

Introduction to Automotive Service

Chapter 37 Suspension and Steering Systems

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class serves as an introduction to the world of automotive service. It correlates material to task lists specified by ASE and NATEF.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	<p>Explain learning objectives to students.</p> <ol style="list-style-type: none"> 1. Prepare for ASE Suspension and Steering (A4) certification test content area "B" (Suspension System Diagnosis and Repair). 2. Describe how a suspension system works. 3. Describe the various types of suspensions. 4. Discuss steering columns and intermediate shafts. 5. Describe how rack and pinion steering gear works. 6. Identify steering linkage components 7. Describe how the movement of the steering wheel causes the front wheels to turn.
Establish the Mood or Climate	Provide a WELCOME , Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

ICONS



Ch37 Suspension and Steering Systems

1. SLIDE 1 CH37 SUSPENSION & STEERING SYSTEMS
2. SLIDE 2 EXPLAIN suspensions

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VIDEOS [Steering System \(62 Links\)](#) [Suspension System \(55 Links\)](#)

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3. SLIDE 3 EXPLAIN Vehicle Frames
4. SLIDE 4 EXPLAIN Figure 37-1 typical truck frame is an excellent example of a ladder-type frame. The two side members are connected by a crossmember.
5. SLIDE 5 EXPLAIN Figure 37-2 (a) Separate body and frame construction; (b) Unitized construction: the small frame members are for support of the engine and suspension components. Many vehicles attach the suspension components directly to the reinforced sections of body and do not require rear frame section.
6. SLIDE 6 EXPLAIN Figure 37-3 Welded metal sections create a platform that combines the body with the frame using unit-body construction.
7. SLIDE 7 EXPLAIN Suspension System

DISCUSSION: Ask students to discuss differences between truck and car suspension systems. Ask the students to discuss why only some pickup trucks are constructed with ladder type frames

DISCUSSION: Ask the students to discuss why manufacturers like to use unitized construction.

DISCUSSION: Ask the students to discuss what they believe is the best type of frame construction.

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DEMONSTRATION: Show the underside of vehicles with unitized and frame construction. Point out differences

HANDS-ON TASK: Have the students identify vehicles with unitized & frame construction.

8. **SLIDE 8 EXPLAIN** FIGURE 37-4 Most early vehicles used single straight axles

HANDS-ON TASK: Have the students identify both independent and solid axle rear suspensions.

9. **SLIDE 9 EXPLAIN** Figure 37-5 An independent suspension means that if one wheel hits a bump, only that wheel moves upward and allows the opposite wheel to remain unaffected by the bump. This type of suspension allows for smoother ride and is used in most front suspensions and many rear suspensions

Spring and Shock Absorber

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DISCUSSION: Discuss why non-independent suspension work better in a truck than would an independent suspension system.

10. **SLIDES 10-11 EXPLAIN** springs

12. **SLIDE 12 EXPLAIN** Figure 37-6 spring rate of a coil spring is determined by the diameter of the spring and the diameter of the steel used in its construction plus the number of coils and the free length (height).

DEMONSTRATION: Show examples of coil spring ends.

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DEMONSTRATION: Show examples of replacement coil springs.

DISCUSSION: Ask the students to discuss tools they could use to compress a spring.

13. **SLIDE 13 EXPLAIN** Figure 37-7 When leaf spring is compressed, spring flattens and becomes longer. Shackles allow for this lengthening. Rubber bushings are used in ends of spring and shackles are used to help isolate road noise from traveling into passenger compartment

DEMONSTRATION: Show examples of center bolts, shackles, and rebound clips.

DEMONSTRATION: Show examples of steel leaf springs and composite leaf springs

DISCUSSION: Ask the students to discuss why adding heavy-duty springs will not increase the gross vehicle weight rating

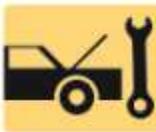
HANDS-ON TASK: Have the students label parts of a leaf spring and leaf spring suspension. Have students use sticky notes or a similar product

DISCUSSION: Ask students to discuss what is affected when center bolt moves in spring perch.

