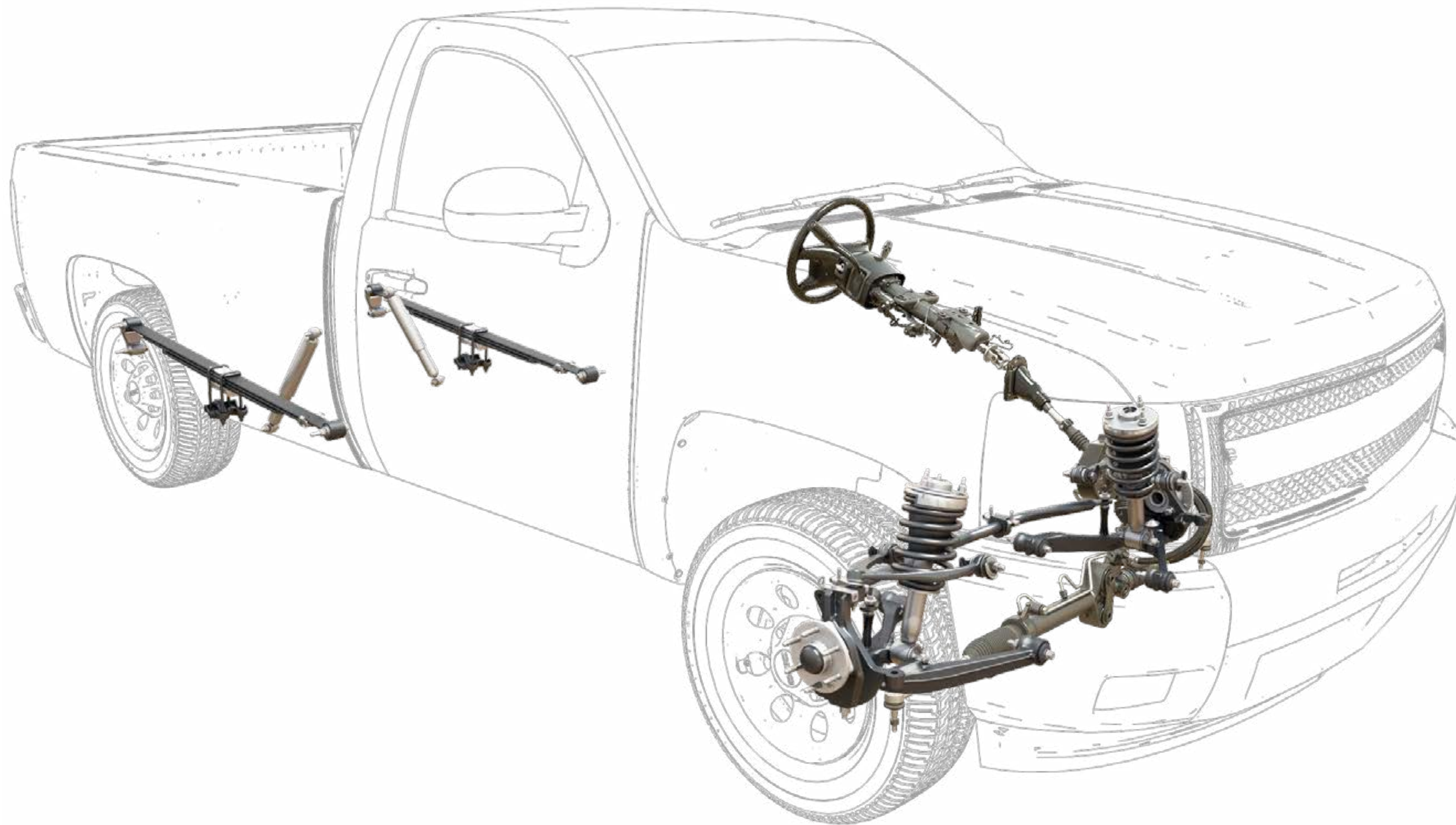


The Steering and Suspension system is engineered to allow the vehicle to turn and absorb road irregularities. The suspension is comprised of springs, suspension arms or links and shock dampers. These components allow the wheel to move independently of the vehicle body or frame in a controlled manner to absorb bumps and keep the tire in contact with the road surface. The steering system is comprised of a steering gearbox or rack, steering column and steering linkage. These components allow the driver to change direction by angling the front wheels to the left or right in unison.

