

Suspension Systems



Purpose of Suspension Systems

- isolate passengers from pot holes & bumps



- support the weight of the vehicle and its' load



- maintain tire contact with road surface



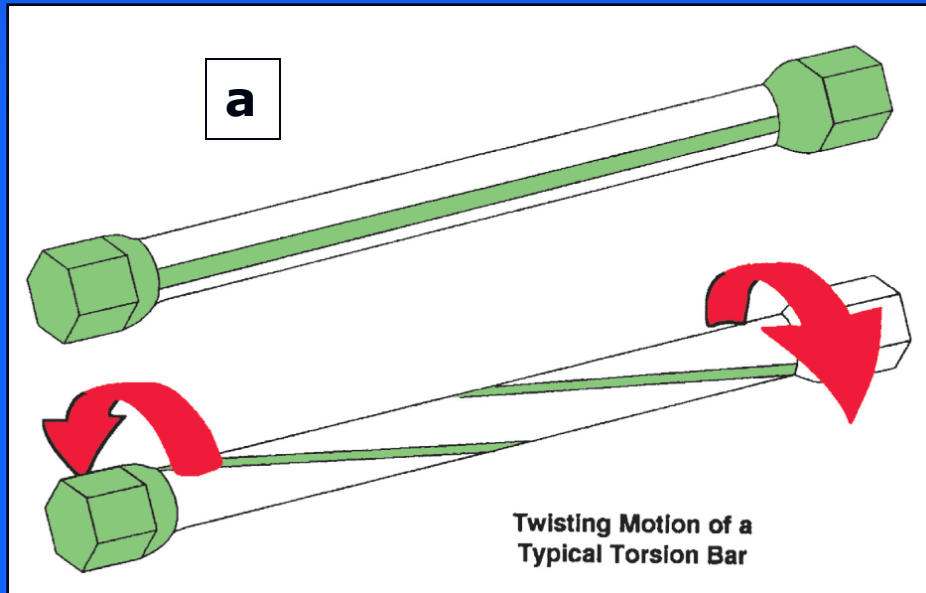
Suspension System Components



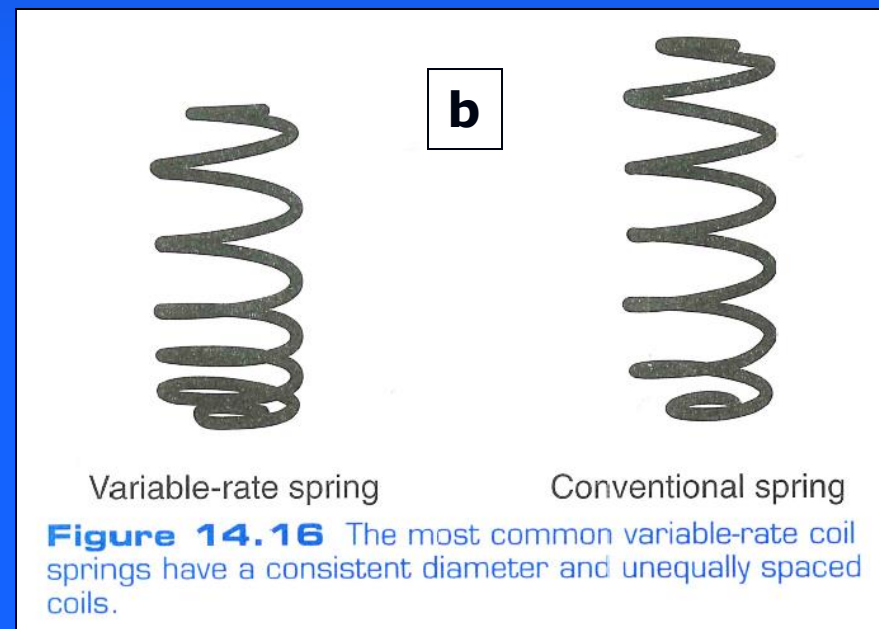
Types of Suspension Springs

- springs live between the frame or body and the axles
- the spring absorbs irregularities in the road surface

a) torsion bars



b) coil springs

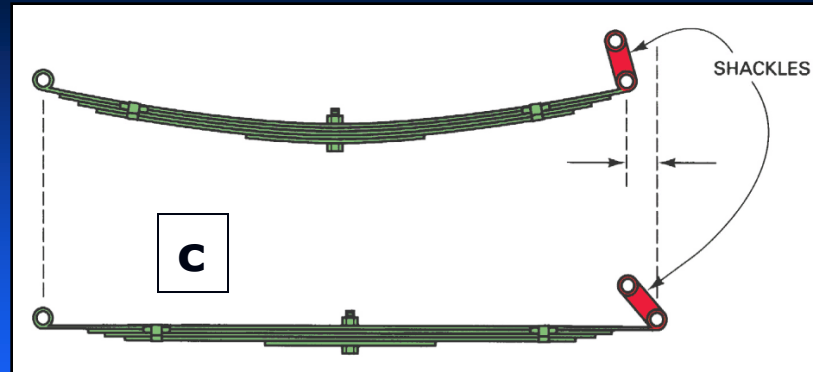




Types of Suspension Springs

c) leaf springs

- oldest form of suspension spring
- can be multi-leaf (most common)
- or single, fiberglass “mono-leaf”



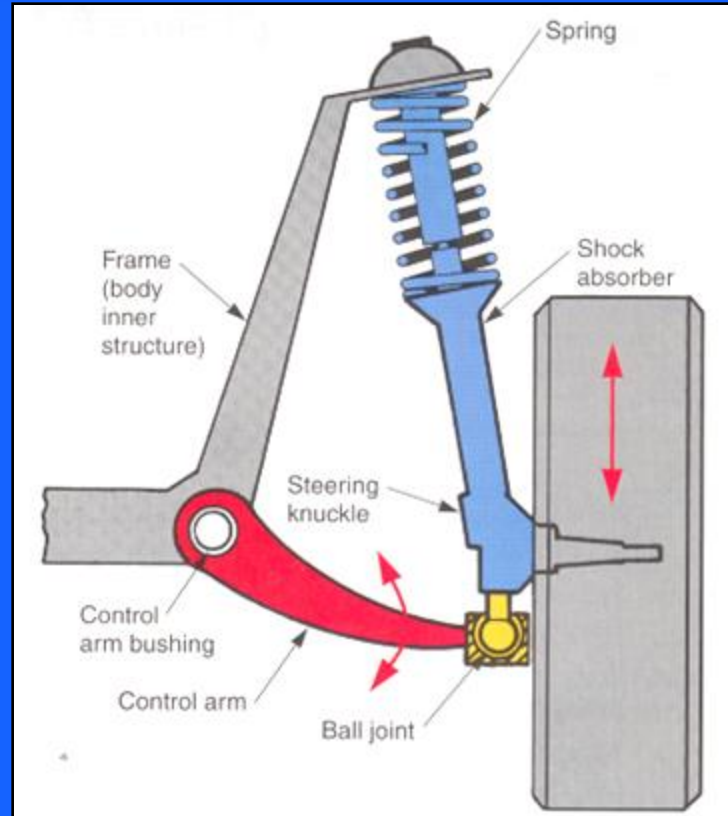
d) air bags

- not common – are available on 2014 Dodge pick-ups
- “hot rods” & custom cars often use air bags
- used on many tour buses and highway trucks & trailers



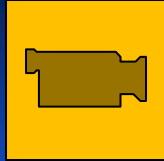
Control Arms

- control arms act as pivot points for the steering knuckle
- control arms or strut rods also prevent fore/aft movement of the tire during braking, acceleration and turns
- the inner end of the control arm mounts to the frame or body
 - mounted via a rubber or urethane bushing
- the other end is attached to the steering knuckle through a ball joint

