to a MacPherson strut suspension except that the coil spring is seated on the lower control arm and is not part of the strut assembly.
FIGURE 25–11 Multilink front suspension design varies depending on the vehicle manufacturer.
SERVICING THE SUSPENSION SYSTEM

• Suspension systems are designed and manufactured to provide years of trouble-free service with a minimum amount of maintenance.
  • In fact, the suspension system is often “invisible” or “transparent” to the driver because the vehicle rides and handles as expected.
• It is when the driver notices that the vehicle is not riding or handling as it did, or should, that a technician is asked to repair or align the vehicle and fix the problem.
## SERVICING THE SUSPENSION SYSTEM

### SUSPENSION PROBLEM SYMPTOM CHART

<table>
<thead>
<tr>
<th>Item or System to Check</th>
<th>Noise</th>
<th>Instability/Wander</th>
<th>Pull to One Side</th>
<th>Excessive Steering Play</th>
<th>Hard Steering</th>
<th>Shimmy</th>
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<tr>
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<td>Loose/worn mounts/bushings</td>
<td>Loose/worn mounts/bushings on strut assemblies</td>
<td>Worn/damaged struts/shock absorbers</td>
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<td>Worn/damaged struts/shock absorbers</td>
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<td>Front, camber and caster</td>
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<td>Front, especially caster</td>
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<td>Ball joint lubrication</td>
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ROAD TEST DIAGNOSIS

• If possible, perform a road test of the vehicle with the owner of the vehicle.
• It is also helpful to have the owner drive the vehicle.
• While driving, try to determine when and where the noise or problem occurs, such as the following:
  • In cold or warm weather
  • With cold or warm engine/vehicle
  • While turning, left only, right only
ROAD TEST DIAGNOSIS

• A proper road test for any suspension system problem should include the following:
  • Drive beside parked vehicles
  • Drive into driveways
  • Drive in reverse while turning
  • Drive over a bumpy road
DRY PARK TEST (SUSPENSION)

- A **dry park test** can also be used to help locate worn or defective suspension components.
- The dry park test is performed by having an assistant move the steering wheel side to side while feeling and observing for any freeplay in the steering or suspension.
- For best results, the vehicle should be on a level floor or on a drive-on-type hoist with the front wheels pointing straight ahead.
- In this suspension analysis using the dry park test, the technician should observe the following for any noticeable play or unusual noise:
  - Front wheel bearings
  - Control arm bushing wear or movement
  - Ball joint movement
Road Test—Before and After

TECH TIP

- Many times technicians will start to work on a vehicle based on the description of the problem by the driver or owner. A typical conversation was overheard where the vehicle owner complained that the vehicle handled “funny,” especially when turning. The owner wanted a wheel alignment, and the technician and shop owner wanted the business. The vehicle was aligned, but the problem was still present. The real problem was a defective tire. The service technician should have road-tested the vehicle before any service work was done to confirm the problem and try to determine its cause. Every technician should test drive the vehicle after any service work is performed to confirm that the service work was performed correctly and that the customer complaint has been resolved. This is especially true for any service work involving the steering, suspension, or braking systems.
VISUAL INSPECTION

- All suspension components should be carefully inspected for signs of wear or damage.
- A thorough visual inspection should include checking all of the following:
  - Shock absorbers
  - Springs
  - Stabilizer bar links
  - Stabilizer bar bushings
  - Upper and lower shock absorber mounting points
  - Bump stops
  - Body-to-chassis mounts
  - Engine and transmission (transaxle) mounts
  - Suspension arm bushings.
FIGURE 25–12 A leaking strut. Either a cartridge insert or the entire strut will require replacement. If a light film of oil is seen, this is to be considered normal. If oil is dripping, then this means that the rod seal has failed.
FIGURE 25–13 This front coil spring looks as if it has been heated with a torch in an attempt to lower the ride height of the vehicle. Both front springs will require replacement.
FIGURE 25–14 It is easy to see that this worn control arm bushing needed to be replaced. The new bushing is shown next to the original.
BALL JOINTS
DIAGNOSIS AND INSPECTION

• The life of ball joints depends on driving conditions, vehicle weight, and lubrication.

• Even with proper care and lubrication, the load-carrying (weight-carrying) ball joints wear more than the follower ball joints.

• Ball joints should be replaced in pairs, both lower or both upper, to ensure the best handling.