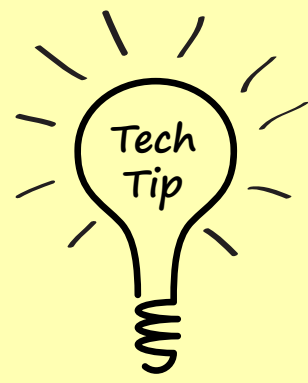


Shocks and Struts

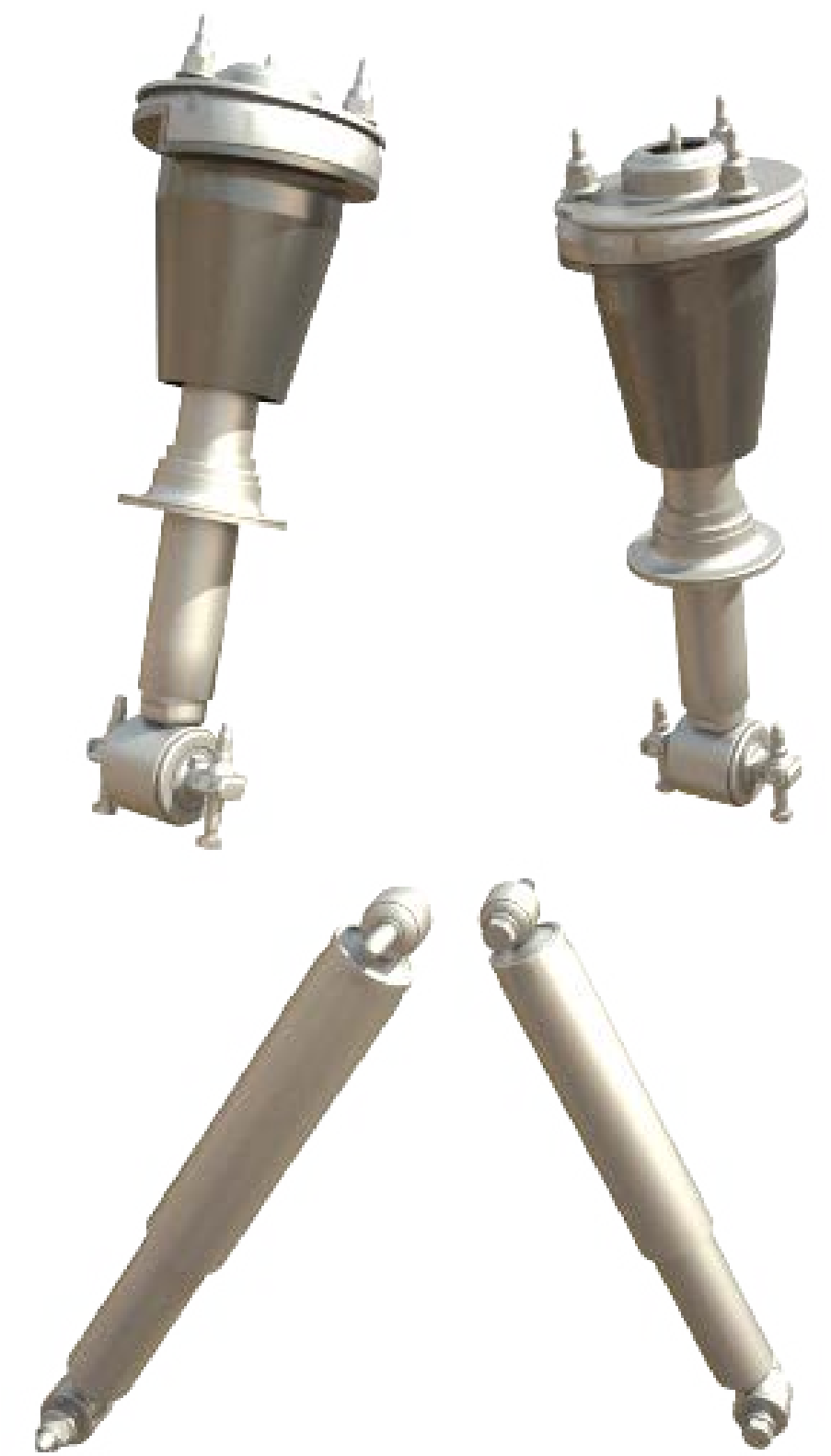
Description/Function: To control the oscillation of the suspension, dampers known as shocks or struts are used. A shock absorber is a hydraulic piston and cylinder that is designed to resist the up and down movement of the suspension. The piston has a valve or orifice that allows the piston to move up and down the cylinder tube at a controlled rate. The valving is tailored to the vehicle and suspension characteristics by the manufacturer. A strut is a shock absorber that is designed to hold the spring as well as sustain proper wheel alignment. Commonly used on front-wheel drive vehicles, struts are identified by the lower coil spring perch located on the strut tube.

Faults/Symptoms:

Shocks and Struts do wear over time and use. Rough roads accelerate wear and striking curbs or pot holes can damage them. Symptoms include: Excessive suspension oscillation, abnormal noises over bumps, or harsh ride. Faults include: leaking hydraulic oil, damaged or leaking valving, bent piston shaft, dented or bent shock tube.



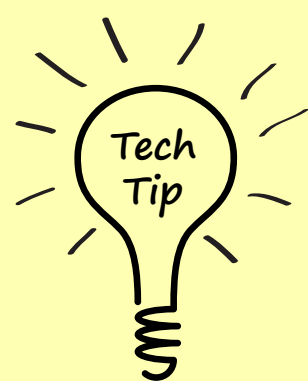
Shocks or Struts should be replaced in axle pairs at minimum, preferably replace all four at the same time to ensure best ride quality.



Springs

Description/Function: The springs support the weight of the vehicle. Springs commonly used on vehicles include: coil springs, leaf springs and air springs. Coil springs are spiral shaped components made from special steel wire. Leaf springs are a stack of curved steel bars called leaves. Air springs are rubber bladders that are filled with air. Springs compress and expand as the wheel moves up and down over bumps. Coil springs are used in car and trucks, leaf springs are typically found on the rear suspension of some trucks, large SUVs and older cars. Air springs can be found on large luxury cars and some trucks and SUVs.

Faults/Symptoms: Springs are pretty durable; however corrosion and overloading the vehicle can damage them. Symptoms include: abnormal noises, harsh ride, uneven or low ride heights, or bottoming out over speed humps. Faults include: broken coils or leaves, leaking air bladders, and sagging springs



Springs should be replaced in axle pairs to provide correct ride height and handling.

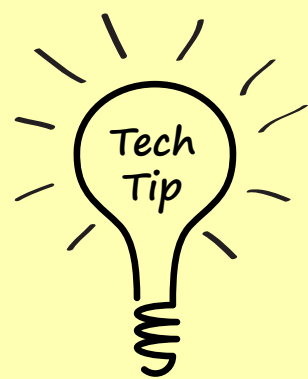
Inspect springs regularly for corrosion. Corrosion or rust causes the spring to weaken, leading to failure.