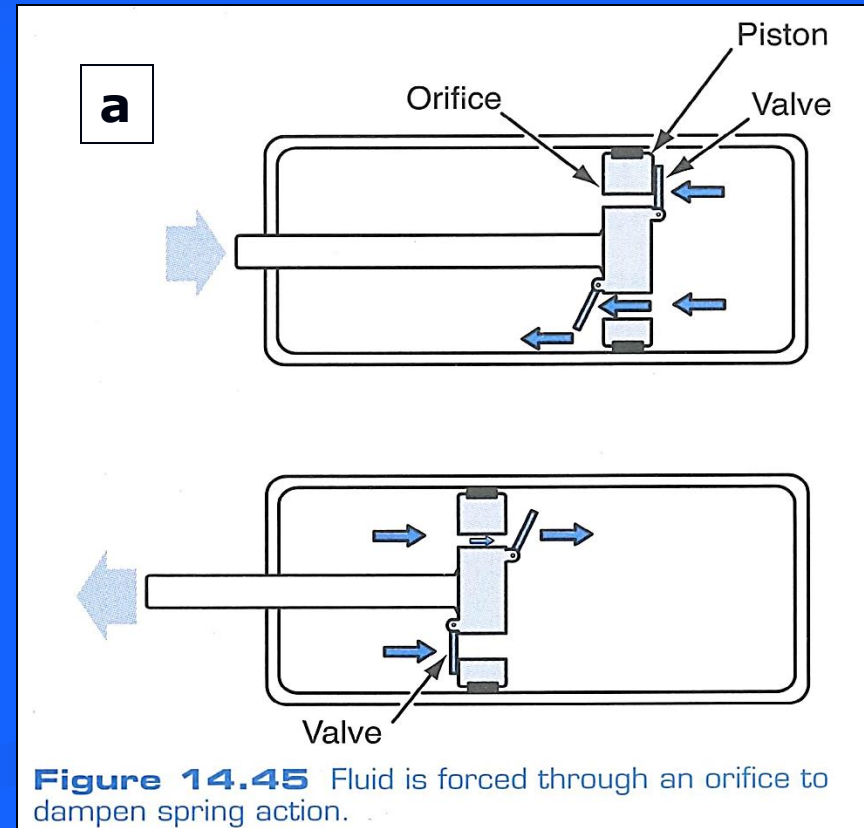
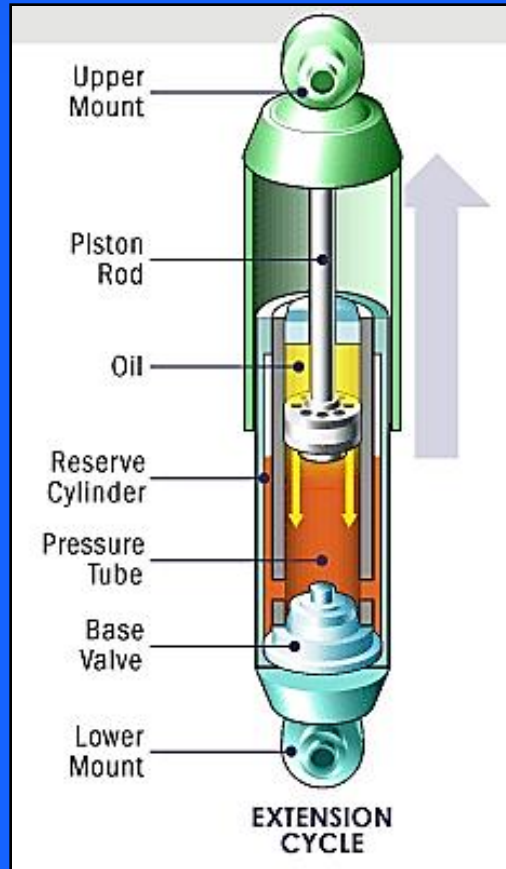
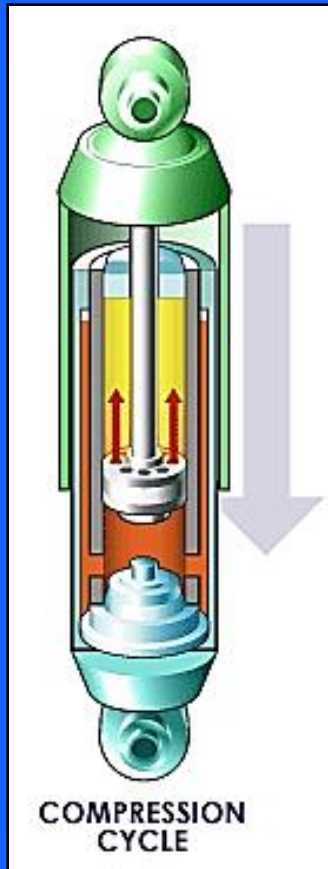




Shock Absorbers

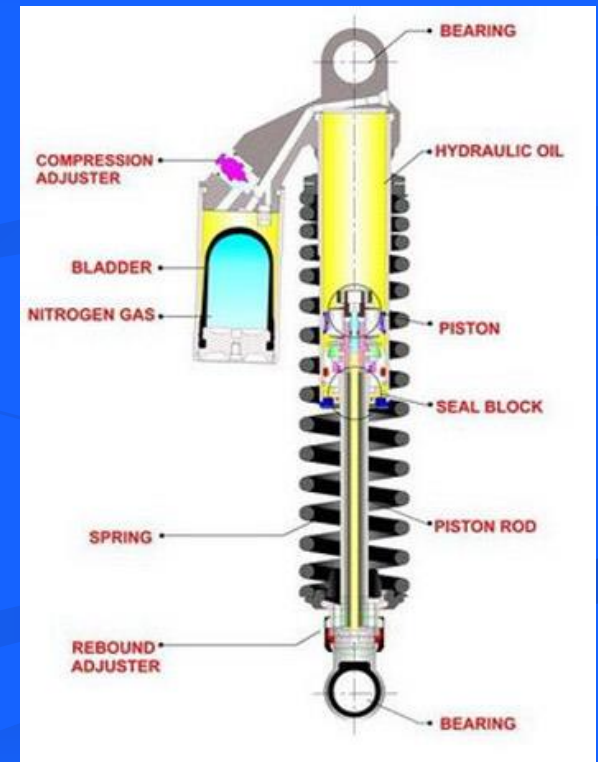


- shocks are dampers – they soften the bounce of the spring
- springs actually absorb shock
- shocks DO NOT support the weight of the vehicle
- without shocks, springs would compress & rebound many times
- spring oscillations are slowed by forcing hydraulic fluid through small passages
 - this is the principle of fluid displacement (fig a)



Shock Absorbers

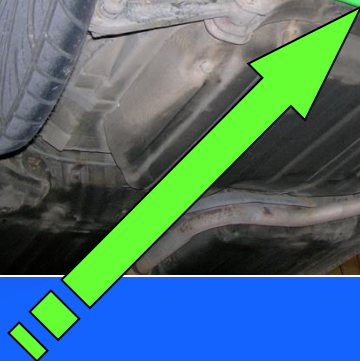
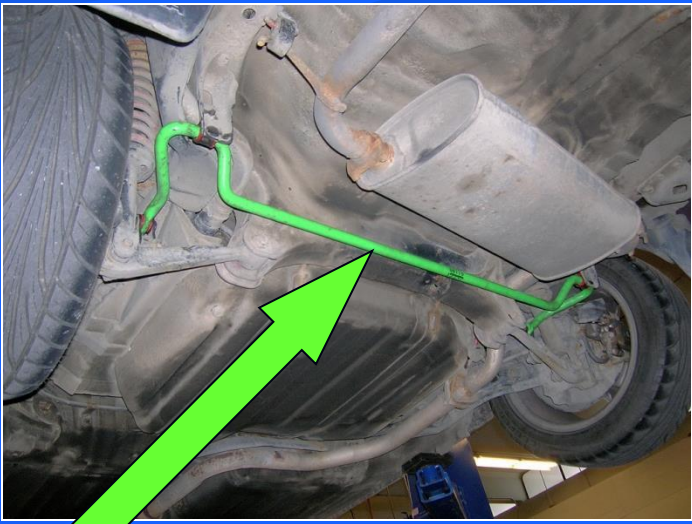
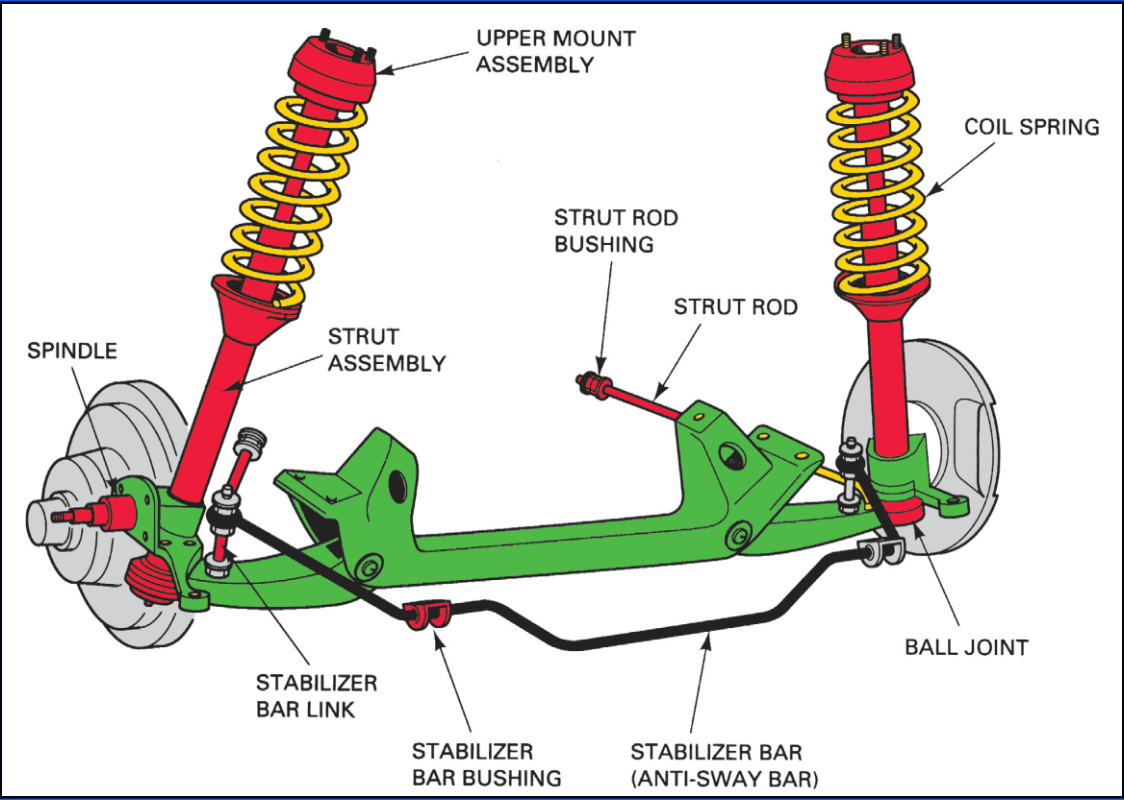
- When a shock no longer dampens and softens the bounce of a spring, it needs to be replaced. You can also look for visual indications of failure like leaks or damage/corrosion to the shock.
- Shock absorbers are typically installed with 2-3 standard bolts.
- Uneven tire wear is also an indicator of worn shocks.
- Gas-charged shocks use low pressure gas to prevent oil foaming.





