

Module 6: Steering Axle Components

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Terms and Definitions

READY FOR REVIEW

- The bearing is the part that helps spread the force of a load to reduce the friction and wear of a moving part.
 - The drag link is the cast rod or tube connecting the pitman arm to the steering knuckle assembly.
 - End play is the amount of lateral movement of the hub along the spindle due to clearance in the bearings.
 - The journal is that part of a shaft, axle, or spindle that turns in a bearing.
 - The kingpin is the pin connecting the axle to the spindle.
 - Packing is the act of forcing grease into wheel bearings.
 - The pitman arm is the arm that connects the steering gear to the drag link.
 - Preload is the adjustment of bearings so that there is a slight load on them to ensure proper internal alignment and limit end play.
 - Press fit is the tight fit between mating parts, such that they must be “pressed” into place.
 - Races are the tracks or channels in which something rolls or slides.
 - The seal is the material used to form a leak-proof connection between moving or fixed parts.
 - The spindle is the small shaft or axle on which a wheel turns and is also called the steering knuckle.
 - The steering axle is the heat-treated forged steel I-beam with integral spring seats.
- Note:** The steering axle is typically the front axle, and it is rated and identified with a tag located between spring pads on the front side of the center beam section.
- Tie rods (cross tubes) are the metal connecting bars that are threaded with left- and right-hand end threads that provide for toe-in adjustment.
 - The tie rod assembly is a three-piece construction, consisting of a tie rod and two tie rod end assemblies. The ends are threaded to the rod and locked with clamp bolts.
 - The wheel and hub assembly consists of a tire, rim, hub, bearings, and other components mounted on an axle in such a way that it rotates to allow movement of a vehicle.
 - The wheel bearing is used to distribute the load of a vehicle on its axles.

Typical Steering Axle Components

READY FOR REVIEW

- Steering gear.
- Pitman arm.
- Drag link.
- Steering axle.
- Kingpin.
- Steering knuckle assembly.

Steering Linkage

READY FOR REVIEW

- The steering gear is connected to the drag link by the pitman arm.
- When the steering gear is activated for a right turn, the direction of the steering linkage movement is to the right.
- For a left turn, the steering linkage moves to the left.

Parts of a Steering Knuckle Assembly (Spindle Assembly)

READY FOR REVIEW

- Axle knuckle.
- Upper bushing.
- Thrust bushing.
- Axle I-beam.
- Draw key.
- Steering arm.
- Ackermann arm.
- Tie rod end.
- Kingpin.

Lubricants Used on Steering Axle Components

READY FOR REVIEW

- There are basically two types of lubricants used on steering axle components:
 1. Multipurpose lithium grease that meets NLGI-1 or -2 specifications is used for kingpins and tie rod ends (if equipped with lube fittings) and for grease-lubricated wheel bearings.
 2. Synthetic lubricants that are compatible with API GL-5 are used for oil-lubricated wheel bearings on heavy-duty axles.

Typical Steering Axle Problems and Causes

READY FOR REVIEW

- Hard steering.
 - Low tire pressure.
 - Low pressure in power steering system.
 - Improper front end alignment.
 - Insufficient lubrication.
 - Bent steering knuckle or linkage.
 - Worn steering gear or linkage.
 - Steering column misalignment.
- Loose steering and truck wanders.
 - Incorrect front end alignment.
 - Broken spring.
 - Tight steering gear or linkage.
 - Loose spring shackles.
 - Unequal tire inflation.
- Truck pulls to one side.
 - Dragging brake.
 - Tight or dry wheel bearing.
 - Unequal tire inflation.
 - Unequal caster (it will pull to the side with less caster).
- Shimmy (low speed).
 - Worn tires.
 - Out-of-balance tires.
 - Road condition.
 - Bent or out-of-round rim.
- Shimmy (high speed).
 - Bent or out-of-round rim.
 - Inconsistencies in tire construction.
 - Tires out of balance.
 - Worn suspension.
 - Worn bearings.
 - Improperly adjusted hub bearings.
- Worn or broken steering ball stud.
 - Truck would wander.
 - Steering would be loose.
 - Vehicle would be unstable.
- Worn kingpins and knuckle bushings.
 - Worn or missing seals and gaskets.
 - Incorrect lubricant.
 - Lack of lubrication or not following correct procedure or scheduled frequency.

Purposes of Wheel Bearings

READY FOR REVIEW

- There are four main purposes of wheel bearings:
 1. To spread the weight of the vehicle and its load over a greater surface.
 2. To reduce the friction of wheel rotation.
 3. To reduce wear on the parts.
 4. To provide a replaceable wear surface.

Parts of a Wheel Bearing (Tapered Roller Shown)

READY FOR REVIEW

- | | |
|---------------|--------------|
| ■ Outer race. | ■ Roller. |
| ■ Inner race. | ■ Cone. |
| ■ Bore. | ■ Separator. |
| ■ Face. | ■ Cup. |