Control Arm

Description/Function: Structural members of the suspension that locate the wheel providing proper geometry for the tire to remain in contact with the road. These can be large steel or aluminum arms or multiple smaller links made from steel or aluminum. They are attached to the vehicle and steering knuckle through bushings or ball-joints which allow the wheel to move up and down without binding.

Faults/Symptoms: Control Arms can be damaged from corrosion and impacts with curbs and large pot holes. Symptoms include: abnormal tire wear, abnormal noises over bumps, loose or vague handling, which may be more pronounced during acceleration or braking. Faults include: bent arms, worn joints and bushings.



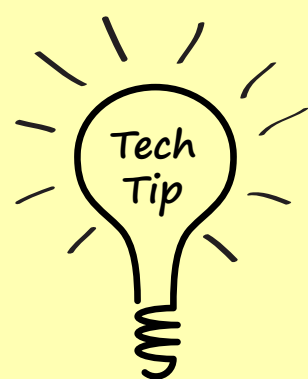
Some control arms have integral ball-joints that require the arm to be replaced if the joint becomes worn.

When replacing control arms tighten bolts with control arm at normal ride height position, this prevents preloading/twisting the bushing.

Ball Joint

Description/Function: Spherical ball and socket made from steel. Designed to pivot and articulate to allow the suspension to move up and down.

Faults/Symptoms: Ball-Joints wear over time, and wear can be accelerated if water or dirt enters the grease boot. Symptoms include: abnormal tire wear, abnormal noises over bumps, loose or vague handling, which may be more pronounced during acceleration or braking. Faults include: excessive ball to socket clearance, stiffness/binding, corrosion, torn grease boot.

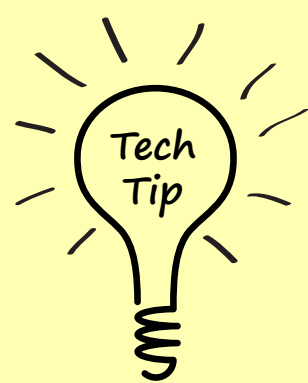


Ensure correct orientation of ball-joints during installation, incorrectly installed ball-joints can cause suspension or steering to bind.

Sway-Bar Links

Description/Function: The sway bar or anti-roll bar is a suspension component that helps limit body sway or leaning when cornering. The bar is shaped to attach to a lever arm at each wheel on the axle. Sway bar links connect the lever ends of the bar to their respective control arm. When the vehicle enters a left turn the body will lean to the right, causing the right or outer control arm to move up, this lifts the sway bar lever. This force is transferred to the left or inner sway bar lever which lifts the control arm. This reaction causes the left or inner side of the vehicle to lower. The larger the sway bar diameter the greater weight transfer that can occur. High performance cars and trucks have larger diameter sway bars.

Faults/Symptoms: Sway bars links can be attached with bushings or by ball-joints. Symptoms include: abnormal noises over bumps, loose or vague handling, which may be more pronounced during cornering. Faults include: corrosion, broken links, worn bushings or joints.



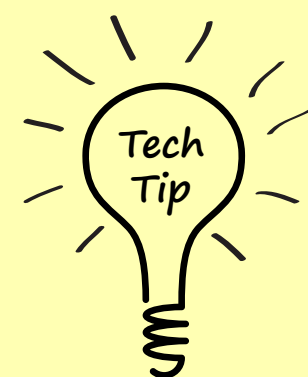
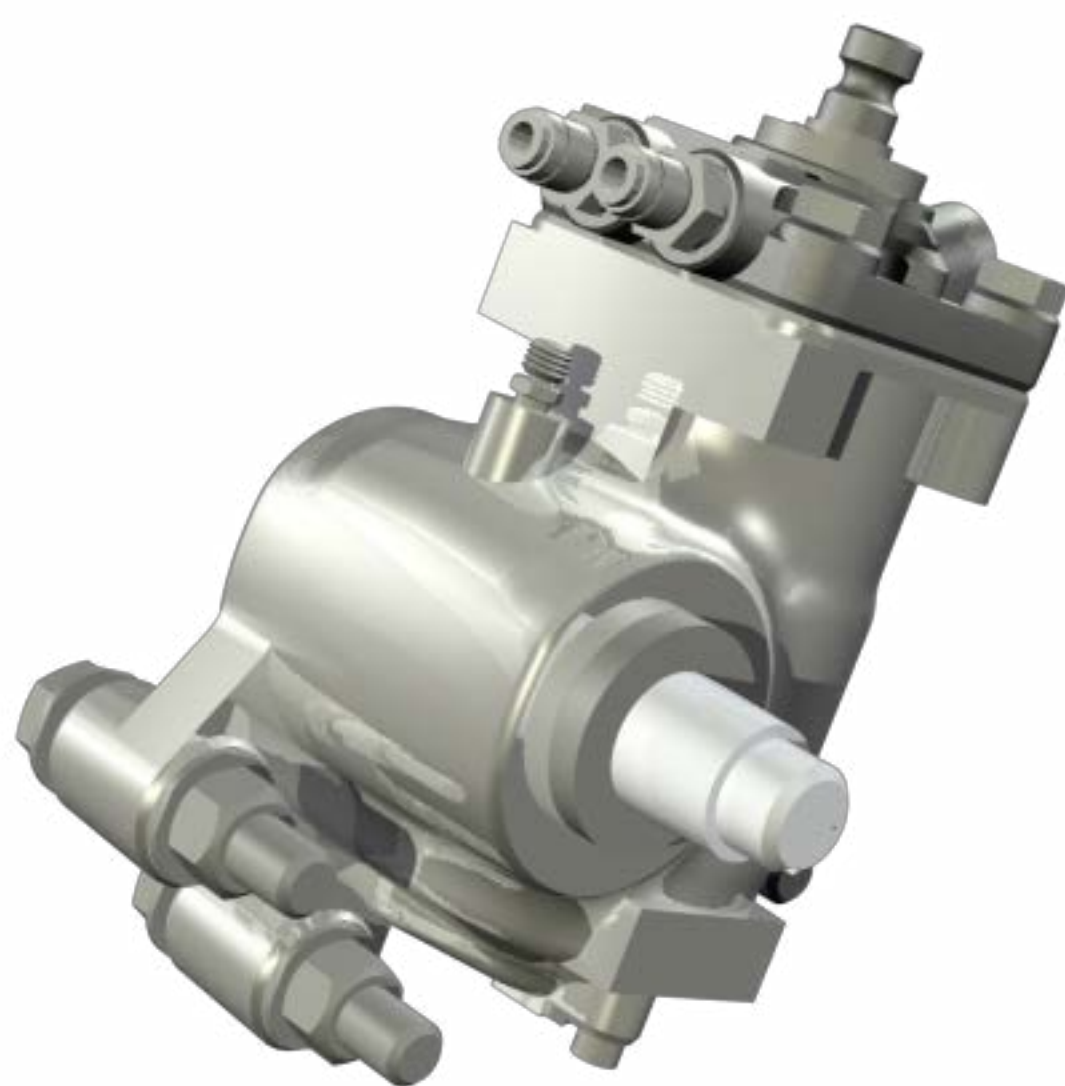
When replacing links, lift vehicle so both wheels of the axle are off the ground.