Anti-roll Bars

- anti-roll, stabilizer or sway bars help limit body roll during cornering
 - made of spring steel
- can be used on the front suspension only, or front & rear suspension



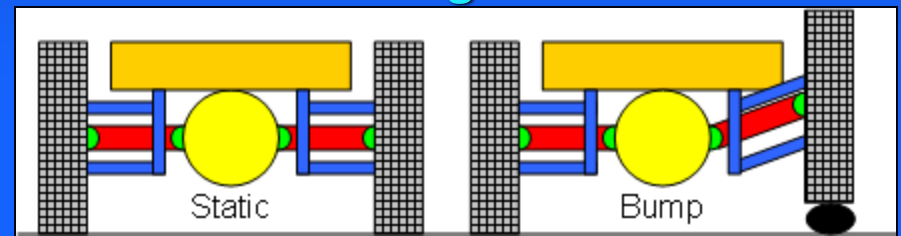


Suspension System Types

- 2 broad categories of suspensions systems include...

❖ independent suspension 🍌

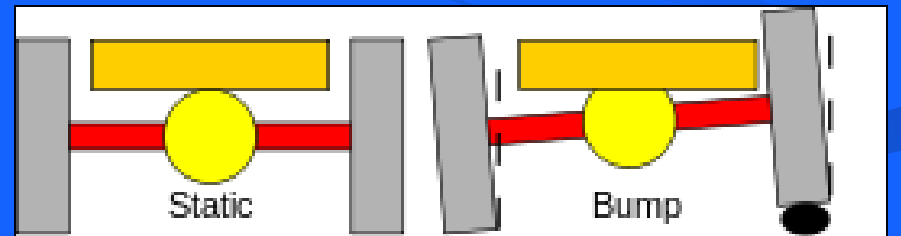
- wheels can rise & fall on their own without affecting the other wheel



❖ dependent suspension



- when a wheel travels over bumps and dips that motion is transferred to the opposite



Front Suspension System Types

- *pivot points*, *springs* & *shocks* can be arranged in various configurations...

Short-long arm suspension aka “double wishbone”

- uses upper & lower control arms
- used on many rear-drive domestic cars
- equal length arms would cause tires to scrub across the road

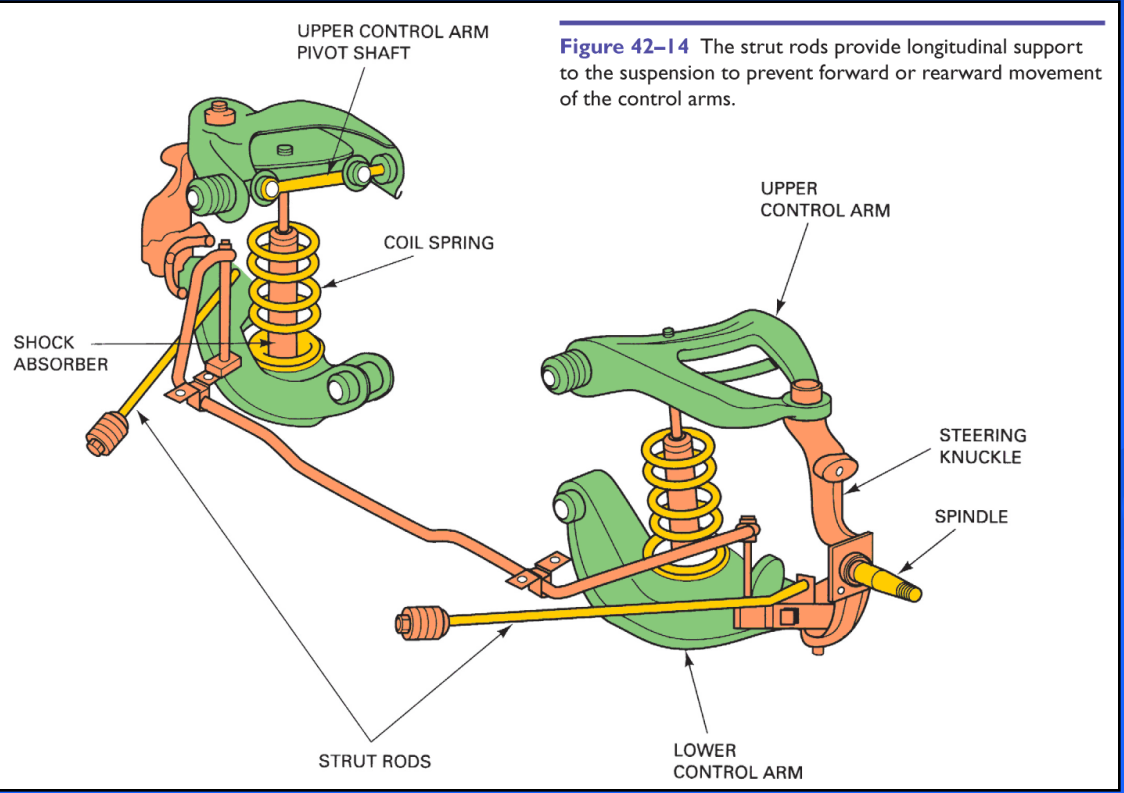
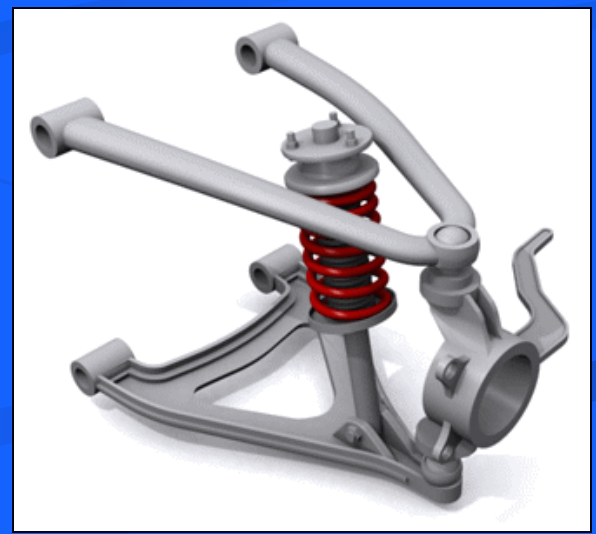
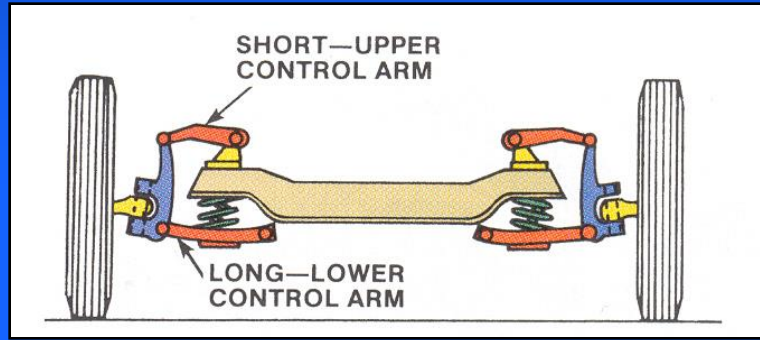
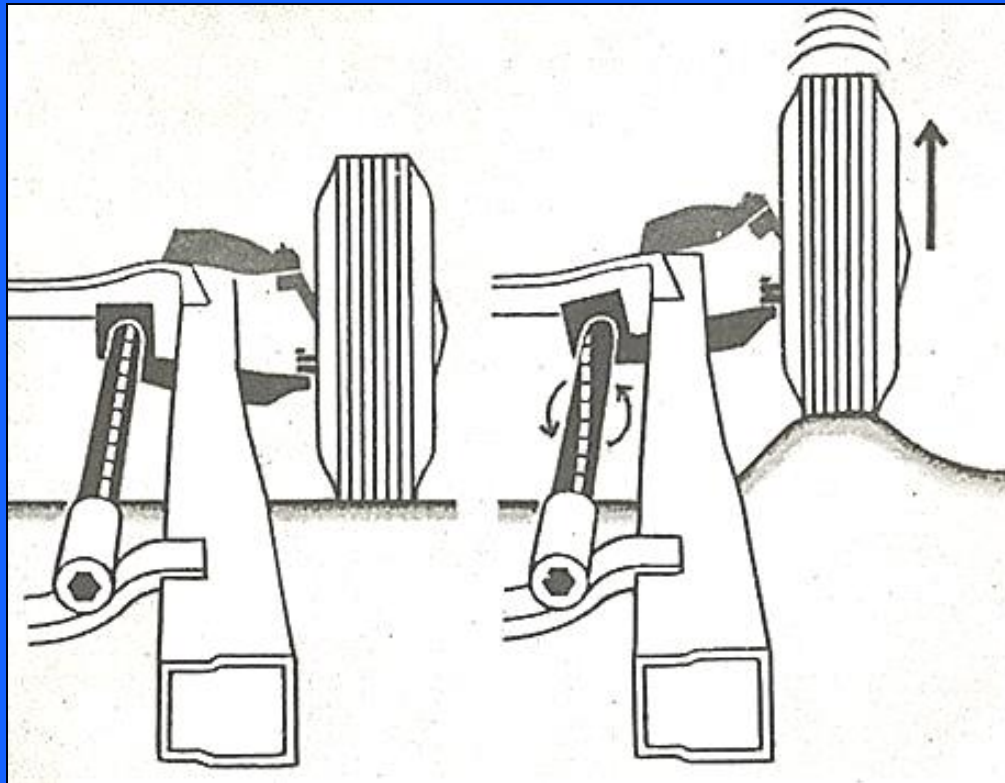


