## Module 7: Front Suspension

### TERMS AND DEFINITIONS

**Axle rating** is the amount of weight the axle is approved to carry.

**Note:** This capacity is measured at the ground and is abbreviated GAWR (gross axle weight rating).

- The axle seat is the flat machined area of an axle where the spring rests, and contains two holes for each U-bolt and one blind hole for the center bolt head.

- **Spring rate** refers to what the leaf springs can deflect at either a constant rate or a progressive rate, depending on their design as load is added. For example, with a constant rate, if 3000 lbs (1361 kg) deflects the spring 1 inch (2.5 cm), 6000 lbs (2722 kg) would deflect the same spring 2 inches (5 cm). With a progressive rate, the arrangement of the amount of deflection varies with the same load conditions.

- **Jounce** is the upward flexing (compression) of the spring as it absorbs energy while a wheel is going over a bump.

### DIMENSIONS AND LOAD RATINGS OF SPRING ASSEMBLIES

- A leaf is one thin sheet or plate of an object.

- A leaf spring is a special type of elastic or resilient device (spring) made up of stacked strips or leaves.

- **Radius** (plural: radii) is the distance from the center to the edge of a circle, or one-half of the diameter.

**Note:** This dimension is critical when measuring U-bolts.

- **Rebound** is the downward flexing of the spring as it releases energy while the wheel returns to its normal position.

- Spring rate is the amount of load that will deflect the spring 1 inch (2.5 cm).

- **Sprung weight** is the weight of the vehicle that is supported by the springs.

- **Unsprung weight** is the weight that is not supported by the springs and includes the axle, tires, rims, brakes, and some of the steering components.

### PURPOSE OF FRONT SUSPENSION

The front suspension serves five purposes:

1. To support the weight of the vehicle.
2. To cushion the frame and cab of the vehicle from road shocks.
3. To transfer braking forces to the frame.
4. To maintain axle alignment.
5. To keep the wheels in contact with the road surface at all times to provide optimum traction.

### FRONT SUSPENSION COMPONENTS

- Shock absorber.
- Caster adjustment shim.
- Spring eye pin.
- Bushing.
- U-bolt.
- Rubber axle stop.
- U-bolt saddle.

- Shackle hanger brackets.
- Shackle assembly.
- Shackle pins.
- Leaf spring assembly.
- Spring clip.
- Spacer block.
- Axle seat.
Front hanger bracket.
- Attaches the front of the leaf spring assembly to the frame.
- Bolted or riveted to the frame.
- Locates the spring assemblies so that the front axle will be exactly perpendicular to the frame rails.

Spring eye pin.
- Made of hardened steel.
- Passes through holes in the front hanger bracket and the spring eye, allowing the spring assembly to pivot inside the bracket.
- May be smooth stock or threaded and usually contains a drilled passage for lubricant.
- Is fastened rigidly in the front hanger bracket by pinch bolts.

Bushings.
- Provide a bearing surface between the eye of the spring and the pin.
- Usually contain some type of grease reservoir. Internal grooves are filled with grease from the spring pin.
- Are used in each end of the spring and in the rear hanger (three on each assembly).
- May be several types—smooth bore, threaded, or integral rubber.

Leaf spring assembly.
- Absorbs, stores, and then releases energy as the vehicle passes over bumps.
- Made up of individual leaves held together with a round center bolt, which keeps the leaves in alignment before the spring assembly is installed in the vehicle and serves as a locating dowel for the front axle.

Note: After the assembly is in place, the tension of the U-bolts maintains the spring assembly alignment.

Spring clips are used to prevent individual leaves from spreading sideways.

U-bolts.
- Hold the spring assembly to the axle seat.
- Maintain the leaves in alignment when properly torqued.

U-bolt saddle (sometimes called a top plate).
- Contains a groove for each U-bolt.
- Locates the tops of the U-bolts and distributes their clamping force over a larger area.