Some sway bar links are adjustable; follow manufacturer's service information regarding adjustment.

Steering Gear

Description/Function: The steering gear box is what transfers the turning of the steering wheel into a push pull force to move the wheels. Typically the steering gear is based on a recirculating ball design with power hydraulic assist. Once very common on cars and trucks, it is now only found on some trucks and SUVs.

Faults/Symptoms: Symptoms include: excessive steering effort, excessive play, abnormal noises. Faults include: Fluid leaks, binding, worn internal parts, restricted/worn spool valve.



When replacing ensure steering gear/rack is centered before reconnecting the steering column.

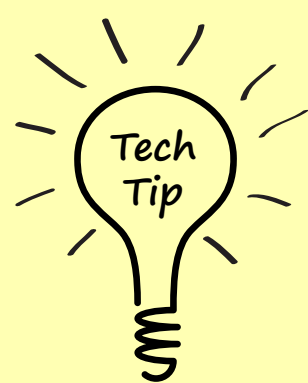
Center and lock steering column before disconnecting steering shaft to prevent damage to air bag coil.

Do not allow telescoping steering shaft to become over-extended or separated during steering gear/rack replacement, shaft will become unusable.

Steering Rack

Description/Function: The steering rack is what transfers the turning of the steering wheel into a push pull force to move the wheels. Typically the steering rack is based on a rack and pinion gear design with power hydraulic or electric assist. Once was just used on a few cars, now it is common to both cars and trucks.

Faults/Symptoms: Symptoms include: excessive steering effort, excessive play, abnormal noises. Faults include: Fluid leaks, binding, worn internal parts, restricted/worn spool valve.



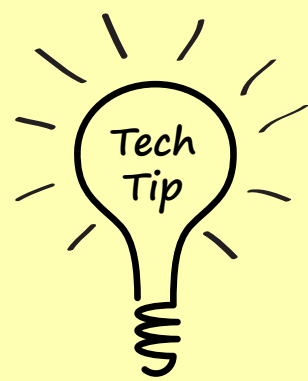
When replacing ensure steering gear/rack is centered before reconnecting the steering column.
Center and lock steering column before disconnecting steering shaft to prevent damage to air bag coil.
Do not allow telescoping steering shaft to become over-extended or separated during steering gear/rack replacement, shaft will become unusable.