• Defective or worn ball joints can cause looseness in the suspension and the following common driver complaints:
  • Loud popping or squeaking whenever driving over curbs, such as into a driveway
  • Shimmy-type vibration felt in the steering wheel
  • Vehicle wander or a tendency not to track straight
  • Excessive freeplay in the steering wheel
FIGURE 25–15 Grease fitting projecting down from the surrounding area of a ball joint. The ball joint should be replaced when the area around the grease fitting is flush or recessed.
FIGURE 25–16 Indicator ball joints should be checked with the weight of the vehicle on the ground.
FIGURE 25–17 Typical dial indicator used to measure the suspension component movement. The locking pliers attach the gauge to a stationary part of the vehicle and the flexible coupling allows the dial indicator to be positioned at any angle.
BALL JOINTS
DIAGNOSIS AND INSPECTION

• If the coil spring or torsion bar is attached to the lower control arm, the lower ball joint is the load-carrying ball joint.
• This includes vehicles equipped with modified MacPherson-strut-type suspension.
FIGURE 25–18 If the spring is attached to the lower control arm as in this SLA suspension, the jack should be placed under the lower control arm as shown. A dial indicator should be used to measure the amount of free-play in the ball joints. Be sure that the looseness being measured is not due to normal wheel bearing endplay.
FIGURE 25–19 The jack should be placed under the lower control arm of this modified MacPherson-type suspension.
FIGURE 25–20 If the spring is attached to the upper control arm, the jack should be placed under the frame to check for ball joint wear.
FIGURE 25–21 A special tool or a block of wood should be inserted between the frame and the upper control arm before lifting the vehicle off the ground. This tool stops the force of the spring against the upper ball joint so that a true test can be performed on the condition of the ball joint.
What Is the Difference Between a Low-Friction Ball Joint and a Steel-on-Steel Ball Joint?

• Before the late 1980s, most ball joints were constructed with a steel ball that rubbed on a steel socket. This design created friction and provided for a tight high-friction joint until wear caused looseness in the joint.
What Is the Difference Between a Low-Friction Ball Joint and a Steel-on-Steel Ball Joint?

FREQUENTLY ASKED QUESTION

- Newer designs use a polished steel ball that is installed in a hard plastic polymer, resulting in a low-friction joint assembly. Because of the difference in friction characteristics, the vehicle may handle differently than originally designed if incorrect-style ball joints are installed. Most component manufacturers state that low-friction ball joints in a vehicle originally equipped with steel-on-steel high-friction ball joints are usually acceptable, but high-friction replacement ball joints should be avoided on a vehicle originally equipped with low-friction ball joints.
FIGURE 25–22 The jacking point is under the frame for checking the play of a lower ball joint used with a MacPherson strut.
FIGURE 25–23 This worn and rusty ball joint was found by moving the wheel and looking for movement in the joint.
BALL JOINTS

BALL JOINT REMOVAL

• Take care to avoid damaging grease seals when separating ball joints from their mounts.

• The preferred method to separate tapered parts is to use a pullertype tool that applies pressure to the tapered joint as the bolt is tightened on the puller.

FIGURE 25–24 Taper breaker tool being used to separate the upper ball joint from the steering knuckle. This is especially important for vehicles equipped with aluminum alloy control arms.
BALL JOINT REMOVAL

FIGURE 25–25 A pinch bolt attaches the steering knuckle to the ball joint. Remove the pinch bolt by turning the nut, not the bolt.
FIGURE 25–26 If the pinch bolt is over tightened, the steering knuckle can be deformed. A deformed knuckle can cause the pinch bolt to break and the ball joint could become separated from the steering knuckle.
BALL JOINTS
BALL JOINT REMOVAL

FIGURE 25–27 By drilling into the rivet, the holding force is released.

USING 1/8" DRILL, DRILL RIVETS APPROXIMATELY 1/4" DEEP IN CENTER OF RIVET
FIGURE 25–28 The head of the rivet can be removed by using a larger-diameter drill bit as shown.
FIGURE 25–29 Using a punch and a hammer to remove the rivet after drilling down through the center and removing the head of the rivet.
FIGURE 25–30 Press-in ball joints are best removed using a large C-clamp press, as shown.
The Rattle Story

REAL WORLD FIX

A customer complained that a rattle was heard every time the vehicle hit a bump. The noise sounded as if it came from the rear. All parts of the exhaust system and suspension system were checked. Everything seemed okay until the vehicle was raised with a frame-type hoist instead of a drive-on type. Then, whenever the right rear wheel was lifted, the noise occurred. The problem was a worn (elongated) shock absorber mounting hole. A washer with the proper-size hole was welded over the worn lower frame mount and the shock absorber was bolted back into place.
Kingpins are usually used on trucks, sport utility vehicles, and other heavy-duty vehicles.