Figure 42-14 The strut rods provide longitudinal support to the suspension to prevent forward or rearward movement of the control arms.



Double Wishbone with Torsion Bars

- one end fixed to the frame or body structure
- other end fits into the lower control arm
- torsion bar twists with control arm movement causing control arm to return to its original position
- ride height is adjustable – not possible on coil or leafs



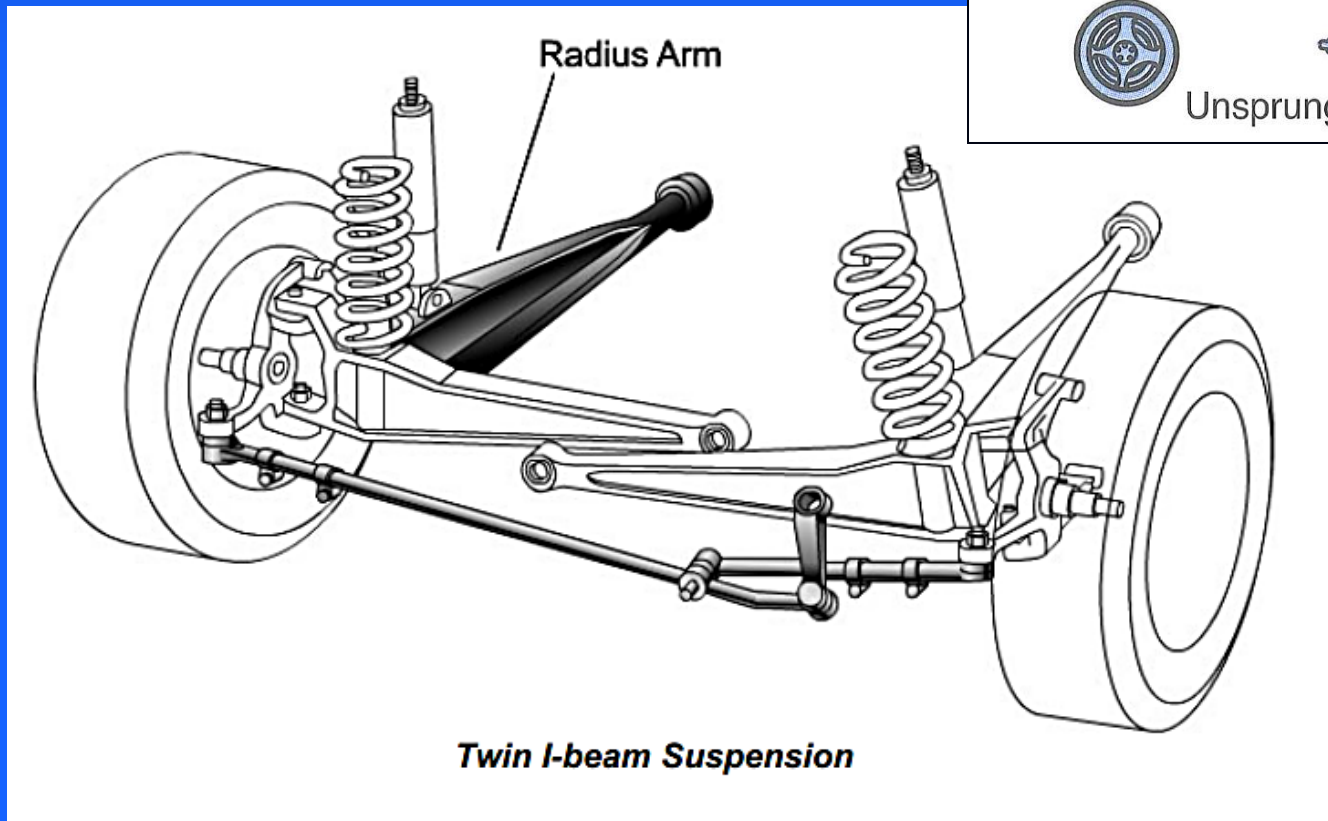
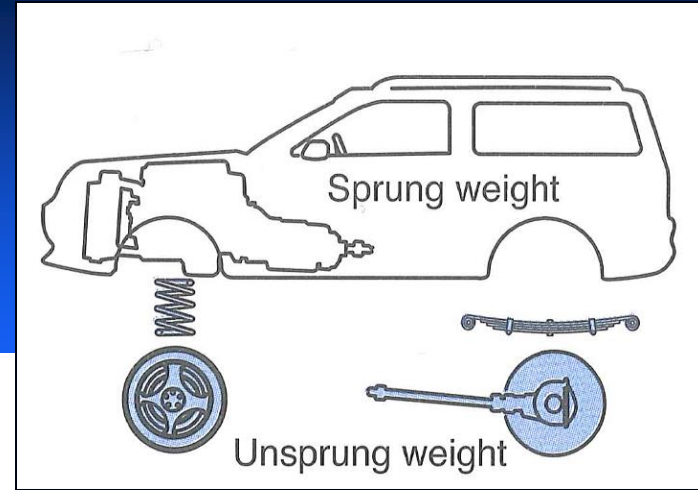
- torsion bar suspension...





Twin I-Beam Suspension

- rugged construction, high un-sprung weight 🙄
 - sprung weight: everything supported by the spring
 - un-sprung weight: everything below the spring
 - used on many Ford trucks