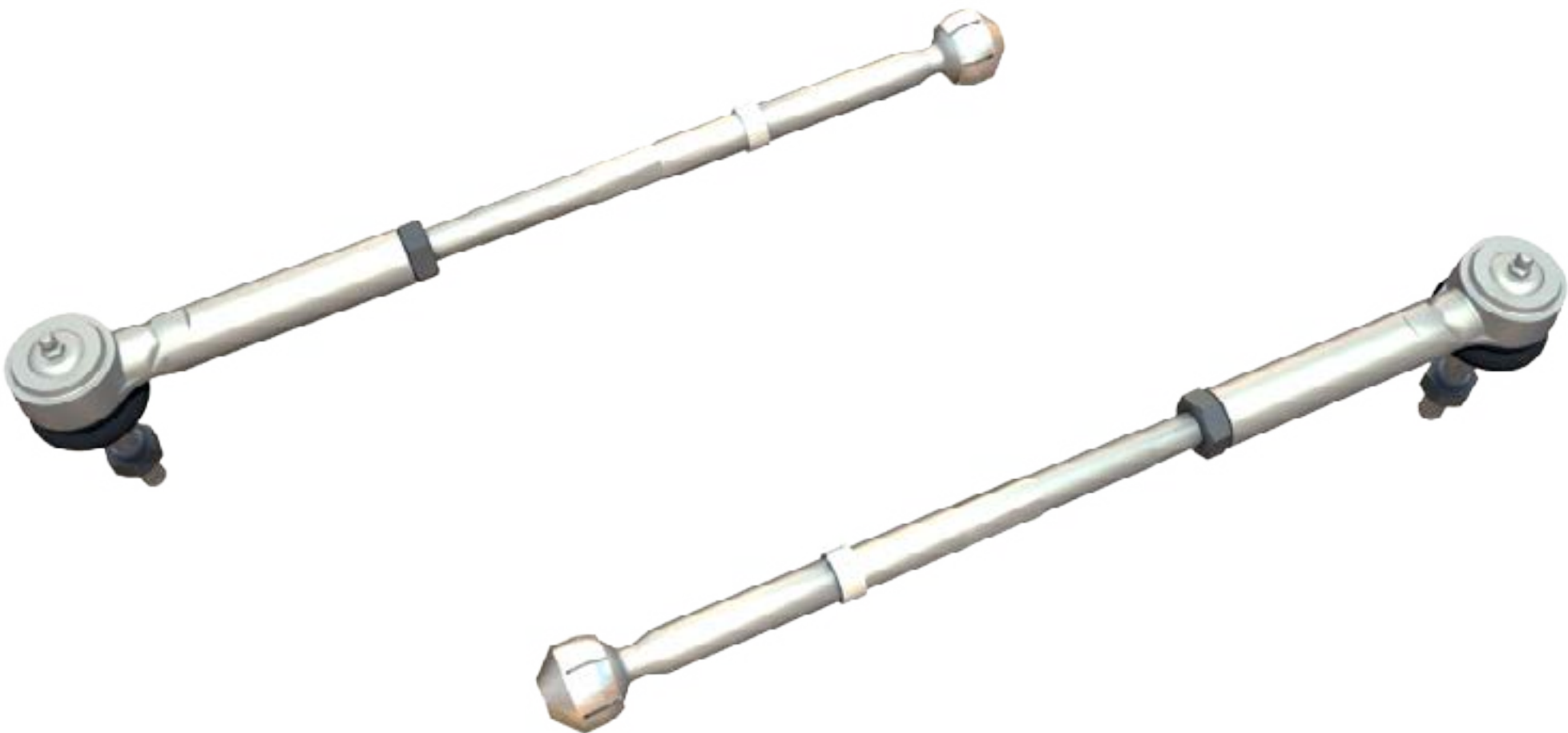
Tie Rods

Description/Function: Tie rods are steel links that connect the steering rack or steering gear to the steering knuckle. Transfers the push-pull force to the wheels. Tie rods are typically adjustable either with threaded adjusting sleeves or through threaded tie-rod ends.

Faults/Symptoms: Symptoms include: abnormal tire wear, abnormal noises over bumps, loose or vague handling and abnormal tire wear. Faults include: bent from impact with object, worn tie rod end, frozen adjusting sleeve/threads.



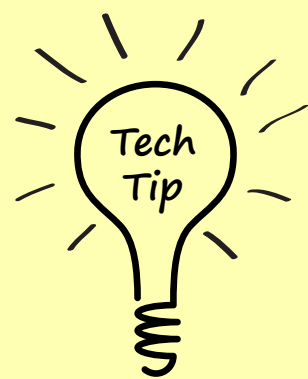
Some vehicles have adjustment on just one tie rod. Only total toe is adjustable.
Replace adjusting sleeves when replacing tie-rods so equipped.



Tie-Rod End

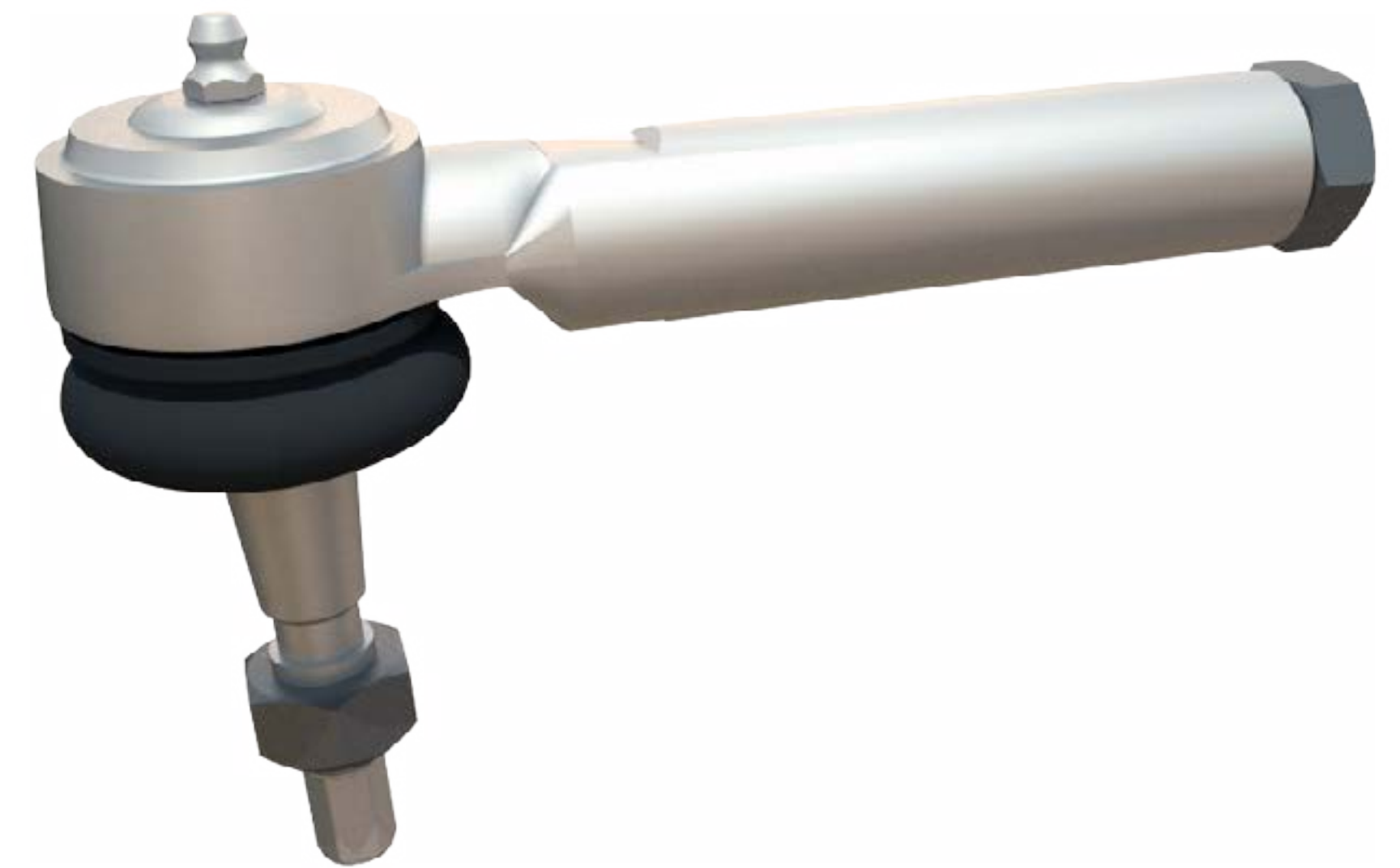
Description/Function: Tie Rod ends contain spherical ball and socket joints that allow the tie rod to articulate with the suspension and to pivot when the wheels are angled for turns. They also connect the tie rod to the steering knuckle and steering rack/linkage. A rubber boot protects the joint from dirt and water intrusion.

