In the last decade every aspect of the automobile has changed. And the suspension system has not been immune to technical improvements. For years, shock absorbers were simple hydraulic units that controlled spring oscillations. Today, these hydraulic dampeners have been replaced with electronic adjustable dampers that are capable of varying suspension stiffness and ride quality to match changing driving conditions. Many of today’s vehicles offer automatic leveling systems that use air shocks or air springs to control ride height.

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**SHOCKS AND STRUTS**

The shock absorber uses oil to improve ride quality and safety. Suspension springs tend to continue to cycle between extensions and contraction after encountering irregularities in the road. Spring oscillations cause the vehicle to “float” up and down long after the bump has passed. The oil in the shock flows through orifices to dampen the movement of the suspension and reduce the spring oscillations. The shock absorber helps maintain tire contact with the road, but it does not support the weight of the vehicle.

Shock absorber applications are determined by the jounce and rebound ratio. Ratios from 50/50 to 80/20 are available.

**Jounce:** when suspension is compressed (such as when encountering a bump in the road)

**Rebound:** when suspension extends as the tire encounters a hole in the road

The strut assembly consists of a shock absorber and coil spring combined into a single unit. Unlike the shock absorber, the strut assembly supports the weight of the vehicle while maintaining ride height and providing a pivot for the front wheels to turn.

The modified MacPherson strut system assembly does not rotate as the vehicle is turned. It’s used on sport vehicles to reduce camber changes and to keep the entire tread of the tire in contact with the road.

**MORE THAN JUST A COMFORTABLE RIDE**

Most people associate struts and shock absorbers with ride quality and comfort, but they also affect handling and driving safety. They are a vital part in the operation of Electronic Stability Control (ESC) and the Antilock Brake System (ABS).

The ESC system programming is calibrated to how the vehicle’s suspension handles. If any component of the suspension system is weak, ESC may not function effectively.

Worn rear shocks or struts can allow wheel bounce during hard braking. If the tires lose contact with the road on ABS-equipped vehicles, it can unnecessarily trigger the ABS system.

Other than damage from impact, shocks or struts seldom experience catastrophic failure; rather they deteriorate gradually over time. Because of this, drivers may not notice the diminishing changes in ride control capabilities. That’s why most vehicle and shock manufacturers recommend replacing shocks and struts at specified mileage intervals.

**TYPES OF SHOCKS**

A conventional twin-tube shock absorber has an outer tube that acts as the oil reservoir and stores the gas charge. The outer tube surrounds the inner piston chamber. Up and down movement of the shock moves the piston, forcing the oil to flow through orifice valves. Restricted oil flow slows piston movement.

The monotube shock does not use an outer fluid reservoir, and all the oil remains in the piston chamber. A floating piston separates the oil from a high-pressure nitrogen gas charge. Downward movement of the piston pushes the oil against the floating piston and compresses the gas charge underneath it. This creates an “air spring” effect that keeps the oil under constant pressure to reduce foaming. If the oil foams, the air bubbles offer less resistance to the motions of the piston, fading the shock’s dampening characteristics.
Nivomat shocks are self-contained, gas-pressurized shock absorbers that automatically level the vehicle to the proper position. The control sleeve controls oil flow through the spiral cut and release bore in the pump rod. When a vehicle is loaded, the additional weight moves the pump rod down and opens the valve. Oil is drawn from the reservoir, through the hollow pump rod and inlet valve, into the pump chamber. This increases the pressure in the accumulator and returns the piston and shaft to the level position, where the control sleeve closes the spiral cut.

The shocks and struts on many late model vehicles are part of an active electronic suspension system that adjusts ride control to changing driving conditions. Automatic level control systems are designed to maintain correct vehicle ride height under different load changes. Level control systems use air pressure that is pumped into air shocks or air springs in response to change in load. Most air suspension systems are automatic and have height level sensors, air control solenoids, relays, an electric air pump, and an electronic control module (ECM).

Like ordinary hydraulic shocks and struts, the components of the air leveling and air suspension system eventually wear out. They can also fail electronically. An inspection of an automatic level control or air suspension system should include the compressor, height sensors, hoses, hose connections, air shocks (or air struts), electrical connectors, relays, solenoids, wire harness, electrical components, dryer, and pressure regulator.

Availability of replacement parts can be an issue on older air leveling/suspension equipped vehicles. Fortunately, NAPA has replacement shocks and struts for many of these older applications, as well as conventional replacement shocks and struts as a lower cost repair alternative.

