

Installation Instructions



KNORR-BREMSE® IPS90™ AND IPS100™ (INTEGRAL POWER STEERING) HYDRAULIC POWER STEERING GEAR PITMAN ARM CONNECTION SERVICE KIT FOR COMMERCIAL VEHICLES

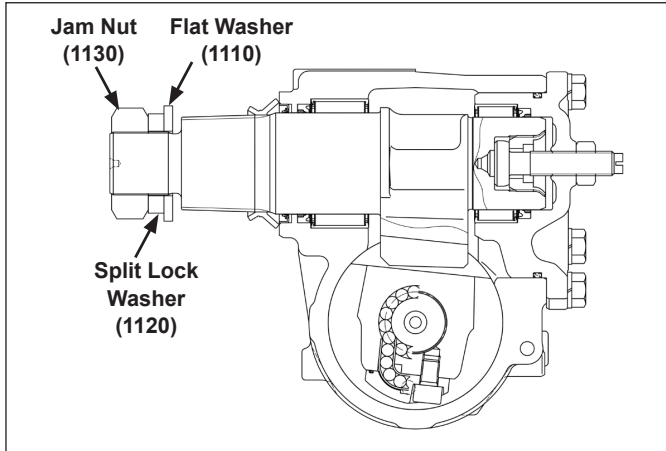


Figure 1 - Pitman Arm Connection

KIT COMPONENTS

See Figure 1. The Knorr-Bremse® IPS90™ and IPS100™ (Integral Power Steering) Hydraulic Power Steering Gear Pitman Arm Connection Service Kit contains the following parts:

Item No.	Description	Qty.
1120	Split Lock Washer	1
1110	Flat Washer	1
1130	Jam Nut	1



WARNING

Steering gears are heavy. When assembling and disassembling the steering gears, make sure to follow all safety protocols.

Steering fluid can get hot and reach temperatures of up to 250° F (121° C). Use the appropriate Personal Protective Equipment (PPE) when servicing.

Comply with OSHA guidelines.

Avoid high-pressure hydraulic wash on steering gears and steering sub-systems.

Unless and/or otherwise mentioned, use of a hammer or heat to disassemble steering components is not permitted.

Use manufacturer-recommended steering fluid only. Mixing of fluids may cause internal damage to rubber or plastic components.

GENERAL SAFETY GUIDELINES



WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS

TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following guidelines should be observed **AT ALL TIMES**:

- ▲ Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear personal protection equipment.
- ▲ Stop the engine and remove the ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, **EXTREME CAUTION** should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated, or electrically charged components.
- ▲ Do not attempt to install, remove, disassemble, or assemble a component until you have read, and thoroughly understand, the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
- ▲ If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle. If the vehicle is equipped with a Bendix® AD-IS® air dryer system, a Bendix® DRM™ dryer reservoir module, a Bendix® AD-9si®, AD-HF®, or AD-HFi™ air dryer, be sure to drain the purge reservoir.
- ▲ Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.
- ▲ Never exceed manufacturer's recommended pressures.
- ▲ Never connect or disconnect a hose or line containing pressure; it may whip and/or cause hazardous airborne dust and dirt particles. Wear eye protection. Slowly open connections with care, and verify that no pressure is present. Never remove a component or plug unless you are certain all system pressure has been depleted.
- ▲ Use only genuine Bendix® brand replacement parts, components, and kits. Replacement hardware, tubing, hose, fittings, wiring, etc. must be of equivalent size, type, and strength as original equipment and be designed specifically for such applications and systems.
- ▲ Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.
- ▲ Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.
- ▲ For vehicles with Automatic Traction Control (ATC), the ATC function must be disabled (ATC indicator lamp should be ON) prior to performing any vehicle maintenance where one or more wheels on a drive axle are lifted off the ground and moving.
- ▲ The power **MUST** be temporarily disconnected from the radar sensor whenever any tests USING A DYNAMOMETER are conducted on a vehicle equipped with a Bendix® Wingman® system.
- ▲ You should consult the vehicle manufacturer's operating and service manuals, and any related literature, in conjunction with the guidelines above.