FIGURE 25–31 Typical kingpin assembly.
To remove a typical kingpin, follow these basic steps:

- Remove the tire, brake drum, and backing plate or caliper.
- Remove the lockpin. The lockpin is usually tapered with a threaded end for the nut. Drive the lockpin out with a drift (punch).
- Remove the grease caps and drive the kingpin from the steering knuckle and axle with a hammer and a brass punch or a hydraulic press, if necessary.
KINGPIN DIAGNOSIS AND SERVICE

FIGURE 25–32 Driving a kingpin out with a hammer.
FIGURE 25–33 This galled kingpin bushing must be replaced.
SHOCK ABSORBERS AND STRUTS

DIAGNOSIS

• Shock absorber life depends on how and where the vehicle is driven.
• Original equipment (OE) shock absorbers are carefully matched to the vehicle springs and bushings to provide the best ride comfort and control.
• As the control arm bushings and ball joints age, the energy built up in the springs of the vehicle is controlled less by the friction of these joints and bushings, requiring more control from the shock absorbers.
• Shock absorber action is also reduced as the seals inside wear.
Replacement shock absorbers may be required when any or all of the following symptoms appear:

- Ride harshness
- Frequent bottoming out on rough roads
- Extended vehicle movement after driving on dips or a rise in the road
- Cuppy-type tire wear
- Leaking hydraulic oil
- Springs and shock absorbers should be replaced in pairs.
The Shock Stud Trick

TECH TIP

- Front shock absorbers used on many rear-wheel drive vehicles equipped with an SLA-type front suspension are often difficult to remove because the attaching nut is rusted to the upper shock stub. A common trick is to use a deep-well 9/16-in. socket and a long extension and simply bend the shock stud until it breaks off. At first you would think that this method causes harm, and it does ruin the shock absorber—but the shock absorber is not going to be reused and will be discarded anyway.
The Shock Stud Trick

TECH TIP

• The usual procedure followed by many technicians is to simply take a minute or two to break off the upper shock stud, then hoist the vehicle to allow access to the lower two shock bolts, and then the shock can easily be removed. To install the replacement shock absorber, attach the lower bolts, lower the vehicle, and attach the upper rubber bushings and retaining nut.
SHOCK ABSORBERS AND STRUTS
FRONT SHOCK REPLACEMENT

• Front shock absorbers provide ride control and are usually attached to the lower control arm by bolts and nuts.
• The upper portion of the shock usually extends through the spring housing and is attached to the frame of the vehicle with rubber grommets to help insulate noise, vibration, and harshness.
• Most front shock absorbers can be replaced either with the vehicle still on the ground or while on a hoist.
• The front suspension of most vehicles allows the removal of the shocks without the need to support the downward travel of the lower control arm.
• The downward travel limit is stopped by a rubber stop or by the physical limit of the suspension arms.
FIGURE 25–34 Most shock absorbers used on the front suspension can be removed from underneath the vehicle after removing the attaching bolts or nuts.
MACPHERSON STRUT REPLACEMENT

On most vehicles equipped with MacPherson strut suspensions, strut replacement involves the following steps.

- Hoist the vehicle, remove the wheels, and mark the attaching bolts/nuts.
- Remove the upper strut mounting bolts except for one to hold the strut until ready to remove the strut assembly.
- Remove the brake caliper or brake hose from the strut housing.
MACPHERSON STRUT REPLACEMENT

