# Installation Instructions

## HYDRAULIC LIMIT STOP VALVE FOR KNORR-BREMSE® IPS90™ AND IPS100™ (INTEGRAL POWER STEERING) HYDRAULIC POWER STEERING GEARS FOR COMMERCIAL VEHICLES

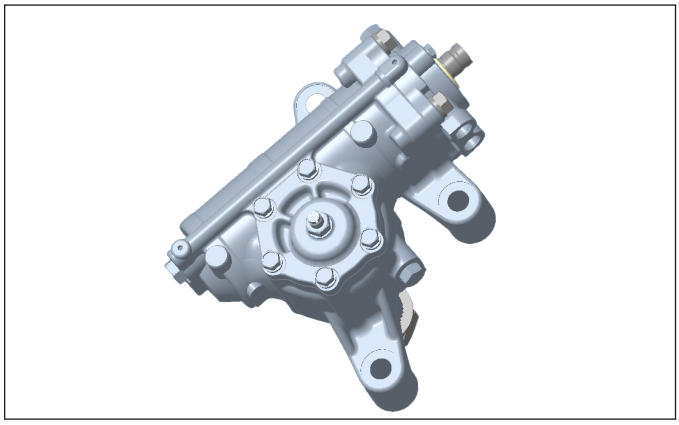

*Figure 1 - Hydraulic Limit Stop Valve*

**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 up to 250° F (121° C). Use the appropriate 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 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.

## KIT COMPONENTS

The hydraulic limit stop valve service kit for Knorr-Bremse® IPS90™ and IPS100™ (Integral Power Steering) hydraulic power steering gears contains the following parts:

| Item No. | Description | Qty. |
|---|---|---|
| 150 | Stop Valve Assembly | 1 |
| 942 | Plunger Assembly | 1 |
| 946 | Plug | 1 |
| 947 | O-ring | 1 |

### REQUIRED TOOLS

- Drain Pan
- M24 Socket with Ratchet
- Socket (with 14-mm key range) and Ratchet
- Tweezers

## AUTOMATIC HYDRAULIC LIMIT STOP VALVE SERVICE PROCEDURE

The hydraulic limit stop valves in steering gears are used to reduce the pressure build-up during the end of travel in the steering gear. By decreasing the pressure build-up, the hydraulic limit stop valves help to reduce system temperature and overloading other steering components. There are two hydraulic limit stop valves in a steering gear: one on the valve housing and the other on the main housing. *See Figure 2.* The hydraulic limit stop valves adjust automatically based on the wheel cut required in left and right turns.

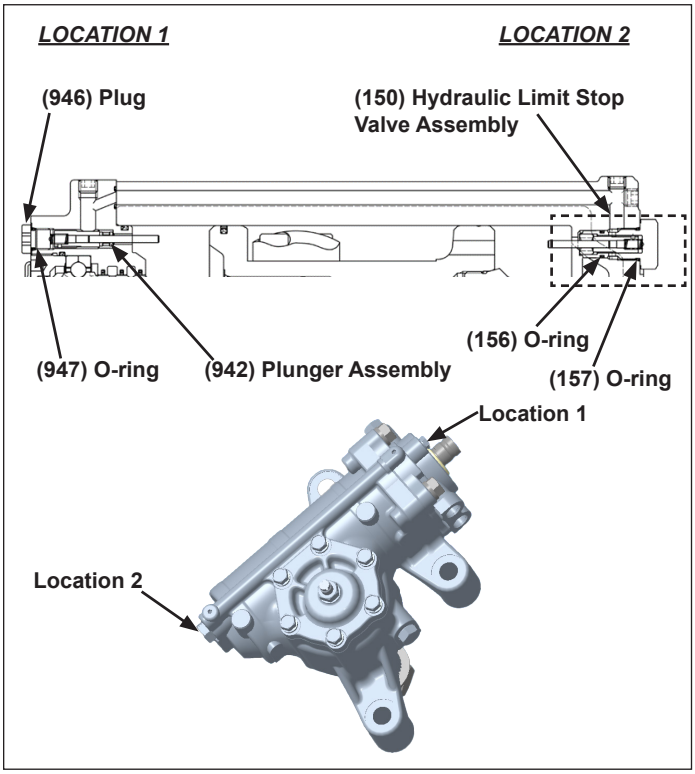


***Figure 2 - Hydraulic Limit Stop Valve - Locations***

**⚠ WARNING**

**Once the plunger in the hydraulic limit stop valve is pressed in, it cannot be repaired and reused in the steering gear.**

The hydraulic limit stop valve must be replaced *in either* of the following instances:

- When there is an external oil leak from the hydraulic limit stop valve; or
- When the wheel cut is reduced.

The hydraulic limit stop valve must be reset *in either* of the following instances:

- When the pitman arm is mistimed; or
- When wheel cut is increased.

**⚠ CAUTION**

**Improper assembly of hydraulic limit stop valves can lead to damage in the steering system.**

**NOTE:** The initial hydraulic limit stop valve setting should be done on new gears or on manufacturers' aftermarket gears. If the hydraulic limit stop valves on a used gear are replaced with new sets, the hydraulic limit stop valve setting procedure must be followed.