Rubber axle stop.
- Used to prevent excessive flexing of the spring if the front wheels should encounter a large bump.
- May be integral with the U-bolt saddle or may be bolted to the frame.

Note: Rubber tips are used to prevent harsh metal-to-metal contact.

Spacer block (or pad).
- May be used to achieve the desired frame height with a particular spring arch/wheel size combination.
- Contains a dowel that will fit into the axle seat and has a hole directly above the dowel to receive the head of the center bolt.

Note: Spacer blocks are not used on all front suspensions.

Caster adjustment shims.
- Installed on top of the axle seat.
- Used to adjust the axle caster (rearward tilt of the kingpins).
- Available in a number of widths and wedge angles. For example: 2½, 3, 3½, and 4 inches (6.4, 7.6, 8.9, and 10.2 cm, respectively) wide and ½°, 1°, 1½°, 2°, 2½°, 3°, 3½°, 4° angles.

Shackle assembly.
- Forms the connection between the rear of the spring and the rear hanger bracket.
- Allows the spring length to change as the spring flexes.

Shackle pins.
- Pass through the rear spring eye and the shackle side links, forming a flexible joint.
- Are very similar in construction to front eye pins.

Shackle hanger brackets.
- Are bolted or riveted securely to the frame.
- Make the last part of the joint between the rear of the spring and the frame.

Shock absorbers.
- Prevent the spring from overflexing during rebound and thus dampen the spring oscillations, which would otherwise occur by using hydraulic fluid movement to absorb energy from the jounce and rebound, thus dampening spring oscillations.
- Do not actually absorb road shocks, and the spring absorbs the energy during jounce.

Shock absorber brackets.
- Form the joint between the shock absorber and the frame at the top and between the shock and the axle at the bottom.
- The upper mount is bolted or riveted to the frame.
- The lower mount is usually fastened to the axle by the U-bolts.
Basic Designs of Springs

A stepped spring is a spring assembly consisting of a stack of spring leaves where the shortest leaf is placed on the bottom and each successive leaf is longer, which helps to distribute the stress evenly.

Tapered leaf spring is a spring assembly consisting of a stack of full-length leaves in which each leaf is tapered in thickness to distribute the stress evenly.

Note: The individual leaves are separated with a Delrin liner to cause a gap between the leaves; the gap allows each spring to act as a separate spring. Tapered leaf springs can carry more weight than a stepped spring of equal weight.

Types of Front Spring Assembly Ends

Front springs are identified according to the ends of the springs.
- Eyes on both ends.
- Eye and hook.
- Eye and pad.

Dimensions and Load Ratings of Spring Assemblies

Dimensions.
- Width.
- Length of long end (eye to center bolt).
- Length of short end (center bolt to eye, hook, or pad).
- Number of leaves.
- Pad thickness.
- Arch.

Load ratings.
- This is a function of length, width, number of leaves, and type of steel and is calculated by the manufacturer.
- This is often stenciled on new springs.

Types of Spring Eyes

There are three basic types of spring eyes:
1. Upturned eye.
2. Berlin eye.

Shapes of U-Bolts

- Square bend.
- Round bend.
- Semi-round bend.
- Flattened square bend.
- Special shape.
Dimensions of U-Bolts

Suspension U-bolts are a critical part of the front suspension. They are grade 8 quality and should never be replaced with ordinary hardware. Both the correct shape and dimensions should be measured for correct replacement.

U-bolt dimensions to measure are:
- Thread diameter and pitch.
- U-bolt length.
- Width.
- Thread length.
- Center radius.
- Corner radius.

Note: It is critical that both radii (center and corner) of U-bolts match the U-bolt saddle; therefore, check for correct fit.

Identification and Measurement of Shock Absorbers

Shock absorbers may be identified by the number stamped on the shock absorber tube or dust cover. If the number is not readable, ways to identify the shock are:
- Collapsed length (slowly push shock until it is collapsed).
- Extended length (slowly pull shock until it is completely extended).
- Rubber bushing inside diameter.