- After removing all lower attaching bolts, remove the final upper strut bolt and remove the strut assembly from the vehicle. Place the strut assembly into a strut spring compressor fixture or use manual spring compressors.
- Compress the coil spring enough to relieve the tension on the strut rod nut. Remove the strut rod nut.
- After removing the strut rod nut, remove the upper strut bearing assembly and the spring.
- Many MacPherson struts are replaced as an entire unit assembly.
- Reinstall the strut in the vehicle.
FIGURE 25–35 Removing the upper strut mounting bolts. Some experts recommend leaving one of the upper strut mount nuts loosely attached to prevent the strut from falling when the lower attaching bolts are removed.
FIGURE 25–36 A brake hydraulic hose is often attached to the strut housing. Sometimes all that is required to separate the line from the strut is to remove a spring clip.
FIGURE 25–37 Use a strut spring compressor fixture to compress the spring on a MacPherson strut before removing the strut retaining nut.
FIGURE 25–38 Removing the strut rod nut. The strut shaft is being helped with one wrench while the nut is being removed with the other wrench. Notice that the spring is compressed before the nut is removed.
FIGURE 25–39 Typical MacPherson strut showing the various components.
FIGURE 25–40 After installing the replacement strut cartridge, reinstall the spring and upper bearing assembly after compressing the spring. Notice that the strut is being held in a strut spring compressor fixture.
FIGURE 25–41 Before final assembly, make sure the marks you made are aligned. Some struts are manufactured with marks to ensure proper reassembly.
FIGURE 25–42 The strut on a modified MacPherson strut assembly can be replaced by removing the upper mounting nuts.
STABILIZER BAR LINK AND BUSHINGS

DIAGNOSIS

- Stabilizer bars twist whenever a vehicle turns a corner or whenever one side of the vehicle rises or lowers.
- The more the body of the vehicle leans, the more the bar twists, and the more the bar counteracts the roll of the body.
- A great deal of force is transferred from the stabilizer bar to the body or frame of the vehicle through the stabilizer links at the control arm and the stabilizer bar mounting bushings on the body or frame.
- The most common symptom of defective stabilizer bar links or bushings is noise while turning, especially over curbs.
STABILIZER BAR LINK AND BUSHINGS

DIAGNOSIS

- When driving up and over a curb at an angle, one wheel is pushed upward.
- Since the stabilizer bar connects both wheels, the bar tends to resist this motion by twisting.
- If one or both links are broken, a loud knock or clanking sound is heard as the bar contacts the control arm.
- Any sound heard when driving should be investigated and the cause determined by a thorough visual inspection.
STABILIZER BAR LINK AND BUSHINGS REPLACEMENT

- Stabilizer links are usually purchased as a kit consisting of replacement rubber bushings, retainers, a long bolt, and spacer with a nut and lock nut.
- GM recommends that stabilizer links be replaced in pairs and two kits purchased so that the links on both the left and the right can be replaced at the same time.

FIGURE 25–43 Stabilizer bar links should be replaced as a pair.
STRUT ROD BUSHINGS
DIAGNOSIS

• Strut rods are used on the front suspension of many front-wheel-drive and rear-wheel-drive vehicles.

• As with any rubber suspension component, strut rod bushings can deteriorate and crack.

• When strut rod bushings fail, the lower control arm can move forward and backward during braking or when hitting bumps in the road.

• Since the lower control arm position is important to vehicle control, when the bushing fails, a pulling or drifting of the vehicle often occurs.
  
  • A common symptom of a defective strut rod bushing is noise and a pull toward one side while braking.
To replace a strut rod bushing, the nut on the end of the strut rod has to be removed.

FIGURE 25–44 A strut rod as viewed from the front of the vehicle.
FIGURE 25–45 Typical strut rod bushing with rubber on both sides of the frame to help isolate noise, vibration, and harshness from being transferred to the passengers.
FRONT COIL SPRINGS
DIAGNOSIS

- Coil springs should be replaced in pairs if the vehicle ride height is lower than specifications.
- Sagging springs can cause the tires to slide laterally (side to side) across the pavement, causing excessive tire wear.

FIGURE 25–46 Notice that if the front coil springs are sagging, the resulting angle of the lower control arm causes the wheels to move from side to side as the suspension moves up and down. Note the difference between the distance at “A” with good springs and the distance at “B” with sagging springs.
FRONT COIL SPRINGS REPLACEMENT