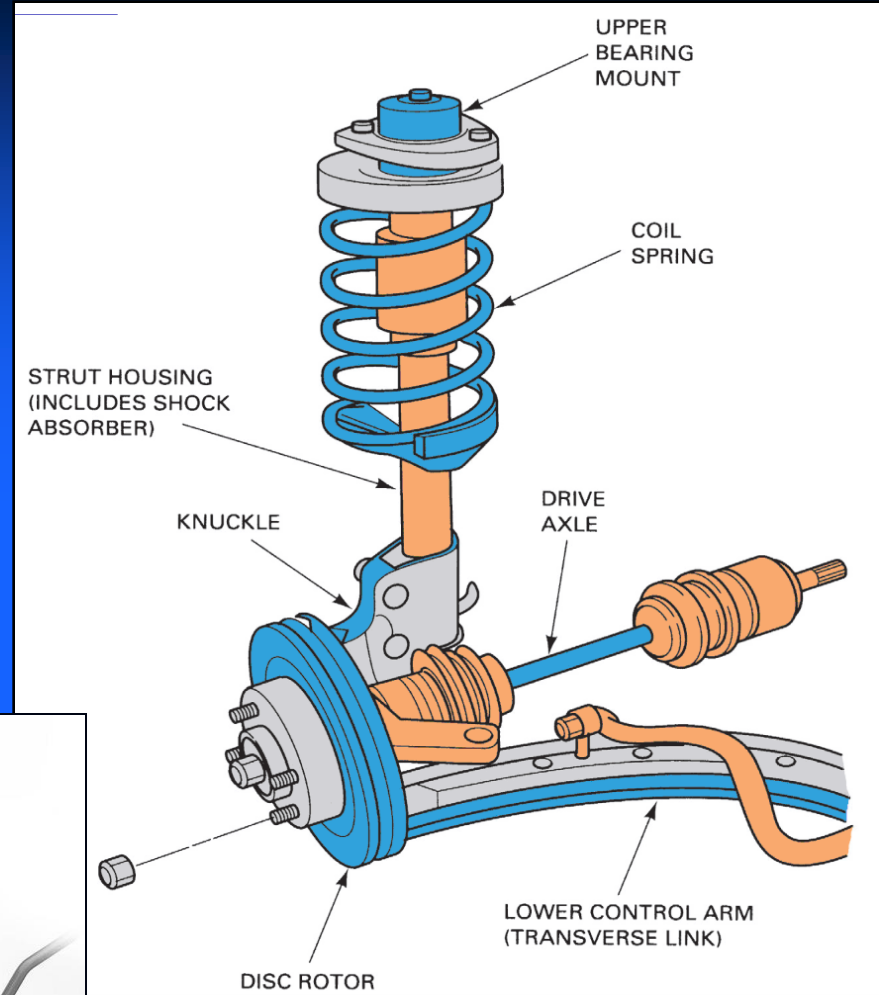


4WD Solid Front Axle with Coils Springs



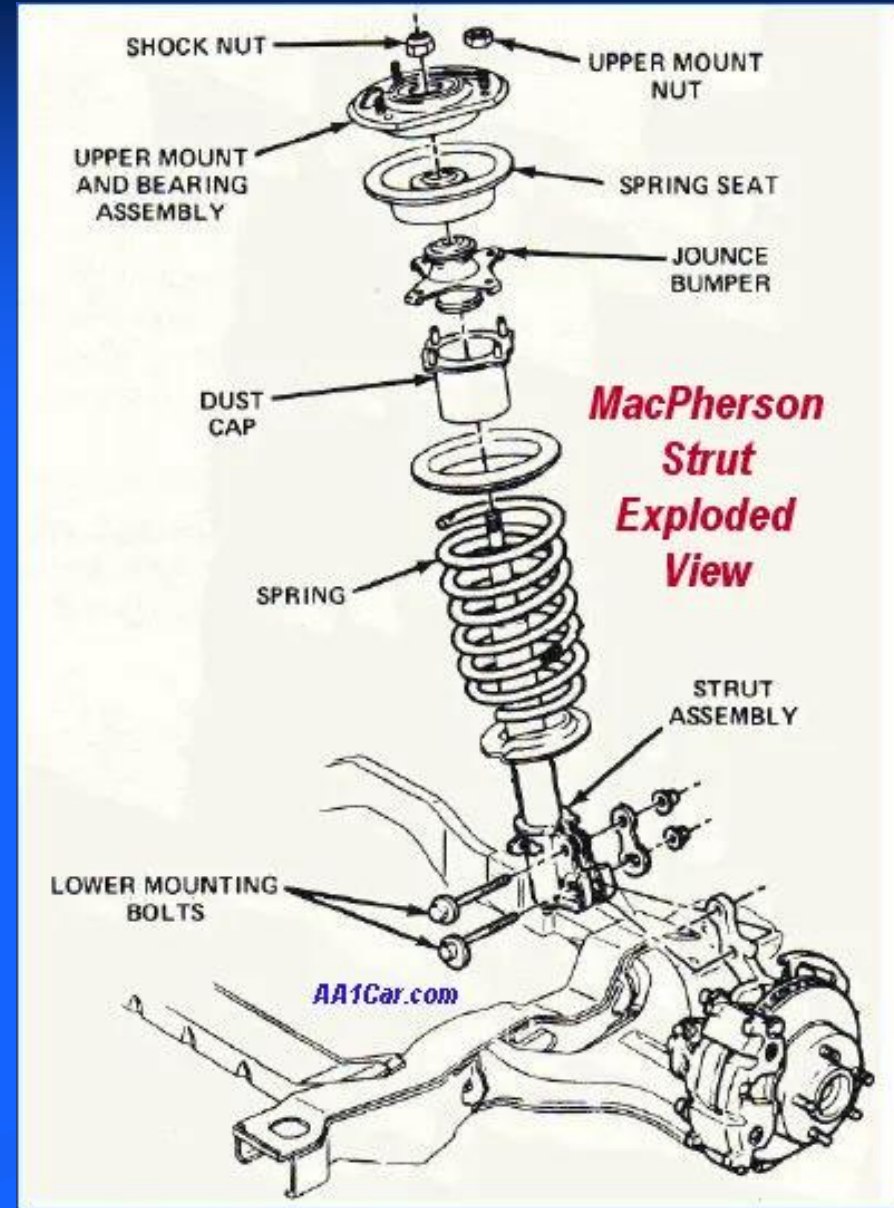
MacPherson Strut

- compact, light, low un-sprung weight
- very popular suspension design
- used with unibody construction
- Spring and shock combination part



Coil Springs and Strut Assemblies

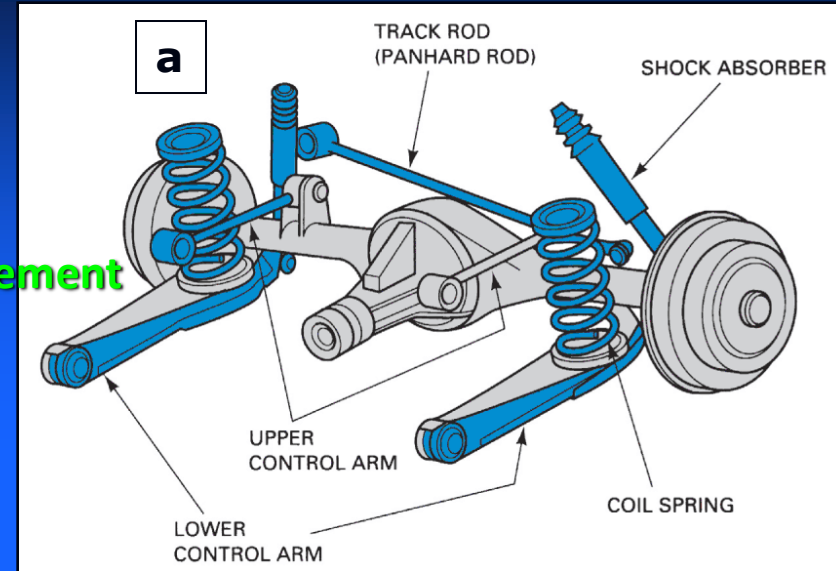
- **Strut assemblies that are broken should be replaced in pairs.**
- **This is to prevent uneven wear on one side of the vehicle.**
- **Struts are popular due to their ease of use and repair.**
- **Basic tools and equipment can be used to replace a strut.**



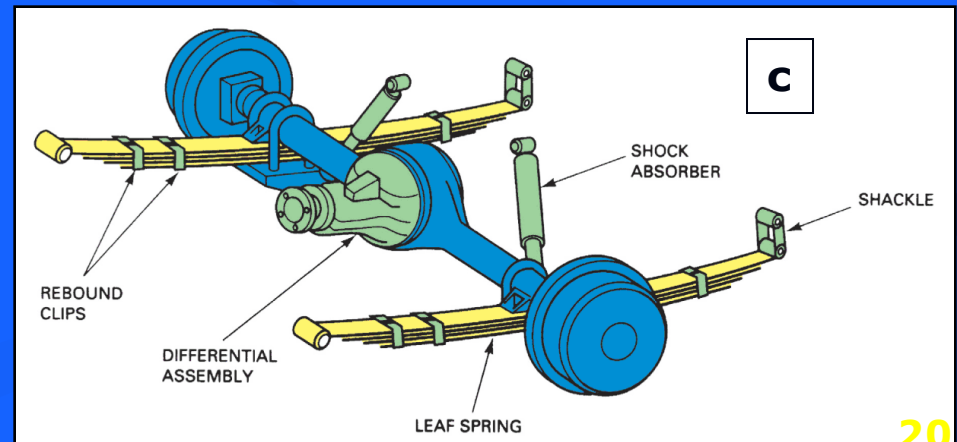
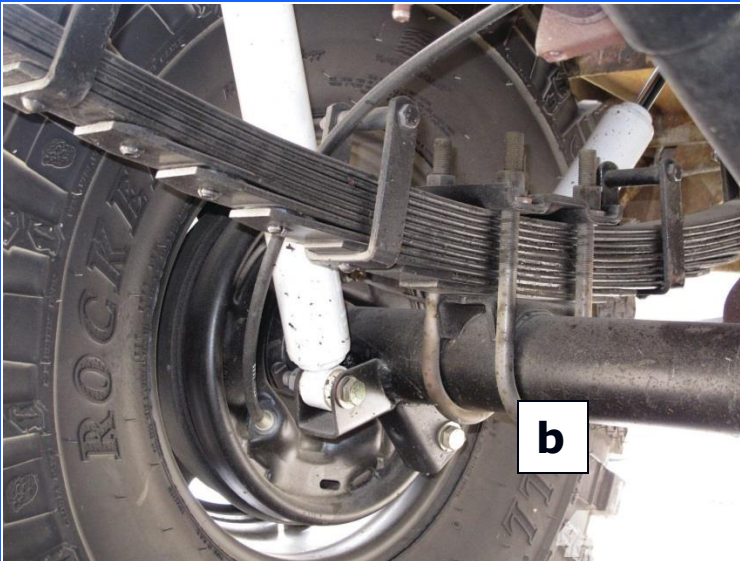
Rear Suspension System Types

Live Axle Suspension – Rear Wheel Drive

- may utilize coil or leaf springs...
- coil springs with control arms (fig. a)
 - pan hard bar prevents left-to-right axle movement