The computerized ride control system is another automatic suspension design. These suspensions are computer controlled and can adapt to different road conditions and driving situations. Systems might use:

- **Actuators** – to direct hydraulic pressure within the shock absorber or strut to adjust from a soft ride to a stiffer ride
- **Internal solenoid valve or electric motor** – to reposition the valving of the shock or strut, varying the resistance of the dampers
- **Magnetorheological fluid** – tiny particles of iron in the fluid cause it to thicken when exposed to a magnetic field created by a small coil inside the shock

Inspect the shocks and struts whenever the vehicle is being serviced for tires, alignment, brake work, oil changes, or other undercar repairs. Inspect for signs of wear (such as fluid leaks) and damaged or missing components.

On strut systems, inspect the upper mount plate for looseness, binding, or noise on turns. Check the coil spring for damage and proper ride height, and inspect the bumper for wear and damage.

Use a bounce test to identify weak shocks or struts. Jounce the suspension up and down several times, then release it. The vehicle should come to rest in 1–1.5 oscillations. If it doesn’t, the shocks/struts are weak and should be replaced.

Shocks/struts could also be worn if:

- The suspension bottoms after hitting a bump
- There’s excessive nose dive when braking
- There’s excessive body lean or sway when cornering
- There’s a bouncy ride
- Wheels shudder or shimmy after hitting a bump
- There’s cupped tire wear
REVIEW QUESTIONS

1. Technician A says Nivomat shocks compressed air to change spring rate. Technician B says Nivomat shocks can be replaced with conventional shocks. Who is correct?
   a. Technician A
   b. Technician B

2. The purpose of the dampeners is:
   a. To maintain ride height
   b. To maintain tire contact
   c. To dampen spring oscillations
   d. Both b and c

3. Technician A says the purpose of the fuel pump check valve is to lock fuel under pressure in the fuel rail. Technician B says struts may be directional and be installed on a designated side of the vehicle. Who is correct?
   a. Technician A
   b. Technician B
   c. Both Technician A and B
   d. Neither Technician A nor B

TECH TIPS

- Nivomat shocks are calibrated for specific vehicle applications. Only replace with the same type of shock.
- OEM shocks on a high-mileage vehicle are probably worn out.
- Place your hand on the upper mount while jouncing the vehicle to help isolate rattles.
- If a strut is noisy (popping, snapping, groaning, or creaking noises) or the steering feels stiff or returns slowly after turning, the upper strut mount plate may be worn out and should be replaced.
- Replace the upper strut mount plates on both sides of the vehicle at the same time.
- As a rule, replace shocks and struts in pairs (both fronts or both rears) to maintain consistent ride control side-to-side. Best practice is to replace all four dampeners at the same time.
- The use of a special shock/strut socket will make it easier to remove and install the dampener since they prevent the shaft from rotating while loosening/tightening the retaining nut.
- Never reuse old shock mounting hardware.
- Perform an alignment after replacing strut assemblies.

REPLACING SHOCKS AND STRUTS

To replace shock absorbers:

1. Access the upper shock mounts for the rear shocks from inside the trunk or passenger compartment (behind the back seat). When installing the new shocks, don’t overtighten to avoid crushing the rubber bushings. Torque fasteners to the vehicle manufacturer’s specifications.

2. Prime conventional shocks before installation to remove air trapped in the oil. Hold the shock upright and pull it all the way out, then turn it upside down and push it all the way in. Repeat until the shock pumps smoothly in both directions. Gas shocks do not require priming.

3. Make index marks and reference lines so the new assembly is installed in the same location. Mark the upper mounts for location of studs/bolts before loosening the fasteners.

4. Some strut assemblies can be serviced by replacing an internal cartridge that contains the shock absorber. Others require replacement of the entire strut housing. If only replacing the cartridge or the strut housing (without the coil spring), use a special spring compressor to disassemble the strut and carefully remove the coil spring.

To replace a shock cartridge:

1. Remove the retaining cap nut and pull the cartridge from the housing tube. Pour a small amount of oil into the housing before installing the cartridge into the tube. The oil will help dissipate heat from the shock unit. Tighten the retainer cap to the specified torque.

2. The front struts may be dedicated to one side of the vehicle. Be sure to install the strut on the correct side. When reassembling, make sure the spring is seated securely in its mounting brackets. Inspect the upper mounting location and replace any worn or damaged parts.

3. Alternatively, replace the entire strut assembly with preassembled replacement struts that include a new spring, new upper bearing plate, new jounce bumper (if used), and dust shields. There is no need for a spring compressor.