14. **SLIDE 14 EXPLAIN** Figure 37-8 torsion bar resists twisting and is used as a spring on some cars and many four-wheel-drive pickup trucks and sport utility vehicles. The larger the diameter, or the shorter the torsion bar, the stiffer the bar. A torsion bar twists very little during normal operation and about a 1/16 of a revolution during a major suspension travel event

DEMONSTRATION: Show examples of torsion bars

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DISCUSSION: Ask the students to discuss why not all manufacturers of SUVs include torsion-bar suspensions as standard equipment.

DISCUSSION: Ask the students to discuss any warning signs that would occur before a torsion bar breaks.

15. SLIDE 15 **EXPLAIN** Front Suspensions

16. SLIDE 16 **EXPLAIN** FIGURE 37-9 typical SLA front suspension using coil springs

Short/Long Arm Suspension

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DEMONSTRATION: Show examples of upper control arms, lower control arms, and spindles.

17. SLIDE 17 **EXPLAIN** Strut Suspensions

18. SLIDE 18 **EXPLAIN** FIGURE 37-10 typical MacPherson strut showing all of the components of the assembly. A strut includes the shock and the spring in one structural assembly

19. SLIDE 19 **EXPLAIN** FIGURE 37-11 Multilink front suspension design varies depending on the vehicle manufacturer

Strut Suspension

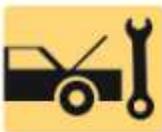
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DEMONSTRATION: Show examples of strut rod bushings

HANDS-ON TASK: Have the students remove and inspect strut rod bushings.

In adverse weather conditions, fasteners may become difficult to remove. Make sure to use sufficient penetrating oil & allow enough time for oil to soak in & work.

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DISCUSSION: Ask the students to discuss why **SOME** manufacturers use modified struts instead of MacPherson struts.

20. **SLIDE 20 EXPLAIN** Suspension System Inspection
21. **SLIDE 21 EXPLAIN FIGURE 37-12** 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

DISCUSSION: Ask the students to discuss what customer complaints will be if the bearing in the upper strut mount goes bad

22. **SLIDE 22 EXPLAIN FIGURE 37-13** It is easy to see that this worn control arm bushing needed to be replaced. The new bushing is shown next to the original

DEMONSTRATION: Show the students examples of control arm bushings **FIGURE 37-13**

23. **SLIDE 23 EXPLAIN FIGURE 37-14** exhaust was found to be rubbing on the frame rail during a visual inspection. Rubber exhaust system hangers are used to isolate noise and vibration from the exhaust system from entering the interior. These rubber supports can fail, causing the exhaust system to be out of proper location
24. **SLIDE 24 EXPLAIN** Steering Wheels
25. **SLIDE 25 EXPLAIN** Steering Columns

DEMONSTRATION: Show how to remove several types of column covers

HANDS-ON TASK: Have the students remove column covers

DISCUSSION: Ask the students to discuss whether mesh-design collapsible steering column or bearing-design collapsible steering column is better

ICONS

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DEMONSTRATION: Show examples of breakaway support brackets and knee bolsters. Show examples of tilt mechanisms

When replacing wires in steering column, make sure wires are placed in wire trough. This will prevent damage to wires.

26. **SLIDE 26 EXPLAIN** FIGURE 37-15 The steering shaft links the steering wheel to the steering gear while the column jacket, which surrounds part of the shaft, supports the brackets and switches. This steering shaft has a small intermediate section between the main section and the steering gear.

Steering Linkage Operation

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27. **SLIDE 27 EXPLAIN** CONVENTIONAL Steering Gears

DISCUSSION: Ask the students to discuss whether a 22:1 steering gear ratio or a 14:1 steering gear ratio is better

28. **SLIDE 28 EXPLAIN** FIGURE 37-16 As steering wheel is turned, nut moves up or down on threads, shown using a bolt to represent worm gear and nut representing gear nut that meshes with teeth of sector gear.