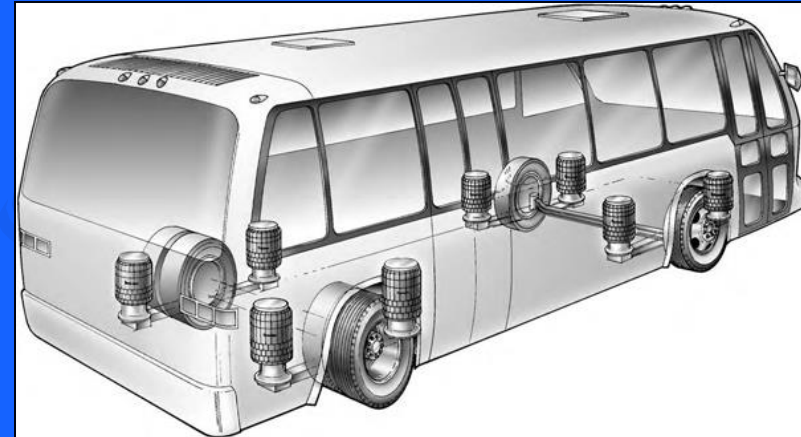
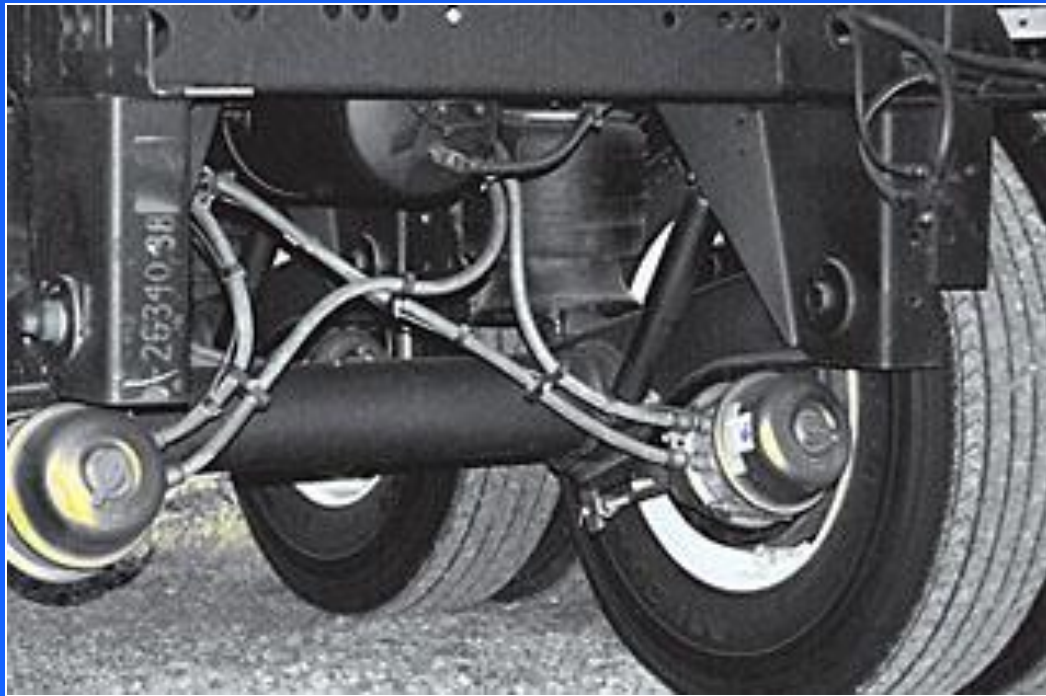


- leaf spring suspension (figs. b & c)



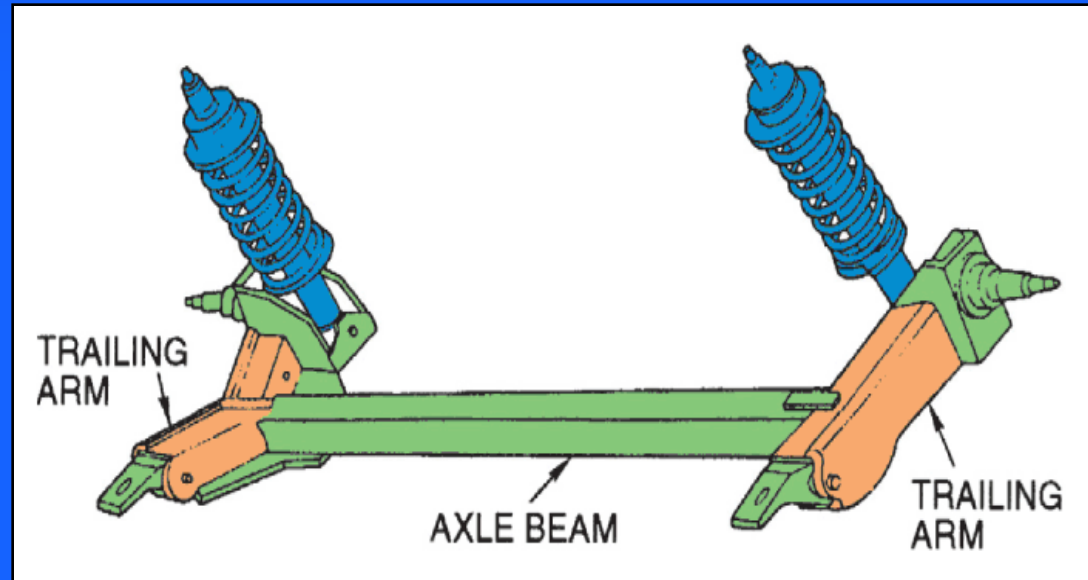
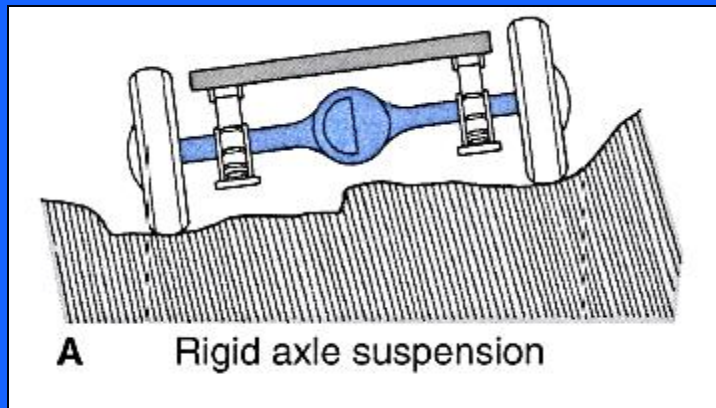
Live Axle Rear Suspension with Airbags

- **air spring suspension**
 - lighter than a coil spring = lower unsprung weight
 - no friction
 - has also been used on front suspension
 - used on transit & tour buses & many semi trailers



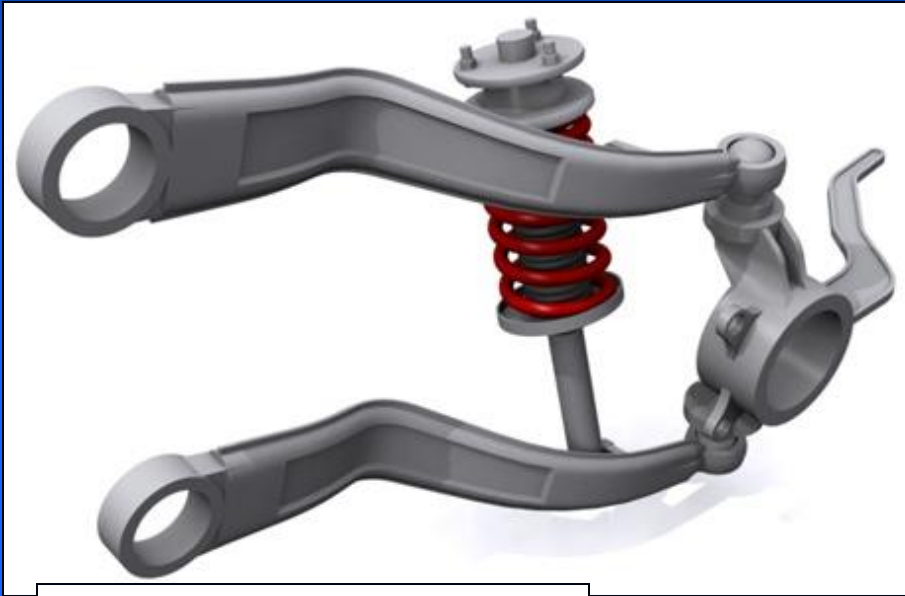
Semi-Independent Rear Suspension (Dead Axle)

- to minimize movement from one side to the other over bumps & holes
 - is achieved via the twisting or deflecting of axle beam under load
 - improved ride & handling over rigid axle suspension
 - not as good as fully independent suspension
 - used on the rear of some front wheel drive vehicles