REMOVING THE POWER STEERING GEAR FROM THE VEHICLE

1. Mark or identify the inlet and return lines at the valve body ports. For slave gear applications, mark the pressure lines that go to the upper and lower pressure chamber of the main housing.
2. Turn off the engine.
3. Lift the front axle sufficiently to raise the wheels clear of the ground or put turntables below the wheels.
4. Disconnect the batteries and open the hood.
5. Remove all dirt from all the fittings and hose connections on the steering gear.
6. Disconnect the return line at the valve body outlet port and place a drain pan below it.
7. Turn the steering wheel to the left as far as it will go. Run the engine for no more than ten (10) seconds until the oil is drained from the reservoir and pump. Switch off the engine and turn the steering wheel back and forth – from full lock to full lock – until all the oil is drained out.
8. Remove both the inlet and return lines. For slave gear applications, put a drain pan below the slave gear before removing the two pressure lines from the slave gear.

NOTE: It is recommended to plug the inlet and return lines after the hydraulic lines are removed.

9. Put the vehicle back on the ground.
10. Place the front tires in the straight-ahead position, apply the parking brakes, and choke the tires.
11. Following the vehicle manufacturer's instructions, disconnect the steering column at the input shaft. This step is not necessary for a slave gear.
12. Disconnect the drag link joint from the pitman arm. Make sure to follow the drag link manufacturer's service procedure.

NOTE: Mask the input and output shaft splines to avoid any damage while handling, or during the removal process



Steering gears are heavy and awkward to handle. It is easy to get fingers pinched or drop the gear when handling it. Maintain a clean work area and plan how to remove and store the old gear and install the new gear.

13. On vehicles with set-forward axle types, the steering gear is assembled inside the frame rail. See *Figure 2*. The pitman arm needs to be disassembled before removing the gear from the frame rail. Refer to the section titled *Removing the Pitman Arm* to disassemble the pitman arm.

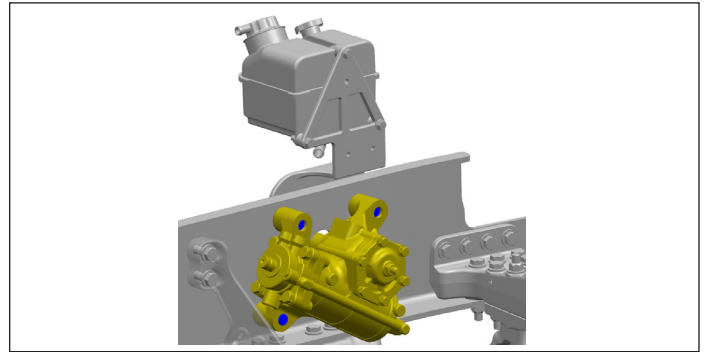


Figure 2 - Set-Forward Axle Type

14. After the pitman arm is disassembled, remove the fasteners that secure the steering gear to the mounting structure. Remove the steering gear from the vehicle per the vehicle manufacturer's instruction.
15. On vehicles with set-back axle types, the steering gear is assembled on the frame rail. See *Figure 3*. The steering gear should be removed with the pitman arm still attached.

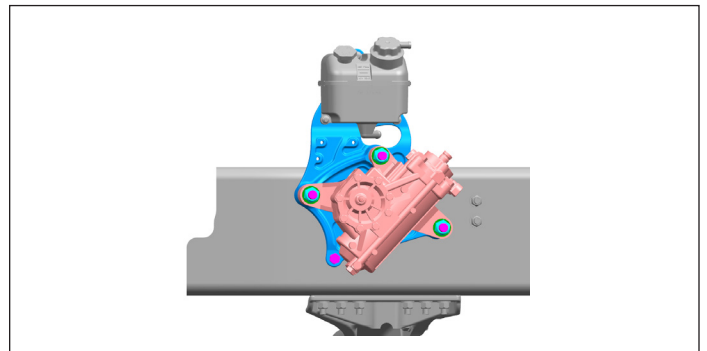


Figure 3 - Set-Back Axle Type

16. Secure the gear with the pitman arm on a fixture or bench vise. Refer to the section titled *Removing the Pitman Arm* to disassemble the pitman arm.