Faults/Symptoms: Symptoms include: abnormal tire wear, abnormal noises over bumps, loose or vague handling, which may be more pronounced during turning or braking. Faults include: excessive ball to socket clearance, stiffness/binding, corrosion, torn grease boot.



Tie Rod ends should be checked for looseness and torn boots during regular scheduled maintenance.

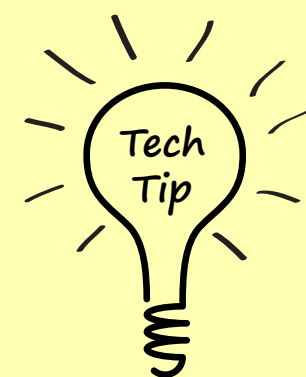
Some tie-rod ends have grease fittings for periodic lubrication.



Pitman Arm

Description/Function: The Pitman arm is a lever bolted to the steering gear that transfers steering force to the steering linkage, either the drag link or tie rods. Often includes a spherical ball and socket joint.

Faults/Symptoms: Symptoms include: abnormal tire wear, abnormal noises, loose or vague handling, which may be more pronounced during turning or braking. Faults include: worn or loose taper spline, excessive ball to socket clearance, stiffness/binding, corrosion, torn grease boot.

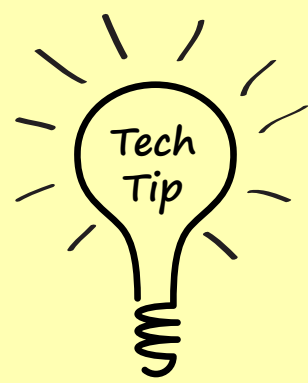
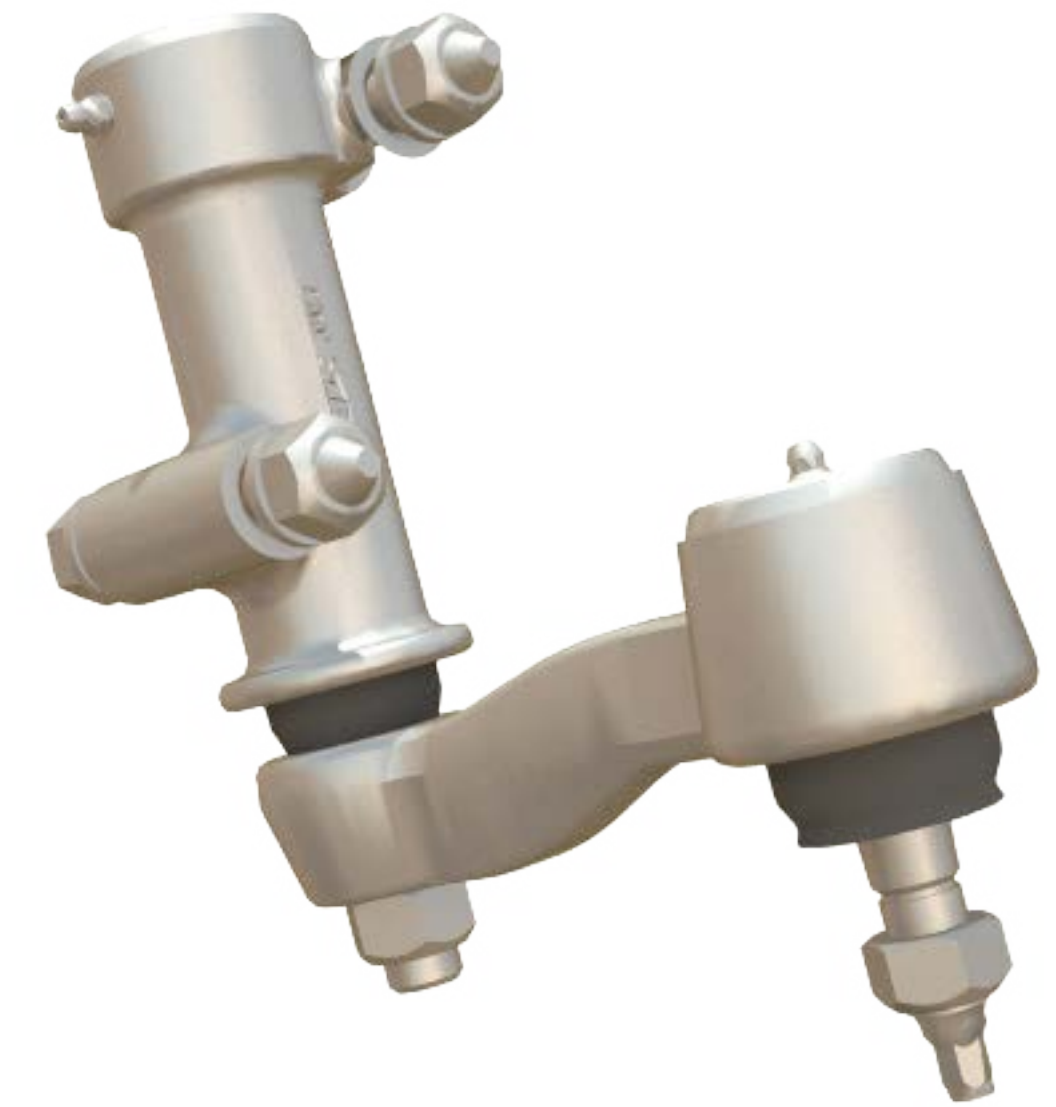