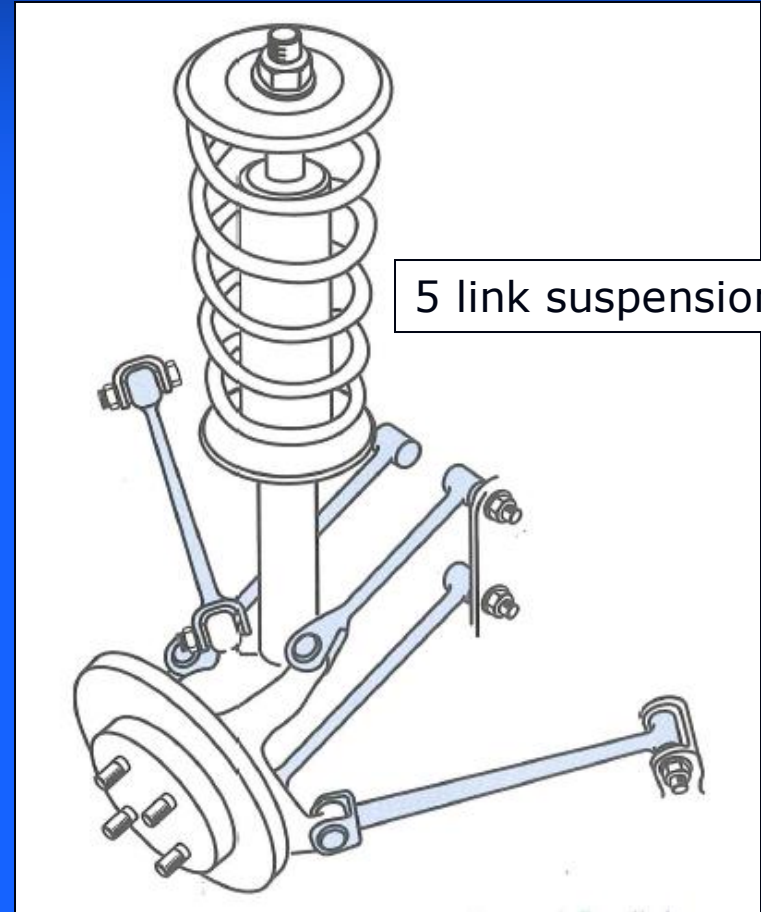


Independent Rear Suspension (Dead Axle)

- no tire scrubbing – arms positioned front to back



Trailing arm suspension



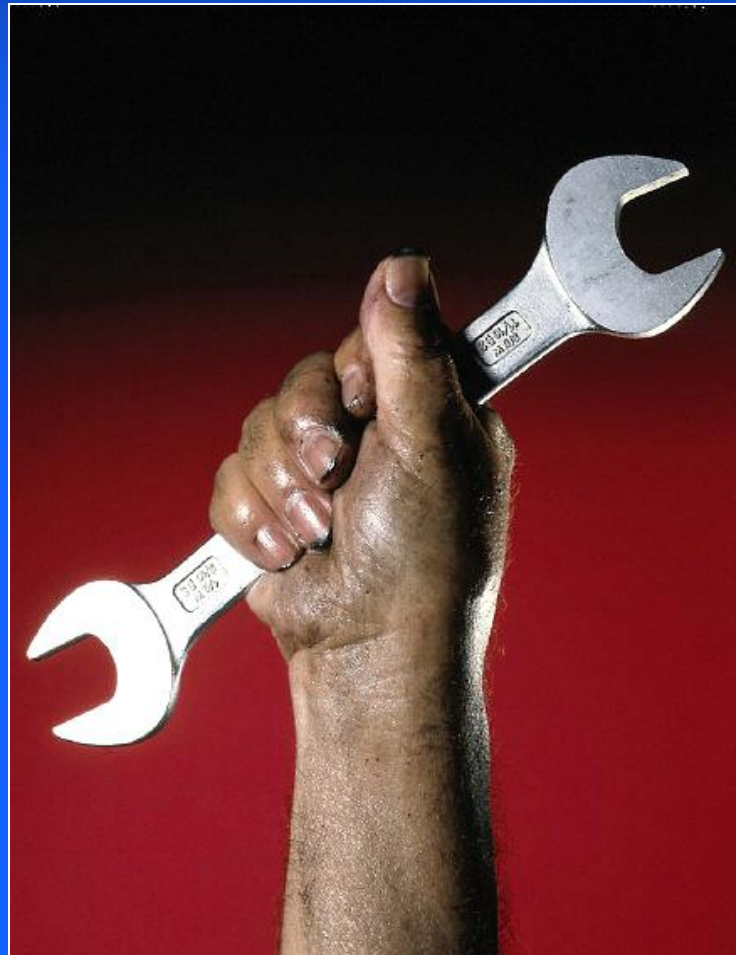
5 link suspension

Independent Short-long Arm Suspension (Live Axle)

- short-long arm suspension with coil-overs
 - used on the back of some performance-oriented rear drive vehicles



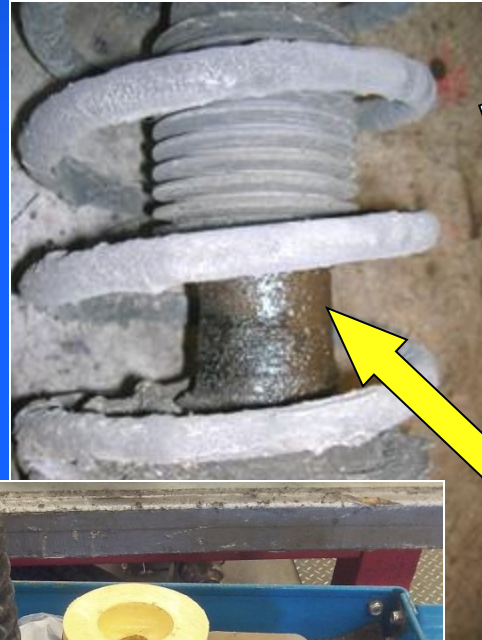
Suspension System Repair





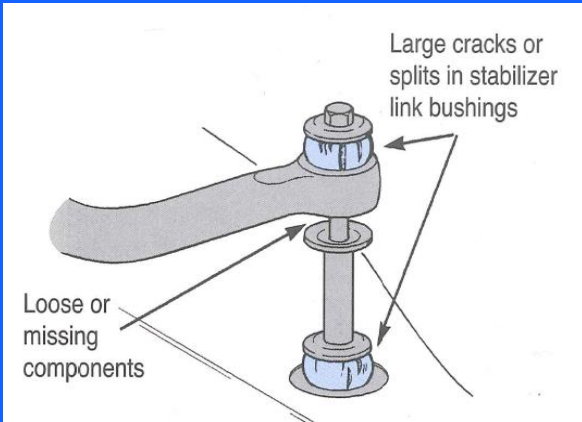
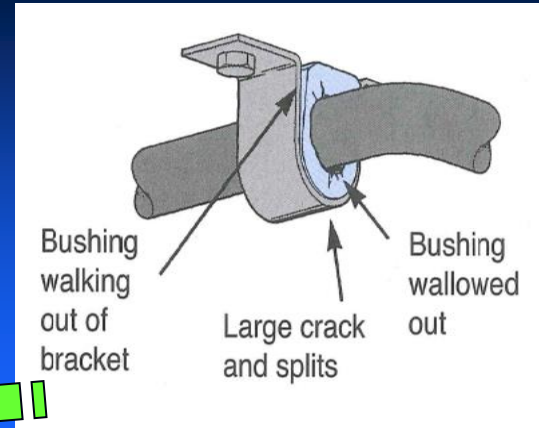
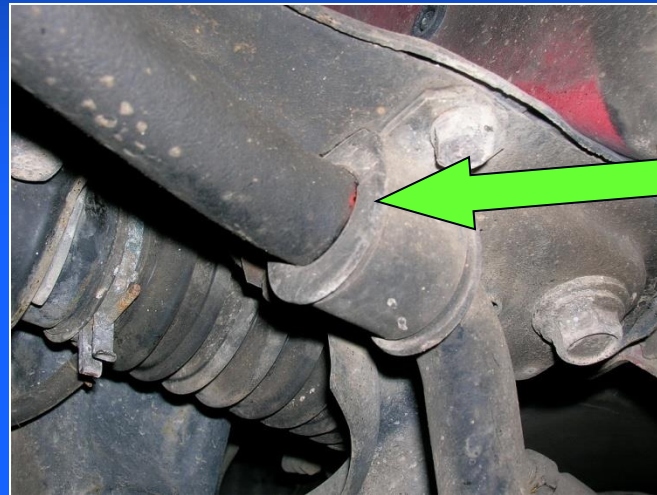
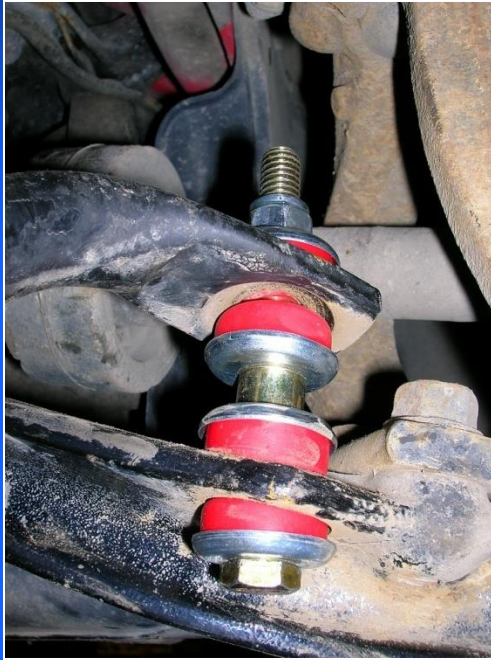
Shocks

- check for oil leaks
- bounce-test car on the ground
- should bounce once or twice, then stop
- age of vehicle & # of km?