NOTE: For slave gear configurations, repeat the previous steps to remove the slave gear.

REMOVING THE PITMAN ARM

Required Tools

- Breaker Bar with M55 Socket
- Pitman Arm Puller



While disassembling the pitman arm, make sure to have all Personal Protective Equipment (PPE). Mask the threads on the steering gear sector shaft. Do not damage the threads on the steering gear sector shaft while disassembling the pitman arm.



After the disassembly of the jam nut and washers, the pitman arm will not come off easily. In order to remove the pitman arm, do not apply hammer blows or heat the pitman arm sector shaft assembly. Heat can damage or melt the seals and the dust cover on the steering gear sector shaft.

NOTE: It is recommended to use new washers and a new nut for reassembling the pitman arm. The service kit contains the necessary components.

See Figure 4.

1. Secure the steering gear onto a fixture or bench vise.
2. Loosen the jam nut using a break bar with an M55 socket.
3. The disassembly sequence is as follows:
 - A. Jam nut (1130)
 - B. Split lock washer (1120)
 - C. Flat washer (1110)
 - D. Pitman arm
4. To disengage the pitman arm from the sector shaft, use a pitman arm puller.

NOTE: It is recommended to wear ear protection headphones or ear plugs when an impact torque wrench is used.

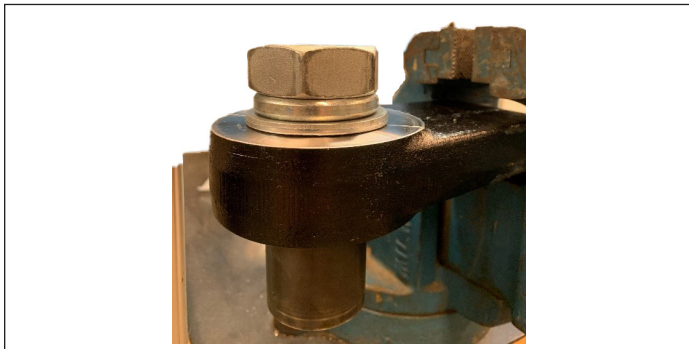


Figure 4 - Removing the Pitman Arm

INSTALLING THE PITMAN ARM

Required Tools

- Impact Torque Wrench with M55 Socket



The pitman arm should be properly installed. Failure to torque the jam nut to the correct installation torque values may affect safe operation of the vehicle.



Improper pitman arm installation may lead to accidents. If the pitman arm is found loose or the spline on pitman arm is damaged, replace the pitman arm. If the thread on the steering gear sector shaft is damaged, replace the steering gear.

NOTE: Mask the splines and threads on the steering gear sector shaft to avoid any damage during servicing. Mask the splines and tapered hole on the pitman arm to avoid any damage during servicing.



While assembling the pitman arm or while torquing the jam nut, make sure to not rotate the steering gear sector shaft. Rotating the steering gear sector shaft may press in the poppets more than required. Doing so will eventually damage the steering system.

1. The pitman arm on set-forward axle vehicles (See Figure 2) should only be assembled after the steering gear is installed on the frame rail.
2. The pitman arm on set-back axle vehicles (See Figure 3) should be assembled before installing the steering gear on the frame rail.
3. Install the pitman arm on the steering gear sector shaft. Make sure that the timing mark on the steering gear sector shaft and the pitman arm align (See Figure 5).
4. The assembly sequence while installing the pitman arm to the steering gear is as follows:
 - A. Pitman arm to the sector shaft of the steering gear
 - B. Flat washer (1110)
 - C. Split lock washer (1120)
 - D. Jam nut (1130)



Failure to follow the proper assembly sequence may lead to loss of torque retention on the pitman arm sector shaft assembly. This may eventually affect the safe operation of vehicle.