On some trucks there are different pitman arms for 2WD and 4WD applications.

Idler Arm

Description/Function: The idler arm is the companion to the pitman arm. It is used on independent front suspensions with a steering gear box. It is a lever that pivots in a frame mounted bearing, and swings in an identical arc as the pitman arm. It supports the opposite end of the steering linkage. It typically includes a spherical ball and socket joint.

Faults/Symptoms: Symptoms include: abnormal tire wear, abnormal noises, loose or vague handling, which may be more pronounced during turning or braking. Faults include: worn or loose bearing, excessive ball to socket clearance, stiffness/binding, corrosion, torn grease boot.

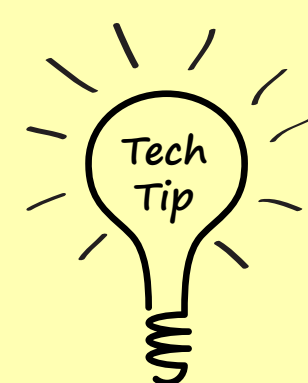


On some trucks there are different idler arms for 2WD and 4WD applications.

Drag Link

Description/Function: Steering link that is connected on one end to the pitman arm and the opposite end to the idler arm, serves as connection point for tie rods. May also have connection to steering damper and include spherical ball and socket joints. Some steering systems, particularly on larger trucks and SUVs with straight front axle (non-independent) have the drag link connecting the steering knuckles to each other.

Faults/Symptoms: Symptoms include: abnormal tire wear, abnormal noises, loose or vague handling, which may be more pronounced during turning or braking. Faults include: bent, excessive ball to socket clearance, stiffness/binding, corrosion, torn grease boot.

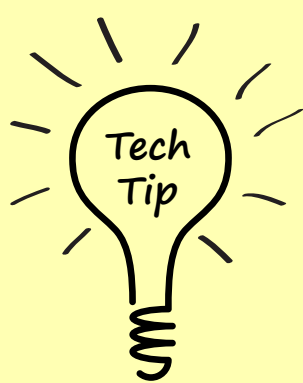


The drag link is adjustable on straight-front-axle trucks for setting total toe. If drag link has joints with grease fittings, periodic lubrication will extend the service life of the joints.

Power Steering Pump

Description/Function: The Power Steering pump generates the hydraulic energy needed by the steering gear or steering rack to provide assist. The pump is located on the engine and is driven via an accessory belt. The pump contains a pressure/flow control valve to maintain hydraulic pressure at all engine speeds and steering demand.

Faults/Symptoms: Symptoms include: excessive steering effort, abnormal noises, and excessive steering feedback. Faults include: Fluid leaks, sticking pressure/flow valves, worn internal parts, and fluid contamination.



When replacing a power steering pump the entire hydraulic system needs to be flushed and the system filled with the manufacturer specified power steering fluid.

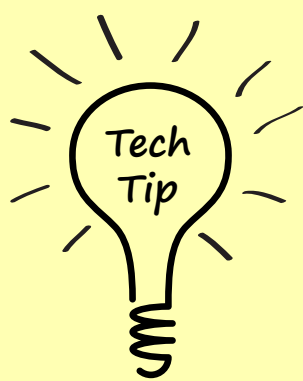
Follow the manufacturer's specified bleeding procedure to remove air and minimize noise.