Power Steering Gear

Power Steering Hydraulics

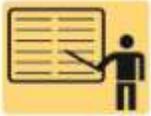
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DEMONSTRATION: Show examples of constant ratio steering gear sector shafts and variable-ratio steering gear sector shafts

DEMONSTRATION: Show the students examples of typical manual recirculating ball steering gears.

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DEMONSTRATION: Show how to use a beam-type inch-pound torque wrench to perform an overcenter adjustment. Show how to adjust worm bearing preload by installing selectively sized shims. Show how to use a spanner wrench and a ruler or tape measure to adjust worm gear freeplay

29. SLIDE 29 **EXPLAIN** Rack-and-Pinion Steering Gears

Rack and Pinion Steering

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30. SLIDE 30 **EXPLAIN** FIGURE 37-17 Rack-and-pinion steering gear operation is simple, direct, and the rack is in a straight line to the front wheels

DEMONSTRATION: Show components of a typical manual rack-and-pinion steering gear

DISCUSSION: Ask the students to discuss whether a rack and-pinion steering gear or a conventional steering gear is better

DEMONSTRATION: Show how to adjust the rack-and pinion gear preload

31. SLIDE 31 **EXPLAIN** FIGURE 37-18 typical rack-and-pinion steering gear as viewed from under the vehicle. A small air tube is used to transfer air between the boots as they extend and compress during turns

32. SLIDE 32 **EXPLAIN** Steering Linkage

DEMONSTRATION: Show example of parallelogram steering linkage. Show examples of steering dampeners used on light trucks, vans, & some luxury cars.

DEMONSTRATION: Show examples of center-take-off rack-and-pinion steering gear assemblies

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33. **SLIDE 33 EXPLAIN FIGURE 37-19** Steering movement is transferred from pitman arm that is splined to the sector shaft (pitman shaft), through the center link and tie rods, to the steering knuckle at each front wheel. Idler arm supports the passenger side of center link and keeps steering linkage level with road. This type of linkage is called a parallelogram-type design.

DISCUSSION: Ask the students to discuss whether front steer or rear steer is better

34. **SLIDE 34 EXPLAIN FIGURE 37-20** Two different styles of tie rod ends. (a) dual bearing design with a preload spring. (b) nylon wedge bearing type allows for extended lube intervals. Wear is automatically compensated by tapered design & spring-loaded bearing
35. **SLIDE 35 EXPLAIN FIGURE 37-21** All joints should be checked by hand for any lateral or vertical play.

DEMONSTRATION: Show how to check steering components by using the dry park test:

HANDS-ON TASK: Have the students do a **Dry Park Test**

36. **SLIDE 36 EXPLAIN** Steering Linkage Lubrication

DEMONSTRATION: Show examples of Zerk fittings, both in hand and on the vehicle.

DEMONSTRATION: Show examples of grease guns and grease cartridges. Show how to use a grease gun and cartridge to grease a tie rod end

37. **SLIDE 37 EXPLAIN FIGURE 37-22** Greasing a tie rod end. Some joints do not have a hole for excessive grease to escape, and excessive grease can destroy the seal

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ON-VEHICLE NATEF TASK (A4-D-6) Lubricate Suspension and steering system (P-2)

38. **SLIDE 38 EXPLAIN FIGURE 37-23** Part of steering linkage lubrication is applying grease to the steering stops. If these stops are not lubricated, a grinding sound may be heard when the vehicle hits a bump when the wheels are turned all the way in one direction or the other. This often occurs when driving into or out of a driveway that has a curb.

ON-VEHICLE NATEF TASK (A4-A-3) Research applicable vehicle and service information. (P-1) Page 340

SEARCH INTERNET: Have the students search Internet for other vehicles that share the same platform as their own vehicle. Or have the students draw the name of a vehicle "out of a hat."

Homework: complete Ch37 crossword puzzle:
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