- The only solution recommended by the vehicle manufacturer is to replace the damaged springs in pairs (both front and both rear, or all four).
- Several aftermarket alternatives include the following:
  - Helper or auxiliary left springs
  - Spring inserts for coil springs
  - Air shocks or airbag devices
FIGURE 25–47 Spring compressing tool in place to hold the spring as the ball joint is separated. Note that the stabilizer bar links have been removed to allow the lower control arm to move downward enough to remove the coil spring.
FIGURE 25–48 The steering knuckle has been disconnected from the lower ball joint. The lower control arm and coil spring are being held up by a floor jack.
FIGURE 25–49 A rubber mallet is being used to support the upper control arm as the lower control is being lowered using a floor jack. After all of the tension has been removed from the coil spring it can be removed and the replacement installed.
FIGURE 25–50 Spring insulators install between the spring seat and the coil spring to reduce noise.
FIGURE 25–51 The holes in the lower arm are not only used to allow water to drain from the spring seat, but also are used as a gauge to show the service technician that the coil spring is correctly seated.
The owner of a six-month-old full-size pickup truck complained that occasionally when the truck was driven up into a driveway, a loud grinding sound was heard. Several service technicians worked on the truck, trying to find the cause for the noise. After the left front shock absorber was replaced, the noise did not occur for two weeks, and then started again. Finally, the service manager told the technician to replace anything and everything in the front suspension in an attempt to solve the customer’s intermittent problem.
Five minutes later, a technician handed the service manager a small, deformed rock. This technician had taken a few minutes to carefully inspect the entire front suspension. Around the bottom coil spring seat, the technician found the rock. Apparently, when the truck made a turn over a bump, the rock was forced between the coils of the coil spring, making a very loud grinding noise. But the rock did not always get between the coils. Therefore, the problem occurred only once in a while. The technician handed the rock to the very happy customer.
STEERING KNUCKLES
DIAGNOSIS

- Most steering knuckles are constructed of cast or forged cast iron.
- The steering knuckle usually incorporates the wheel spindle and steering arm.
- The steering knuckle/steering arm can become bent if the vehicle is in an accident or hits a curb sideways.
- Often this type of damage is not apparent until vehicle handling or excessive tire wear is noticed.
- Unless a thorough inspection is performed during a wheel alignment, a bent steering knuckle is often overlooked.
STEERING KNUCKLES REPLACEMENT

- If the steering knuckle is bent or damaged, it must be replaced.
  - It should *not* be bent back into shape or repaired.
- To replace the steering knuckle, both ball joints must be disconnected from the knuckle and the brake components removed.
  - Be sure to support the control arm and spring properly during the procedure.
- See a factory service manual for the exact procedure and fastener torque for the vehicle you are servicing.
Most torsion bar suspensions are designed with an adjustable bolt to permit the tension on the torsion bar to be increased or decreased to change the ride height.

Unequal side-to-side ride height can be corrected by adjusting (turning) the torsion bar tension bolt.

**FIGURE 25–52** By rotating the adjusting bolt, the vehicle can be raised or lowered.
CONTROL ARM BUSHINGS
DIAGNOSIS

• Defective control arm bushings are a common source of vehicle handling and suspension noise problems.

• Most suspension control arm bushings are constructed of three parts: an inner metal sleeve, the rubber bushing itself, and an outer steel sleeve.

• (Some vehicles use a two-piece bushing that does not use an outer sleeve.)
CONTROL ARM BUSHINGS REPLACEMENT

- To remove an old bushing from a control arm, the control arm must first be separated from the suspension and/or frame of the vehicle.
- Several methods can be used to remove the bushing from the control arm, but all methods apply force to the outer sleeve.
- While an air chisel is frequently used to force the steel sleeve out of the suspension member, a puller tool is most often recommended by General Motors.
CONTROL ARM BUSHINGS

REPLACEMENT

FIGURE 25–53 An adapter and a press or large clamp are used to remove the old bushing from the control arm and to install a new bushing.
CONTROL ARM BUSHINGS REPLACEMENT

- The upper control arm bushings can be replaced in most vehicles that use a short/long-arm-type suspension by following just four easy steps:
  - Raise the vehicle and support the lower control arm with a safety stand or floor jack.
  - Disconnect the upper control arm from the frame by removing the frame-attaching nuts or bolts.
  - Using the upper ball joint as a pivot, rotate the upper control arm outward into the wheel well area. With the control arm accessible, it is much easier to remove and replace the upper control arm pivot shaft and rubber bushings.
  - After replacing the bushings, simply rotate the upper control arm back into location and reattach the upper control arm pivot shaft to the vehicle frame.
SUMMARY

1. A thorough road test of a suspension problem should include driving beside parked vehicles and into driveways in an attempt to determine when and where the noise occurs.