Wheel Bearing Defects

READY FOR REVIEW

- Mechanical damage is the deforming or breaking of the bearing assembly as a result of mechanical stress, such as rough handling or improper fit, such that the bearing must be replaced. Examples would be cracked, bent, or broken parts—cages, races, rollers, separators.
- Smearing refers to metal smears on the surface of the races due to slippage as a result of improper fit, poor lubrication, overloading, or rough handling, in which case the bearings must be replaced.
- Galling refers to the metal smears on the ends of the rollers, usually caused by overheating from inadequate lubrication or overloading, in which case the bearing must be replaced.
- Abrasive step wear is wear of the ends of the rollers due to fine particles in the lubricant; the bearing must be replaced if the wear is excessive, or simply cleaned and repacked if the wear is minor.
- Abrasive roller wear refers to wear patterns on the rollers and race from contamination by the abrasives, in which case the bearing can be reused if the wear is minor.
- Misalignment is the improper fit of the bearing assembly parts due to improper installation or excessive pressure from a foreign object in the hub, usually evidenced by uneven wear of the races. As a result, the bearing must be replaced if the wear is excessive or if the bearing is damaged.
- Indentations are pits and scars on the surfaces of the races and rollers caused by contamination with large particles. It is necessary to clean and repack or replace if the bearings are rough or noisy.
- Brinelling is surface indentations in the raceway that parallel the rollers caused by excessive loading or vibration while the bearing is not rotating. It generally requires replacement of the bearing.
- Spalling is the flaking of the surface metal from metal fatigue or poor-quality bearings, in which case it is necessary to replace the bearings.
- Fretting is corrosion and spotty wear caused by relatively small movements of poorly lubricated parts, in which case it is necessary to replace the bearings.
- Etching is gray or black discoloration of race and roller surfaces, usually with scuffing of the surfaces in patterns parallel to the rollers. It is generally caused by loose fitting of the bearings and requires replacement of the bearing.
- Heat discoloration ranging from faint yellow to dark blue is a result of inadequate lubrication or overloading, in which case it is necessary to replace the bearings.
- Stain discoloration ranging from light brown to black results from using the incorrect lubricant or from contamination by moisture. Bearings can be reused if the stain can be removed by light polishing and there is no evidence of overheating.

Guidelines for Servicing Wheel Bearings

READY FOR REVIEW

- Follow the vehicle manufacturer's recommendations for the selection and installation of wheel bearings.

Note: Compare the identification numbers of the old bearings and the replacement bearings, and do not destroy the old bearings until you record the identification numbers.

- Follow the bearing manufacturer's instructions for the selection and installation of lubricant.
- Follow the vehicle manufacturer's recommendations for wheel bearing service intervals.
- Every wheel has two sets of bearings, an inner bearing assembly and an outer bearing assembly; be sure not to install these backward.
- Keep bearing assemblies together as a set, and do not exchange parts between different assemblies.
- Use only an approved solvent to clean bearings.
- If compressed air is used to clean bearings, use only low pressure and never enough pressure that it causes the rollers to turn.

Caution: A bearing may fly apart if high-pressure compressed air is used.

- Handle the bearings with care to prevent damage.
- Observe asbestos exposure precautions, because the removal and installation of wheel bearings may involve handling brake linings containing asbestos and other components contaminated with brake lining dust.
- Do not reuse cotter pins removed from the spindle, and always install a new cotter pin.
- If the condition of a bearing, seal, or other component is in doubt, replace it.
- Use the proper seal and be careful to install it correctly.
- Pack grease-lubricated bearings using a pressure packer if possible or by hand if necessary.

Guidelines for Adjusting Wheel Bearings

READY FOR REVIEW

- Follow the vehicle service manual procedure to adjust bearings.
- The adjustment of bearings with preload can cause premature bearing failure.
- If recommended by the service manual, use a dial indicator to adjust end play.
- Typical wheel bearing adjustment requires end play of bearing adjustment allowances to be between 0.001 and 0.005 inch (between 0.025 and 0.127 mm) on modern trucks and between 0.003 and 0.009 inch (between 0.076 and 0.228 mm) on older vehicles. It is important that you check the service manual for the correct specifications of the vehicle you are working on.
- While adjusting the bearings, make sure the brakes do not drag on the drum or rotor to produce a false adjustment.
- Make a preliminary adjustment by tightening the spindle (adjusting) nut to the torque recommended by the service manual.
- Rotate the wheel in both directions while tightening to ensure that the bearing is seated.
- To align the locking device, back the nut off the spindle from the initial torque setting by $\frac{1}{6}$ to $\frac{1}{3}$ turn (depending on the manufacturer) to align with the nearest locking hole, and the wheel should rotate freely.
- Do not reuse locking devices (cotter pins, washers with tangs, etc.) that are deformed during installation.

Purposes of Wheel Seals

READY FOR REVIEW

- There are four purposes of wheel seals:
 1. To retain lubricants or liquids.
 2. To exclude dirt, water, and other contaminants.
 3. To separate dissimilar fluids (such as lubricating oil and water).
 4. To confine pressure.

Types of Wheel Seals

READY FOR REVIEW

- One-piece.
 - Unitized, which needs a special driver.
 - Barrier, which is installed with a bare hand.
- Multipiece.
 - Lip seal, which may have a single or double lip.
 - Wear rings, which may have a flat ring or a grit guard.

Guidelines for Installing Wheel Seals

READY FOR REVIEW

- Remove the old seal carefully, taking care when prying out the old seal not to scratch the housing. A special puller is sometimes needed.
- Inspect the bore and shaft for nicks and burrs, and file off any burrs that could cut the new seal.
- Check the shaft and bore dimensions to make sure they match the seal specifications.
- Excessively worn or grooved shafts may be fitted with wear (repair) sleeves to create a new seal running surface; however, these require a special installation tool.
- Never reuse old or damaged seals.
- Make sure the new seal faces in the correct direction. Usually, the lip faces the lubricant or fluid to be retained.
- Prior to installation, prelubricate the sealing element with the same lubricant being retained.
- Use the correct tool to install the seal, including an arbor press, a soft-face hammer, a specially made seal installer, or an old bearing cup, and apply force evenly around the outer edge to avoid cocking the seal.
- Check to see that the seal is fully seated and aligned in its bore. The manufacturer may specify how deep the seal must be installed.
- Check and adjust the fluid level after installing a seal, and check for leaks.