**⚠ CAUTION**

**The axle stops and all steering linkage must be set according to the vehicle manufacturer's specification. The pitman arm timing mark should align with sector shaft (output shaft) timing mark for the hydraulic limit stop valves to be set correctly.**

1. Engage the parking brake. Jack up the vehicle at the front axle. Ensure the tires are not touching the ground.
2. With the engine off and the vehicle unloaded, slowly turn the steering wheel from the center position to full turn in either the left or right direction until the axle stop contact is made. Pull hard on the steering wheel after the axle stop is in contact.
3. After the axle contact is made, return the steering wheel to center and then turn the steering wheel in the other direction until the axle contact is made. Pull hard on the steering wheel after the axle stop is in contact.
4. Lower the jack. The front axle is now loaded. Turn the steering wheel from left to right until the axle contact is made during both turns. Make sure the chassis is not flexing when the axle stops contact.

**⚠ CAUTION**

**Hydraulic limit stop valves should not be disassembled while the engine is running. Do not turn the steering wheel with the hydraulic limit stop valves disassembled. Ensure the vehicle tires are straight ahead while replacing the hydraulic limit stop valves.**

**⚠ WARNING**

**There is no need to disassemble the hydraulic limit stop valve if the steering gear needs hydraulic limit stop valve adjustments. Never reuse the hydraulic limit stop valve after removing it from the steering gear.**

## REPLACEMENT OF THE HYDRAULIC LIMIT STOP VALVE IN LOCATION 1

*See Figure 2.*

1. Put a drain pan below the hydraulic limit stop valve.
2. Remove the plug (946) together with the o-ring (947) by using a ratchet with a 14-mm key range socket.
3. Use tweezers to remove the spring.
4. Use tweezers to remove the plunger assembly (942).
5. Install the new plunger assembly (942).
6. Install the spring.
7. Carefully put the new o-ring (947) on the new plug (946).
8. Tighten the plug (946) to 23 N•m – 27 N•m.

**NOTE:** Do not turn the output shaft more than ±30 degrees from the center position until the pitman arm and drag-link are connected.

## REPLACEMENT OF THE HYDRAULIC LIMIT STOP VALVE IN LOCATION 2

*See Figure 2.*

**⚠ ATTENTION**

**In case an already assembled hydraulic limit stop valve assembly (150) is part of the service kit, the following steps to disassemble and assemble the o-rings on the cartridge in location 2 can be skipped.**

1. Place a drain pan under the steering gear.
2. Using an M24 socket, un-torque the hydraulic limit stop valve assembly from the steering gear.

**NOTE:** If the threads on the housing are damaged, assembly of the hydraulic limit stop valve is not possible.

3. Assemble the o-rings to the new hydraulic limit stop valve assembly, starting with o-ring (157) followed by o-ring (156).

**NOTE:** Ensure the o-ring and o-ring surface are clean.

4. Unmask the threads on the housing. Clean the masked area.
5. Using an M24 socket, torque the hydraulic limit stop valve assembly to 73.6 N•m – 83.4 N•m.

## 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 3,* 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.

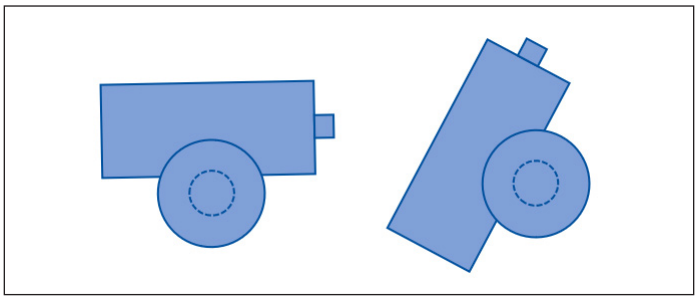

***Figure 3 - Single Gear Bleeding Procedure - Shaft Below Piston Cylinder***

If the gear is mounted with the bulge in the housing for the sector shaft sitting above the piston cylinder, *shown in Figure 4*, 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.

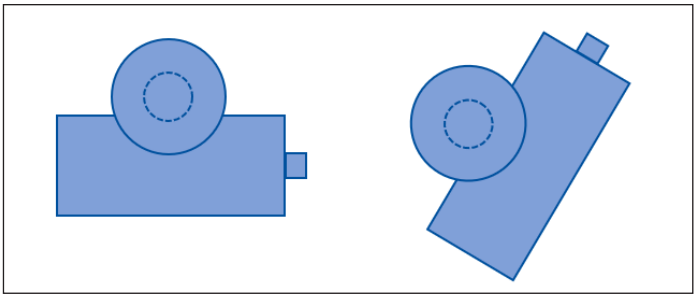

***Figure 4 - Single Gear Bleeding Procedure - Shaft Above Piston Cylinder***

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 N•m – 12.7 N•m. 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 to full 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 N•m – 12.7 N•m. 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 steering 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 steering wheel should move in the opposite direction of the pitman arm on the main steering gear. It may be necessary to put a jack under the steering axle to take some weight off the wheels 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:** You must keep pressure on the steering wheel to keep the valve open and sending fluid to the slave gear. When the 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.
6. Install the drag-link. Do not move the pitman arm on the slave gear by hand. Air may be drawn into the system.
7. Cycle the steering gear from stop to stop. If a catch is noted, look for bleeder plugs on the steering gears. If the steering gear is mounted with the bulge in the housing for the sector shaft sitting above the piston cylinder, follow the procedure outlined for bleeding a single gear with the bulge in the housing for the sector shaft sitting above the piston cylinder. If both gears have bleeder plugs, open the bleeder only when the piston is moving toward the bleeder.

**Knowledge Dock™**
BLOGS • PODCASTS • VIDEOS
24/7/365
Visit knowledge-dock.com

Search for Bendix products quickly and easily at **B2Bendix.com**, our new e-commerce tool.

**Log on and learn from the best.**
Online training that's available when you are – 24/7/365.
Visit brake-school.com

Bendix®