2. A dry park test should be performed to help isolate defective or worn suspension components.

3. Ball joints must be unloaded before testing. The ball joints used on vehicles with a MacPherson strut suspension are not load carrying. Wear-indicator ball joints are observed with the wheels on the ground.

4. Always use a taper-breaker puller or two hammers to loosen tapered parts to remove them. Never use heat unless you are replacing the part; heat from a torch can damage rubber and plastic parts.
5. When installing a tapered part, always tighten the attaching nut to specifications. Never loosen the nut to install a cotter key. If the cotter key will not line up with a hole in the tapered part, tighten the nut more until the cotter key hole lines up with the nut and stud.

6. Defective shock absorbers can cause ride harshness as well as frequent bottoming out on rough roads.

7. Always follow manufacturers’ recommended procedures whenever replacing springs or MacPherson struts. Never remove the strut end nut until the coil spring is compressed and the spring force is removed from the upper bearing assembly.
REVIEW QUESTIONS

1. Describe how to perform a proper road test for the diagnosis of suspension-related problems.
2. List four symptoms of worn or defective shock absorbers.
3. Explain the procedure for replacing front shock absorbers on an SLA-type suspension vehicle.
4. Describe the testing procedure for ball joints.
5. Describe the correct general procedure to remove and replace tapered suspension components.
1. Unusual noise during a test drive can be caused by _______.
   a. Defective wheel bearings or stabilizer bar links
   b. Defective or worn control arm bushings or ball joints
   c. Worn or defective CV joints
   d. All of the above
2. Two technicians are discussing non-indicator-type ball joint inspection. Technician A says that the vehicle should be on the ground with the ball joints loaded, then checked for freeplay. Technician B says that the ball joints should be unloaded before checking for freeplay. Which technician is correct?

a. Technician A only
b. Technician B only
c. Both Technicians A and B
d. Neither Technician A nor B
CHAPTER QUIZ

3. Most manufacturers specify a maximum axial play for ball joints of about ________.
   a. 0.003 in. (0.076 mm)
   b. 0.010 in. (0.25 mm)
   c. 0.030 in. (0.76 mm)
   d. 0.050 in. (1.27 mm)
4. The preferred method to separate tapered chassis parts is to use __________.
   a. A pickle fork tool
   b. A torch to heat the joint until it separates
   c. A puller tool or two hammers to shock and deform the taper
   d. A drill to drill out the tapered part
5. A light film of oil is observed on the upper area of a shock absorber. Technician A says that this condition should be considered normal. Technician B says that a rod seal may bleed fluid during cold weather, causing the oil film. Which technician is correct?

a. Technician A only
b. Technician B only
c. Both Technicians A and B
d. Neither Technician A nor B
CHAPTER QUIZ

6. Before the strut insert can be removed from a typical MacPherson strut assembly, which operation is necessary to prevent possible personal injury?

a. The brake caliper and/or brake hose should be removed from the strut housing
b. The coil spring should be compressed
c. The upper strut mounting bolts should be removed
d. The lower attaching bolts should be removed
7. What should the technician do when replacing stabilizer bar links?

a. The stabilizer bar should be removed from the vehicle before replacing the links.

b. The links can be replaced individually, yet the manufacturer often recommends that the links at both ends be replaced together.

c. The stabilizer bar must be compressed using a special tool before removing or installing stabilizer bar links.

d. Both b and c are correct.
CHAPTER QUIZ

8. A noise and a pull toward one side during braking is a common symptom of a worn or defective ________.
   
   a. Shock absorber
   b. Strut rod bushing
   c. Stabilizer bar link
   d. Track rod bushing
CHAPTER QUIZ

9. To help prevent vehicle wandering on a vehicle with torsion bars, the ride height (trim height) should be within ________ side to side.

a. 0.003 in. (0.076 mm)
b. 0.050 in. (1.27 mm)
c. 0.100 in. (2.5 mm)
d. 0.125 in. (3.2 mm)
10. Two technicians are discussing suspension bushings. Technician A says that replacing control arm bushings usually requires special tools. Technician B says using highperformance urethane bushings may cause excessive noise to be transferred to the passenger compartment. Which technician is correct?

a. Technician A only
b. Technician B only
c. Both Technicians A and B
d. Neither Technician A nor B