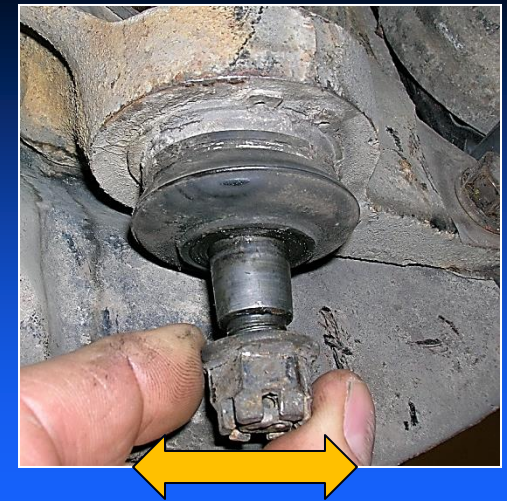


Sway Bar Bushings

- check sway bar mount bushings & outer link kits for wear
 - worn bushings will lead to clunking noises



Testing Ball Joints - examples



- if the ball joint is disconnected from the control arm, move the ball stud by hand...
 - should not move easily or feel sloppy

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Conversion Calculator

1988 Ford Truck Bronco II 4WD V6-177 2.9L

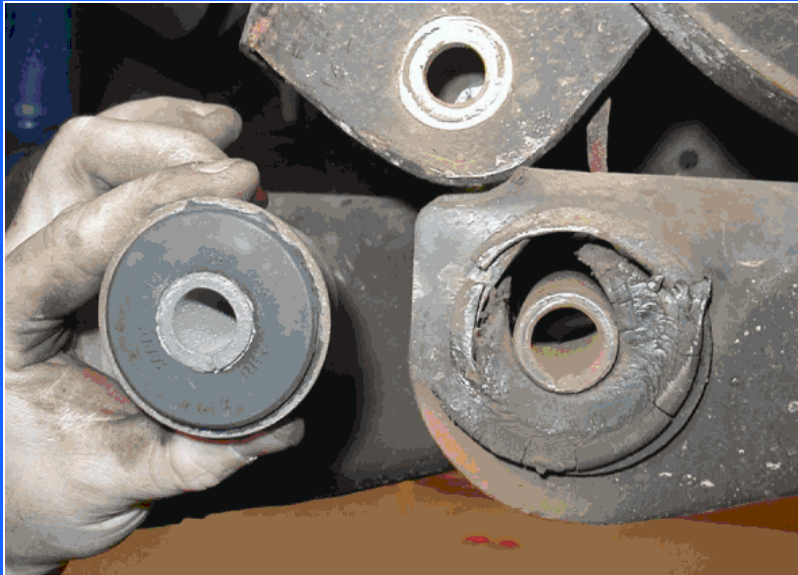
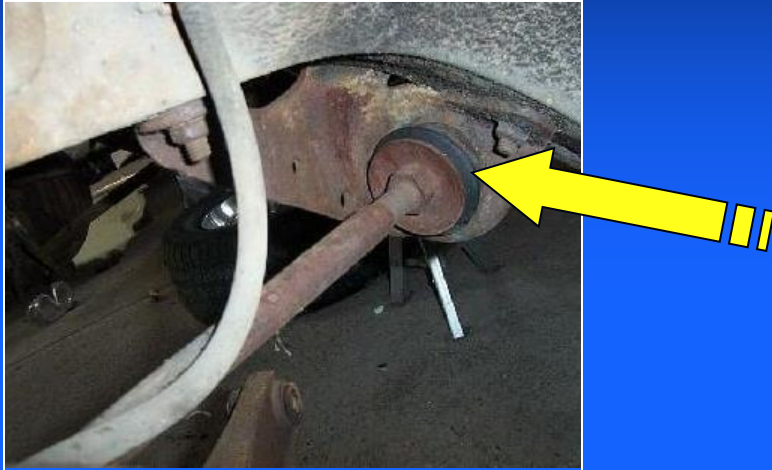
Vehicle Level → Steering and Suspension → Suspension → Ball Joint → Testing and Inspection → Ball Joint, Lower ←

Ball Joint, Lower

1. Raise and support vehicle, then place safety stands under [I-Beam axle](#) beneath [coil spring](#).
2. Grasp lower edge of tire and move wheel in and out, observe lower [spindle](#) arm and lower part of axle jaw.
3. If movement between lower [spindle](#) arm and lower spindle jaw is greater than 1/32 inch, replace lower ball joint.
4. Grasp upper edge of tire and move tire in and out, observe movement between upper [spindle](#) arm and upper part of axle jaw.
5. If movement is between upper part of axle jaw and upper [spindle](#) arm is greater than 1/32 inch, replace upper ball joint.

Control Arm & Strut Rod Bushings

- visually inspect bushings for deterioration
- use a pry bar to check for looseness





Broken Springs

- coils, leaves or torsion bars that are weak or broken will cause the vehicle to sag on the affected corner





Removing/Replacing Springs

- follow proper spring removal procedures!
- use proper spring compressors
- spring's stored energy can injure or kill!

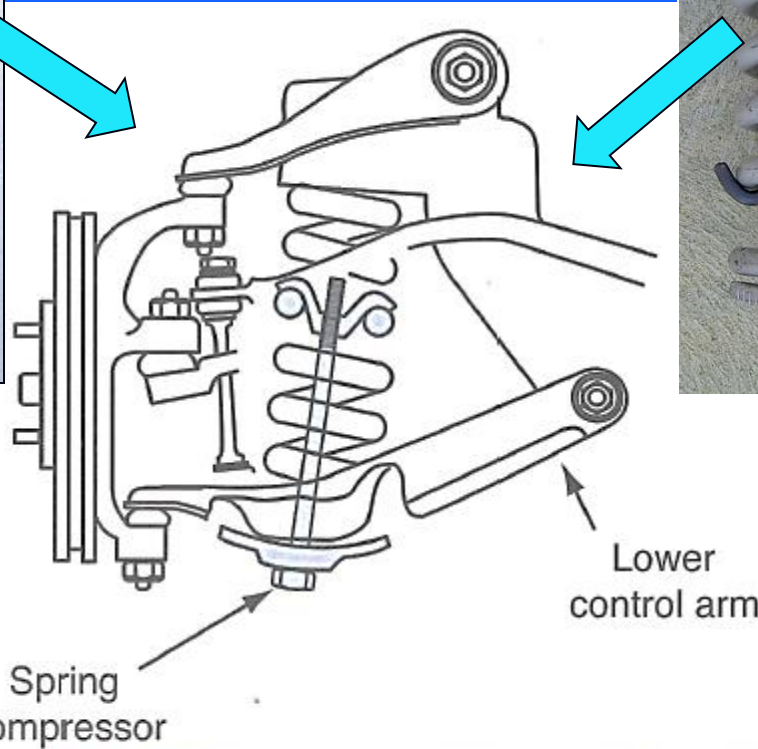
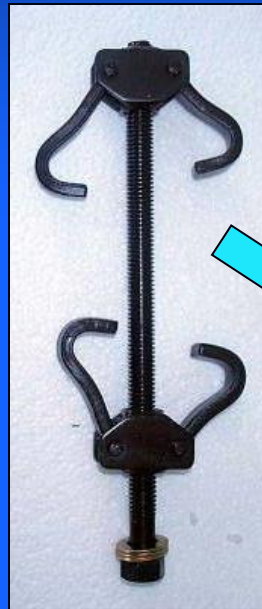


Figure 15.46 A spring compressing tool installed on spring in a short/long arm suspension system.



Compressing McPherson Strut Springs

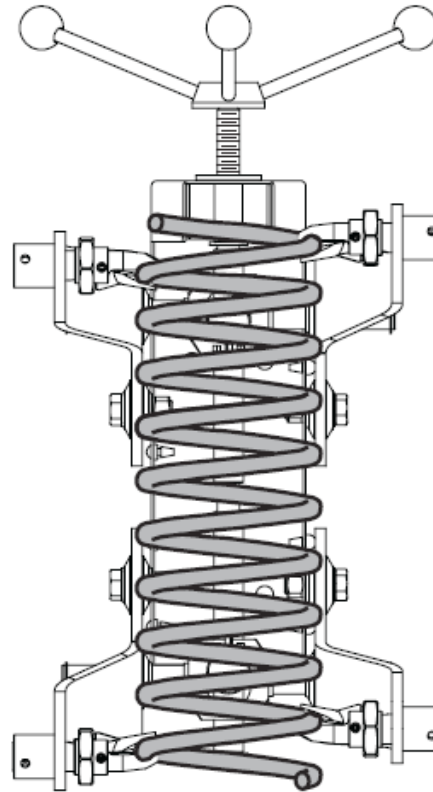
- **NEVER** loosen/remove the **nut at the top of the strut** until spring tension has been released by the coil spring compressor!!!
- the spring should rotate freely when compressed before the nut is removed



Fasten locking jaw to low side of coil. **3**

Figure 1

Fasten locking jaw to low side of coil. **1**



4 Fasten locking jaw to high side of same coil.



2 Fasten locking jaw to high side of same coil.

require your students to call you over before the nut is removed!