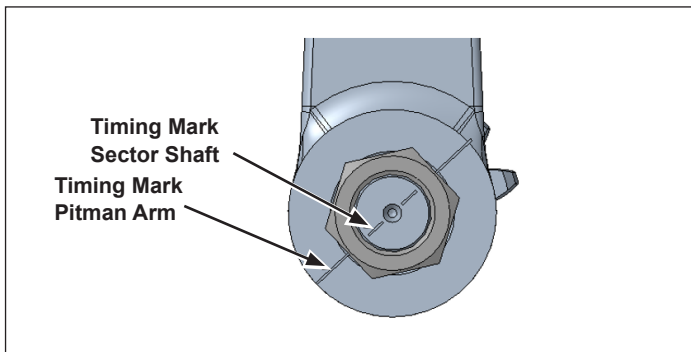


Figure 5 - Installing the Pitman Arm

5. Torque the jam nut to 440 ± 49 N•m (325 ± 36 ft-lbs). Make sure to torque the jam nut until the "click" sound on the torque wrench is heard.
6. Apply a witness paint mark after the assembly is complete. The witness paint mark will serve as an indicator if the jam nut starts to move or starts to lose torque retention.
7. For lash adjustment, loosen the adjustment screw nut if it is already assembled to the steering gear.
8. Wiggle the pitman arm while fastening the adjustment screw clockwise until no lash is felt on the pitman arm.
9. Turn the steering gear sector shaft adjusting screw an additional $1/8 - 1/4$ of a turn.
10. If not yet assembled, assemble the adjustment screw nut.
11. Tighten the nut to $117.7 - 127.5$ N•m ($86.6 - 94$ ft-lbs) while holding the adjustment screw in place.



If only the pitman arm moves and the sector shaft stays rigid or fixed, disassemble the pitman arm and inspect if the splines are fractured. Refer to the section titled *Removing the Pitman Arm*.

INSTALLING THE STEERING GEAR TO THE VEHICLE

1. Install the steering gear to the vehicle frame following the vehicle manufacturer's specifications and reconnect the oil lines (repeat this step for the slave gear, if present).
2. Reconnect the steering gear pitman arm taper hole with the drag link (except slave gears) following the vehicle manufacturer's specifications. Slave gears should not have the drag link installed until the bleeding procedure is performed.
3. Reinstall the steering column lower yoke (not necessary for slave gear). Torque the pinch bolt to the lower yoke to the vehicle manufacturer's specifications. Fill the power steering reservoir to the proper level.
4. Follow the bleeding procedure in the section titled *Single Gear Bleeding Procedure*.

SINGLE GEAR BLEEDING PROCEDURE

Required Tools

- Hex 8 Wrench
- Drain Pan

If the gear is mounted with the bulge in the housing for the sector shaft hanging below the piston cylinder, *shown in Figure 6*, perform the following procedure:

1. With the weight of the vehicle on the ground, start the engine and let it run at idle speed.
2. Turn the steering wheel back and forth – from full lock to full lock – three (3) times. Hold pressure on the steering wheel for about five (5) seconds when you reach the end of travel in each direction.
3. Center the steering wheel. The bleeding procedure is complete.

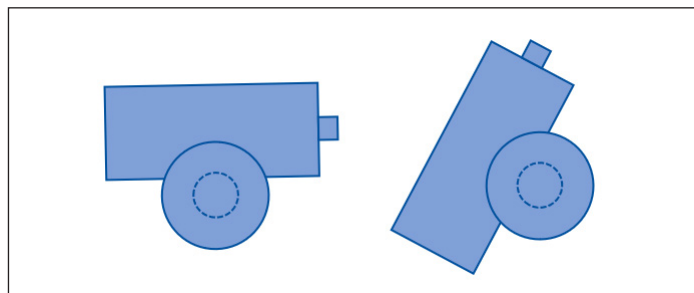


Figure 6 - Single Gear Bleeding Procedure - Shaft Below Piston Cylinder

If the gear is mounted with the bulge in the housing for the sector shaft sitting above the piston cylinder, *shown in Figure 7*, perform the following procedure:

1. Locate the bleeder plug on the steering gear sector shaft housing.
2. Many newer model gears do not have the bleeder plug, even if they are mounted in this manner. Instead, there is a bleed passage cast into the housing which allows the air to be carried to the bearing cap. Bleed this type of gear using steps 1 and 2 for gears mounted with the bulge in the housing for the sector shaft hanging below the piston cylinder.
3. With the weight of the vehicle on the ground, start the engine and let it run at idle speed.

