

## Module 4: Steering Column and Manual Steering Gear

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### Terms and Definitions

#### READY FOR REVIEW

- Bearing preload is the amount of pressure put on a bearing to reduce slack in the bearing.
  - The manual steering gear is the mechanical device used to convert the rotary motion at the steering wheel to a lateral motion at the steering axle.
  - The pitman arm is the part connecting the steering gear shaft and steering linkage.
  - Shims are thin pieces of metal in various thicknesses that may be used to preload bearings.
  - Slack is excessive movement between components.
- Note:** Slack may also be called backlash, freeplay, excess travel, or looseness.
- The steering column is the component fastened to the cab instrument panel that houses the steering shaft with bearing supports and that provides connection between the steering wheel and steering gear assembly.
  - Steering ratio is the numerical ratio representing the number of turns made by the steering wheel to the number of turns made by the steering lever shaft.
  - The steering shaft is the tube or rod that connects the steering wheel (cab mounted) to the steering gear (chassis mounted).
  - The steering U-joint is the universal joint used to connect the steering column to the steering shaft and steering gear assembly.
  - The steering wheel is the wheel assembly mounted on top of the steering column that transfers driver input turning torque effort to the steering gear, which, in turn, controls the direction of the vehicle.
  - The stud is the hinge-like fastener (ball-shaped or tapered cone-shape) in which adjustments can be made to reduce slack.
  - Telescoping is adjusting the height by means of sliding inner and outer tubes.
  - Tilting is adjusting the angle by rotation forward (up) or rearward (down).

### Purposes of Steering Column and Steering Gear Assembly

#### READY FOR REVIEW

- There are three purposes of the steering column and steering gear assembly:
  1. To allow the operator to position the wheels that control the direction of travel.
  2. To allow the turning of the front wheels with a reasonable effort.
  3. To transmit the feel of the road to the operator.

## Basic Types of Steering Columns

### READY FOR REVIEW

- There are two basic types of steering columns:
  1. Fixed (or standard), which is a steering wheel that cannot be moved and is permanently placed in a position that suits the average driver's size and range of seat positions.
  2. Adjustable (or tilt/telescoping), which is a steering wheel that can be moved in height and/or angle to provide the optimum wheel-to-driver relationship in all seat positions.

## Parts of Standard Steering Column and Manual Steering Gear Assembly

### READY FOR REVIEW

- Steering arm.
- Drag link.
- Pitman arm.
- Tie rod.
- Steering wheel.
- Steering column.
- Steering column support bracket.
- U-joint.
- Steering shaft.
- Steering gear.
- Spindle and kingpin assembly.

## Parts of a Tilt/Telescoping Steering Column Assembly

### READY FOR REVIEW

- Steering column support bracket assembly.
- Steering wheel.
- Steering column assembly housing.
- Tilt/telescoping lever.
- Steering column brackets.
- U-joint.
- Steering shaft.

## Parts of a Universal Joint (U-Joint)

### READY FOR REVIEW

- Yoke.
- Spider.
- Snap ring.
- Bearing.

## Basic Types of Manual Steering Gears

### READY FOR REVIEW

- There are three basic types of manual steering gears:
  1. Recirculating ball manual steering gear.
  2. Cam and lever manual steering gear.
  3. Worm and roller manual steering gear.

## Operation of Manual Steering Gears

### READY FOR REVIEW

- Recirculating ball.
  - The input shaft portion has a semicircular grooved helix that provides one-half of the path of travel for the recirculating balls.
  - The other half of the path for the balls is a mating semicircular grooved helix cut on the inside of the nut.
  - As the input shaft rotates, the helix causes the balls to circulate and to force the nut up or down the input shaft.
  - The lower surface of the nut is cut with gear teeth on a rack and mesh with the gear teeth on the sector shaft. This converts the linear motion of the nut into rotational motion of the sector shaft.
- Cam and lever.
  - Uses a constant-diameter worm (called a cam in this case) on the input shaft and a cone-shaped stud on the lever.
  - As the cam turns, the stud follows and converts the arched motion of the contact point into sector shaft rotation.
- Worm and roller.
  - Features an hourglass worm gear on the input shaft with a rotating toothed follower on the sector shaft.
  - As the input worm turns, the roller follows and converts the curvilinear motion on the worm axis into sector shaft rotation.

## Common Problems or Complaints with Manual Steering Gears

### READY FOR REVIEW

- Excess slack (or looseness) caused by worn steering gear or by worn U-joints.
- Hard turning or steering.
- Binding.
- Locking.
- Pulling to one side.
- Noisy steering.

## Common Adjustments Made on Manual Steering Gears and Their Main Purposes

### READY FOR REVIEW

- Side cover adjustment (mid-travel) to reduce travel (slack) on steering gear.
  - Travel-stop adjustment to limit travel of wheels in order to prevent wheels from rubbing on the frame.
  - Preload bearings on worm gear in steering gear to reduce end travel; made with shims or by adjusting plugs or screws.
- Note:** This is usually the first step in steering gear overhaul, as some types of steering gears require clearance on the worm gear bearing instead of preload. Check the manufacturer's recommendations.
- Ball stud adjustment to reduce slack (looseness) on pitman arm or steering arm.

## Specialty Tools Used to Work on Steering Systems

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- A steering wheel puller is used to remove the steering wheel from the steering column.
- A power steering analyzer (tester) is used to check hydraulic operation (flow rate and pressure) through the power steering system.
- A pitman arm puller is used to remove the pitman arm from the steering gear; there are two basic types (bar type and specialty type).
- Special compression, installation, and removal tools are used to work on various seals and bearings used in the steering system.
- The universal joint tool is used for work on the U-joint.
- The trammel bar gauge (alignment bar) is used to check front end alignment.

## Common Lubricants Used in Steering Gear Assemblies

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- Two lubricants are commonly used in steering gear assemblies:
    1. Society of Automobile Engineers (SAE) 80W-90 gear lubricant API GL-5.
    2. SAE 50W HD mineral oil.
- Note:** Refer to equipment service or maintenance manual for recommended lubricant.