Bushings

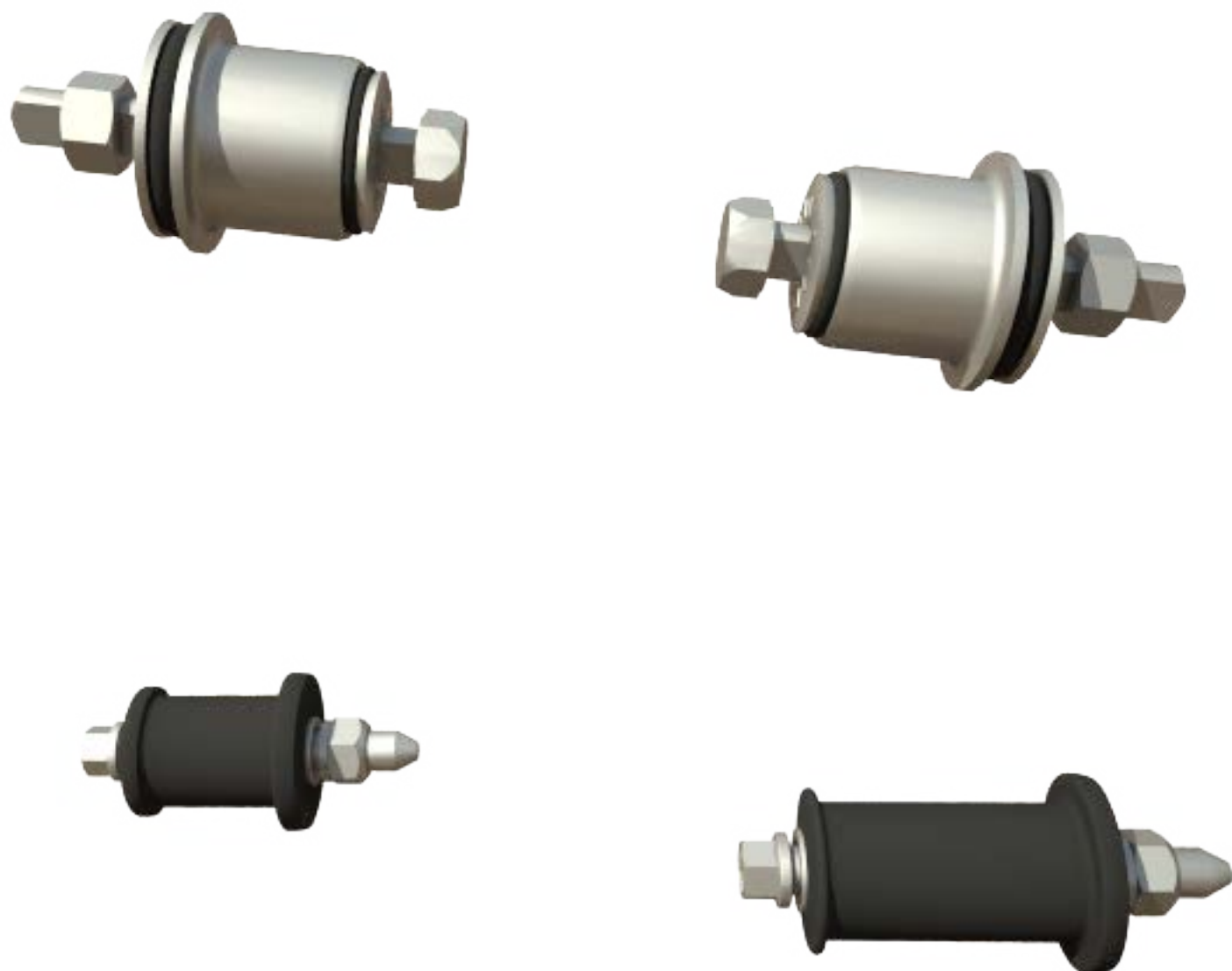
Description/Function: Suspension and chassis components often are supported or connected by bushings. Typically these are made from various rubber compounds that isolate noise and provide needed stiffness within the suspension system.

Faults/Symptoms: Symptoms include: abnormal tire wear, abnormal noises, loose or vague handling, which may be more pronounced during turning, braking or acceleration. Faults include: collapsed bushing material, torn hydraulic filled bushing.



Some bushings are hydraulic types that are filled with a silicon fluid, these can leak indicating failure.

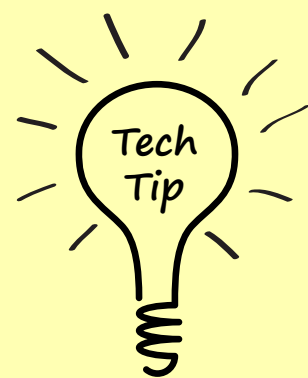
Some bushings must be indexed when pressing in, look for alignment marks, or reference the service manual.



Wheel Bearing

Description/Function: Wheel bearings allow the wheel to rotate with minimal friction. The bearing can include tapered or straight roller or ball-bearing elements. Some bearing are serviced together with the wheel hub. Others are separate components that require periodic lubrication and adjustment.

Faults/Symptoms: Symptoms include: abnormal noises, loose or vague handling, which may be more pronounced during turning, braking or acceleration. Faults include: out of adjustment, lack of or deteriorated lubrication, overheating, or bearing race brinnelling.

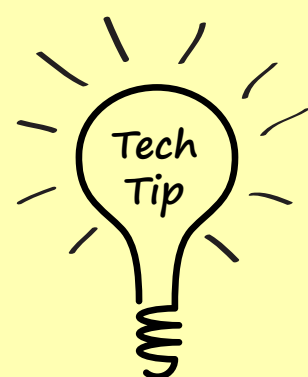


Loose or worn wheel bearings can cause steering related concerns. Check wheel bearing play during inspection.

Power Steering Fluid

Description/Function: Hydraulic medium that transfers force from the power steering pump to the steering gear/rack. Lubricates power steering system components.

Faults/Symptoms: Symptoms include: abnormal noises, increased steering effort. Faults include: contaminated fluid, aeration of fluid.

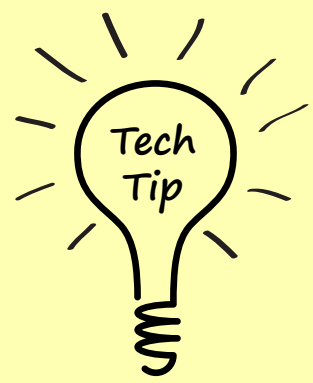


Always use manufacturer's specified fluid, never mix different fluids.
Flush system when replacing components to remove contaminants.

Power Steering Hoses

Description/Function: The power steering hoses are typically a composite of steel and reinforced synthetic rubber hoses with machine crimped fittings and connections. The hose assemblies are designed to withstand high pressure and under hood temperatures.

Faults/Symptoms: Symptoms include: loss of power assist, abnormal noises, fluid leaks. Faults include: Leaks caused by corroded or cracked hydraulic pipe, deteriorated hose material, leaking fittings and seals.



Always replace O-rings on hose fittings before installing new hose. Also it is recommended to replace the fluid with fresh hydraulic fluid specified by the manufacturer during service.