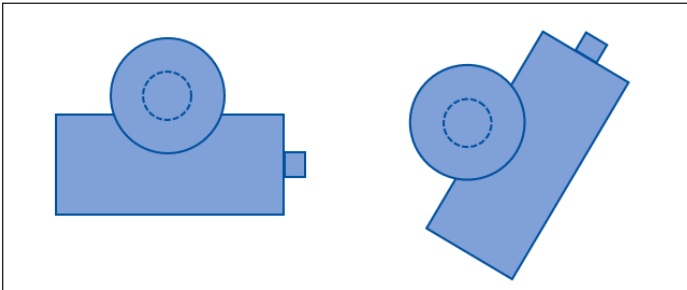


Figure 7 - Single Gear Bleeding Procedure - Shaft Above Piston Cylinder

For the following steps, identify if a left- or right-hand truck gear is installed.

Left-Hand Truck Gears

- A. With assistance, turn the steering wheel all the way to the left. Open the bleeder plug one half turn to one (1) turn using a Hex 8 wrench. With the bleeder still open, turn the wheels all the way to the right. Confirm the air bubbles drain through the tube. When you get all the way to the right, shut the bleeder and torque it to 6.9 - 12.7 N•m (5.1 - 9.4 ft-lbs). Turn the wheels all the way back to the left and repeat the procedure four (4) or more times until no air bubble can be seen through the tube.

NOTE: THE BLEEDER SHOULD ONLY BE OPEN AS YOU ARE TURNING RIGHT! If it is open when turning left, air will be forced back into the system.

Right-Hand Truck Gears

- B. With assistance, turn the steering wheel all the way to the right. Open the bleeder plug one half turn to one (1) turn using a Hex 8 wrench. With the bleeder still open, turn the wheels all the way to the left. Confirm the air bubbles drain through the tube. When you get all the way to the left, shut the bleeder and torque it to 6.9 - 12.7 N•m (5.1 - 9.4 ft-lbs). Turn the wheels all the way back to the right and repeat the procedure four (4) or more times until no air bubble can be seen through the tube.

NOTE: THE BLEEDER SHOULD ONLY BE OPEN AS YOU ARE TURNING LEFT! If it is open when turning right, air will be forced back into the system.

4. Center the steering wheel. The bleeding procedure is complete.
5. After the air drains completely, fill the power steering reservoir to the proper level.

MASTER AND SLAVE GEAR BLEEDING PROCEDURE

1. With the weight of the vehicle on the ground, start the engine and let it run at idle speed. The drag link should be connected to the pitman arm on the main gear, but not connected to the slave gear.
2. Turn the steering wheel all the way to the left until the axle stop contacts the axle, and hold pressure on the steering wheel until the pitman arm on the slave gear moves its full travel. The slave gear should move in the opposite direction of the pitman arm on the main gear. A jack may be needed under the axle to take some weight off the steer tires for them to turn. Keep holding pressure on the steering wheel for 15 seconds after the slave gear stops moving.
3. Turn the steering wheel all the way to the right until the axle stop contacts the axle, and hold pressure on the steering wheel until the pitman arm on the slave gear moves its full travel. Keep holding pressure on the steering wheel for 15 seconds after the slave gear stops moving.
4. Repeat the procedure three (3) more times or until there is no air in the system and the slave gear moves freely.

NOTE: Pressure must be kept on the steering wheel to keep the valve open, sending fluid to the slave gear. When pressure is released, the valve returns to neutral and no pump pressure is sent to the steering gears.

5. Turn the steering wheel until the pitman arm on the slave gear lines up with the drag link, and install the drag link. Do not move the pitman arm on the slave gear by hand, as air may be drawn into the system.
6. Cycle the steering wheel from stop to stop. If a catch is noted, look for bleeder plugs on the steering gears. Depending on whether the steering gear is mounted with the bulge in the housing for the sector shaft sitting above or below the piston cylinder, *refer to the section titled Single Gear Bleeding Procedure*.

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